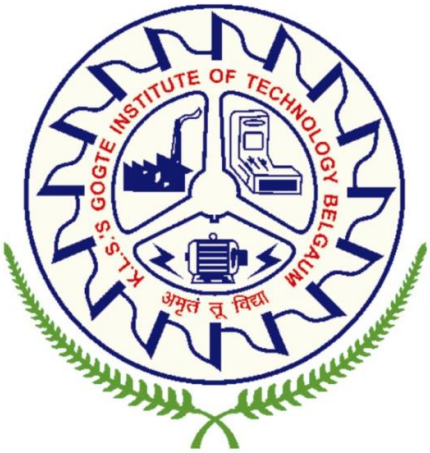
KARNATAK LAW SOCIETY'S

GOGTE INSTITUTE OF TECHNOLOGY

UDYAMBAG, BELAGAVI-590008

(An Autonomous Institution under Visvesvaraya Technological University, Belagavi)

(APPROVED BY AICTE, NEW DELHI)



Department of Electronics and Communication Engineering

M. Tech. in Electronics and Communication Engineering
(Specialization in Digital Communication and Networking (DCN))
Scheme (1st to 4th Semester) and
1st to 4th Semester Syllabus (2024 Scheme)

INSTITUTION VISION

Gogte Institute of Technology shall stand out as an institution of excellence in technical education and in training individuals for outstanding caliber, character coupled with creativity and entrepreneurial skills.

MISSION

To train the students to become Quality Engineers with High Standards of Professionalism and Ethics who have Positive Attitude, a Perfect blend of Techno-Managerial Skills and Problem-solving ability with an analytical and innovative mindset.

QUALITY POLICY

- Imparting value-added technical education with state-of-the-art technology in a congenial, disciplined and a research-oriented environment.
- Fostering cultural, ethical, moral and social values in the human resources of the institution.
- Reinforcing our bonds with the Parents, Industry, Alumni, and to seek their suggestions for innovating and excelling in every sphere of quality education.

DEPARTMENT VISION
The Electronics & Communication Engineering department shall impart quality technical education and entrepreneurship skills to develop creative individuals to face changing global scenario.

MISSION
To augment the national talent pool, with Electronics and Communication Engineers having all-encompassing technical knowledge, principled practices and nationalistic outlook.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)	
1.	The post graduates will acquire core competence in Digital Communication and Networking fundamentals necessary to formulate, analyze, and solve problems in communication and networking domain and to pursue advanced study or research.
2.	The post graduates will engage in the activities that demonstrate desire for ongoing personal and professional growth, and self-confidence to adapt to ongoing technological developments.
3.	The post graduates will maintain high professionalism and ethical standards, effective oral and written communication skills, work as part of teams on multidisciplinary projects under diverse professional environments, and relate engineering issues to the society, global economy and to emerging technologies.

PROGRAM OUTCOMES (POs)	
1.	An ability to independently carry out research /investigation and development work to solve practical problems.
2.	An ability to write and present a substantial technical report/document.
3.	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program.

PROGRAM SPECIFIC OUTCOMES (PSOs)	
1.	Understanding and applying the mathematical and scientific concepts, for analysis and design of Communication and Networking systems.
2.	Developing critical thinking abilities coupled with competence in use of computational tools for professional growth; complimented with communication skills and leadership attributes.
3.	Identifying societal needs and sensitizing individuals towards finding innovative solutions to contemporary issues with multidisciplinary outlook.

I SEMESTER											
Sl. No	Course Type	Course Code	Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Tutorial/SDA	Practical/Seminar	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T/SDA	P					
1	BSC	DCN11	Applied Engineering Mathematics	3	0	0	03	100	100	200	3
2	IPCC	DCN12	Multirate Digital Signal Processing	3	0	2	03	100	100	200	4
3	PCC	DCN13	Advanced Digital Communication	3	0	0	03	100	100	200	3
4	PCC	DCN14	High Speed Communication Networks	3	0	0	03	100	100	200	3
5	PCC	DCN15	Wireless Sensor Networks	3	0	0	03	100	100	200	3
6	PCCL	DCNL16	Communication Networks Laboratory	0	0	4	03	50	50	100	2
7	NCMC	DCN17	Research Methodology and IPR (Online VTU/NPTEL/SWAYAM/NASSCOM/Industry offered course of minimum 8 weeks duration)	Online courses (online.vtu.ac.in)							PP
								550	**550**	**1100**	**18**

Note: **BSC**-Basic Science Courses, **PCC**: Professional core. **IPCC**-Integrated Professional Core Courses, **PCC(PB):** Professional Core Courses (Project Based), **PCCL**-Professional Core Course lab**, NCMC**- None Credit Mandatory Course, **L**-Lecture**, P**-Practical**, T/SDA**-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students) **MRMI19**- Research Methodology and IPR (**Online**) for the students who have **not studied** this course in the Undergraduate level. This course is not counted for vertical progression, Students have to qualify for the award of the master's degree.

M- Master program **xx** – **ME** for Mechanical Engineering Stream, **CV** for Civil Engineering Stream, **EE** – Electrical & Electronics Engineering Stream, **EC**- Electronics and Communication Engineering Stream, **CS**- Computer Science and Engineering **BA**- Business Administration **AR**- Architecture- etc.

BSC: Basic Science Courses: Courses like Mathematics/ Science are the prerequisite courses that the concerned engineering stream board of Studies will decide. **PCC: Professional Core Course:** Courses related to the stream of engineering, which will have both CIE and SEE components, students have to qualify in the course for the award of the degree. **Integrated Professional Core Course (IPCC)**: Refers to a Professional Theory Core Course Integrated with practicals of the same course. The IPCC's theory part shall be evaluated by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. **Project Based Learning Course (PCC(PB):** Project Based Learning course is a professional core Course only Students have to complete

a project out of learning from the course and SEE will be viva voce on project work. **PCCL: Professional Core Course Laboratory:** Practical courses whose CIE will be evaluated by the class teacher and SEE will be evaluated by the two examiners.

Skill development activities: Under Skill development activities in a concerning course, the students should

1. Interact with industry (small, medium, and large).
2. Involve in research/testing/projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits/ fieldwork.
4. Accustom to the use of standards/codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in the modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc. Students and the course instructor/s are to be involved either individually or in groups to interact together to enhance the learning and application skills of the study they have undertaken. The students with the help of the course teacher can take up relevant technical – activities that will enhance their skills. The prepared report shall be evaluated for CIE marks.

Research Methodology and IPR- None Credit Mandatory Course (NCMC) if students have not studied this course in their undergraduate program then he /she has to take this course at **http://online.vtu.ac.in** and to qualify for this course is compulsory before completion of the minimum duration of the program (Two years), **however, this course will not be considered for vertical progression**.

II SEMESTER											
Sl. No	**Course**	**Course Code**	**Course Title**	**Teaching Hours /Week**			**Examination**				**Credits**
				Theory	**Tutorial/ Skill Development Activities**	**Practical/ Seminar**	**Duration in hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
				L	T/SDA	P					
1	IPCC	DCN21	Antenna Theory and Design	3	0	2	03	100	100	200	4
2	PCC(PB)	DCN22	Cyber Security	2	0	2	03	100	100	200	3
3	PCC	DCN23	Adaptive Signal Processing	3	0	0	03	100	100	200	3
4	PEC	DCN24x	**Professional Elective – I**	3	0	0	03	100	100	200	3
5	PEC	DCN25x	**Professional Elective – II**	3	0	0	03	100	100	200	3
6	MDC	DCN26x	**Multidisciplinary Course**	3	0	0	03	100	100	200	3
7	PCCL	DCNL27	Advanced Digital Communication laboratory	0	0	4	03	50	50	100	2
8	AEC/SEC	DCN28X	**Ability/Skill Enhancement Course (Offline/Online)**	00	----	02	02	50	50	100	1
				01	----	00	01				
TOTAL								**700**	**700**	**1400**	**22**

Note: **PCC**: Professional core. **IPCC**-Integrated Professional Core Courses, **PCC(PB):** Professional Core Courses (Project Based), **PCCL**-Professional Core Course lab**, PEC-** Professional Elective Courses, **MDC-** Multi-Disciplinary Courses

, **L-Lecture, P-Practical, T/SDA-Tutorial / Skill Development Activities** (Hours are for Interaction between faculty and students)

L-Lecture, P-Practical, T/SDA-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students) **PBLC**: Project Based Learning Course,

Note: **xxx** means specialization code for example **MDE- Design** Engineering, **LDN-** Digital Communication and Networking, **SCE-** Computer Engineering, **CCT**- Construction Technology, AUD- Urban Design, MBA- Master of Business Administration, **MCA**-Master of Computer Application, etc

Ability / Skill Enhancement Courses					
Course Code	**Course title**	L	T/SDA	P	
DCN281	Modern Communication System Development and Sensor Response Analysis	0	0	2	
DCN282	PCB Design and Fabrication for High-Speed Communication Systems	0	0	2	

Ability Enhancement Courses (AEC): These courses are designed to help students enhance their skills in communication, language, and personality development. They also promote a deeper understanding of subjects like social sciences and ethics, culture and human behaviour, human rights, and the law.
Skill Enhancement Course (SEC): Skill Enhancement Course means a course designed to provide value-based or skill-based knowledge and should contain both theory and lab/hands-on/training/fieldwork. The main purpose of these courses is to provide students with life skills in the hands-on mode to increase their employability.
If AEC/SEC courses are ONLINE (MOOCs) courses suggested by the concerned board of studies. These courses will be made available on **www.online.vtu.ac.in**, however **online courses are not considered for vertical progression**, but qualifying in online courses is mandatory for the award of the degree.

Professional Elective Courses - I		Professional Elective Courses - II	
Course Code	**Course title**	**Course Code**	**Course title**
DCN241	SDN and NFV	DCN251	Pattern Recognition and Classification
DCN242	Statistical Signal Processing	DCN252	High Performance Computing
DCN243	Machine Learning Algorithms	DCN253	Optical Networks
DCN244	ASIC Design*	DCN254	MEMS and Sensors

Multi-Disciplinary Courses	
Course Code	**Course title**
DCN261	Image Processing and Machine Vision
DCN262	CMOS RF Circuit Design
DCN263	Embedded Systems and IoT*

* Project based learning course

For the students who are willing to take up a two-semester duration Industry/Research Internship Leading to Project work /start-up											
III SEMESTER (A)											
Sl. No	**Course**	**Course Code**	**Course Title**	**Teaching Hours /Week**			**Examination**				**Credits**
				Theory	**Tutorial/ Skill Development Activities**	**Practical/ Mini–Project/ Internship**	**Duration in hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
				L	SDA	P					
1	PEC/MDC	DCN31	(Online VTU / NPTEL / SWAYAM / NASSCOM / Industry offered course of 12 weeks duration)							100	3
2		DCN32	(Online VTU / NPTEL / SWAYAM / NASSCOM / Industry offered course of 12 weeks duration)							100	3
		DCN33	(Online VTU / NPTEL / SWAYAM / NASSCOM / Industry offered course of 12 weeks duration)							100	3
3	INT	**DCN34**	Research Internship /Industry-Internship leading to project work/ Start-up	Two-semester duration, SEE in the IV semester which leads to project work /start-up			03	100	---	100	3
TOTAL										**400**	**12**

IV SEMESTER (A)										
Sl. No	**Course**	**Course Code**	**Course Title**	**Teaching Hours /Week**		**Examination**				**Credits**
				Theory	**Practical/Field work**	**Duration in hours**	**CIE Marks**	**SEE Marks Viva voce**	**Total Marks**	
				L	P					
1	INT	DCN41	Research Internship / Industry Internship Leading to Project Work/Start-up	Two Semester Duration		03	100	100	200	12
2	PROJ	DCN42	Project			03	100	100	200	16
TOTAL						**06**	**200**	**200**	**400**	**28**

INT: Industry/ Research Internship leading to the project work /start-up **PROJ**: Project work outcome of Internship (Project Phase-II is Viva voce SEE)

Taking up a two-semester Industry/Research Internship that leads to project work or a start-up can be a highly rewarding experience for students. It allows them to apply theoretical knowledge in practical settings, gain valuable industry or research experience, and potentially develop innovative solutions or business ideas. Here are some key steps and considerations for students pursuing such an internship:

Industry Internship: The main objective of the industry internship is to ensure that the intern is exposed to a real-world environment and gain practical experience. Often, it may be a practical exposure to the theory that has been learned during the academic period. The industry internship helps students understand of analytical concepts and tools, hone their skills in real-life situations, and build confidence in applying the skills learned.

Research Internship: A research internship is an opportunity for students or early career professionals to gain hands-on experience in conducting research under the guidance of a mentor or within a research team. These internships can take place in academic institutions, research organizations, government agencies, or private companies

Research /Industry Internship: In the third-semester Students have to be in touch with a guide/mentor/coordinator and regularly submit the report referred to the progress internship. Based on the progress report the Guide/Mentor/coordinator has to enter the CIE marks at the end of the 3rd semester. At the beginning of the 4th semester, students have to define the project topic out of the learning due to the Internship, upon completion of the project work he/she has to attend the SEE at the parent Institute.

Internship Leading to Start-up: An internship that leads to a startup is an exciting pathway, blending real-world experience with entrepreneurial ambition. Here's a comprehensive guide to transitioning an internship experience into launching your startup: 1) Maximize your internship experience, 2) Identifying Viable Business Ideas, 3) Research and Validation 4) Building a Business Plan 5) Networking and Mentorship 6) Securing Funding 7) Establishing Startup 8) Launching and Marketing. By following these steps, you can effectively transition from an internship to launching a successful startup. This journey requires dedication, resilience, and a willingness to learn and adapt.

DCN31 to DCN33: MOOC courses of 12 weeks duration are the courses suggested by the Board of Studies of the University and will be displayed on www.online.vtu.ac.in. The online courses selected should not be the same as those studied in the first and second semesters of the program. The student will not be eligible to get their degree if they unintentionally select online courses that match previously finished courses. These courses are not considered for the vertical progression; however, qualifying for these courses and earning the credits is a must for the award of the degree. **It is permitted to complete these online MOOC courses either in 3rd semester or in 4th semester.**

For the students who are willing to take an Industry Internship for one-semester duration and independent project work next semester											
III SEMESTER (B)											
Sl. No.	**Course**	**Course Code**	**Course Title**	**Teaching Hours /Week**			**Examination**				**Credits**
				Theory	**Tutorial/ Skill Development Activities**	**Practical/ Mini–Project/ Internship**	**Duration in hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
				L	T/SDA	P					
1	MDC/PEC	DCN31	(Online VTU / NPTEL / SWAYAM / NASSCOM / Industry offered course of 12 weeks duration)						100	100	3
2		DCN32	(Online VTU / NPTEL / SWAYAM / NASSCOM / Industry offered course of 12 weeks duration)						100	100	3
3		DCN33	(Online VTU / NPTEL / SWAYAM / NASSCOM / Industry offered course of 12 weeks duration)						100	100	3
4	INT	DCN34	Industry Internship	One Semester Duration			03	100	100	200	11
TOTAL								**100**	**400**	**500**	**20**

IV SEMESTER (B)										
Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical/ Field work	Duration in hours	CIE Marks	SEE Marks Viva voce	Total Marks	
				L	P					
1	Project	DCN41	Project work	--	08	03	100	100	200	20
				04	**08**	**03**	**100**	**100**	**200**	**20**

Industry Internship: The main objective of the industry internship is to ensure that the intern is exposed to a real-world environment and gains practical experience. Often, it may be a practical exposure to the theory that has been learned during the academic period. The industry internship helps students understand of analytical concepts and tools, hone their skills in real-life situations, and build confidence in applying the skills learned. The students who take up a one-semester Internship in the Industry have to appear SEE at the institute at the end of the semester as per the examination calendar.

Project Work: Students in consultation with the guide shall carry out literature survey/ visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare a synopsis, and narrate the methodology to carry out the project work. Each student, under the guidance of a Faculty, is required to

- Present the seminar on the selected project orally and/or through Power Point slides.
- Answer the queries and be involved in debate/discussion.
- Submit two copies of the typed report with a list of references.
- The participants shall take part in discussions to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident

CIE marks for the project report (20 marks), seminar (20 marks) and question and answer (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Principal. The committee shall consist of internal guide and a faculty from the department with the senior most acting as the Chairperson.

Semester End Examination SEE marks for the project report (30 marks), seminar (10 marks) and question and answer session (10 marks) shall be awarded (based on the quality of the report and presentation skill, participation in the question and answer session) by the examiners appointed by the University.

24DCN31 to 24DCN33: MOOC courses of 12 weeks duration are the courses suggested by the Board of Studies of the University and will be displayed on www.online.vtu.ac.in. The online courses selected should not be the same as those studied in the first and second semesters of the program. The student will not be eligible to get their degree if they unintentionally select online courses that match previously finished courses. These courses are not considered for the

vertical progression; however, qualifying for these courses and earning the credits is a must for the award of the degree. **It is permitted to complete these online MOOC courses either in 3rd semester or in 4th semester.**

For the students who are willing to take a research-leading paper publication in Q1/Q2/Q3 Journals and to a PhD Registration											
IIISEMESTER (C)											
Sl. No	**Course**	**Course Code**	**Course Title**	**Teaching Hours /Week**			**Examination**				**Credits**
				Theory	**Tutorial/ Skill Development Activities**	**Practical/ Mini–Project/ Internship**	**Duration in hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
				L	SDA	P					
1	PCC/IPCC/ MDC/PEC	DCN31	(Online VTU / NPTEL / SWAYAM / NASSCOM / Industry offered course of 12 weeks duration)							100	3
		DCN32	(Online VTU / NPTEL / SWAYAM / NASSCOM / Industry offered course of 12 weeks duration)							100	3
2		DCN33	(Online VTU / NPTEL / SWAYAM / NASSCOM / Industry offered course of 12 weeks duration)							100	3
		DCN34	(Online VTU / NPTEL / SWAYAM / NASSCOM / Industry offered course of 12 weeks duration)							100	3
3	PROJ	DCN35	Project Phase-I	One semester Duration			03	100	---	100	6
TOTAL				**06**	**00**	**00**	**09**			**500**	**18**

IV SEMESTER (C)										
Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical/ Field work	Duration in hours	CIE Marks	SEE Marks Viva voce	Total Marks	
				L	P					
1	Project	DCN41	Project work	--	08	03	100	100	200	22
				04	**08**	**03**	**100**	**100**	**200**	**22**

The research section of the university has to announce the number of seats for M. Tech. students who are seeking PhD (research study) admission through a project leading to the publication of the paper in Q1/Q2/Q3 journals. Only full-time research work will be permitted in the university department or approved research centers of the affiliated colleges of the university (guidelines need to be set up). Based on seat availability, the students are permitted to register for project work leading to the publication of papers in Q1/Q2/Q3 journals and admission to research (PhD) in their 3rd semester of the M. Tech., program

Project Phase-1 Project Phase-I, typically the initial phase in any project, is crucial as it lays the foundation for the entire project. This phase involves defining the project's scope, objectives, and initial planning. Here's a structured approach to effectively carry out Project Phase-I:

- **Project Charter:** Outlines the project's purpose, objectives, and stakeholders.
- **Scope Statement:** Defines the project boundaries and deliverables.
- **Requirements Document:** Captures all project requirements.
- **Project Plan:** Details the approach, timeline, and resource allocation.
- **Risk Management Plan:** Identifies and plans for potential risks.
- **Feasibility Study Report:** Assesses technical, economic, and operational feasibility.

Students in consultation with the guide shall carry out literature survey/visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare a synopsis, and narrate the methodology to carry out the project work. Each student, under the guidance of a faculty, is required to

- Present the seminar on the selected project orally and/or through power point slides.
- Answer the queries and be involved in debate/discussion.
- Submit two copies of the typed report with a list of references.
- The participants shall take part in discussions to foster a friendly and stimulating environment in which the students are motivated to reach high

standards and become self-confident.

Continuous Internal Evaluation (100 Marks).

CIE marks for the project report (60 marks), seminar (20 marks) and question and answer (20marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Principal. The committee shall consist of an internal guide and a faculty from the department with the senior most acting as the Chairperson.

Project Work Phase-II: Each student shall be involved in carrying out the project work jointly in constant consultation with internal guide and external guide and prepare the project report as per the norms of the university to avoid plagiarism. Phase II of a project typically involves the detailed execution of the planned activities, continuous monitoring and control of the project's progress, and making necessary adjustments to ensure the project stays on track. Keep detailed records of all project activities, decisions, and changes. Ensure all project documentation is organized and accessible. Conduct a final project review to evaluate overall performance, achievements, and lessons learned. Document best practices and areas for improvement for future projects.

Paper Publication Process: Publishing a research paper based on your project in a Q1/Q2/Q3 journal involves several key steps, from writing the manuscript to navigating the peer review process. Here's a comprehensive guide:

Writing the Manuscript: Choose a clear and concise title that accurately reflects the content. Write an abstract summarizing the research question, methods, results, and conclusions.

Literature Review: Review relevant existing research to establish the foundation of your study. Identify gaps that your research aims to fill.

Methodology: Describe the research design, methods, and procedures in detail. Include information on data collection, analysis, and any tools or software used.

Results: Present the findings of your research clearly and logically. Use tables, figures, and charts to illustrate key results.

Discussion: Interpret the results and explain their implications. Compare your findings with existing research and discuss any discrepancies or new insights.

Conclusion: Summarize the main findings and their significance. Suggest potential future research directions.

References: Cite all sources used in your research following the journal's citation style.

Journal Selection: Choose a journal that aligns with the scope and focus of your research. Consider the journal's impact factor (Q1, Q2, Q3) and audience.

Review Journal Guidelines: Carefully read the journal's submission guidelines and ensure your manuscript adheres to them.

Prepare Your Manuscript: Format your manuscript according to the journal's guidelines. Include all required sections and supplementary materials.

Cover Letter: Write a cover letter to the journal editor highlighting the significance of your research and why it fits the journal.

Submit the Manuscript: Use the journal's online submission system to submit your manuscript. Ensure all required information and documents are included.

Semester End Examination SEE marks for the project report (60 marks), seminar (20marks) and question and answer session (20 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointed by the University.

APPLIED ENGINEERING MATHEMATICS

Course Code	DCN11	Course type	BSC	Credits L-T-P	3 – 0 – 0
Hours/week: L - T- P	3 – 0 – 0			Total credits	3
Total Contact Hours	L = 45 Hrs; T = 0 Hrs; P = 0 Hrs Total = 45 Hrs			CIE Marks	100
Flipped Classes content	0 Hours			SEE Marks	100

Course learning objectives	
1.	To introduce the basic concepts of linear algebra such as RREF, linear independence and linear transformations.
2.	To explore the concepts of vector spaces, dimension of vector space, rank and change of basis.
3.	To understand the orthogonality of vectors and matrix factorization techniques.
4.	To introduce the probability theory concepts.

Pre-requisites: Engineering Mathematics.

Unit – I	Contact Hours = 9 Hours
Fundamentals of Linear Algebra Systems of Linear Equations, Row Reduction and Echelon Forms (RREF), Vector equations, Matrix equations, solution sets of linear systems, Applications of linear systems, Linear Independence, Linear Transformation.	
Case Study: DFT as a linear Transformation.	

Unit – II	Contact Hours = 9 Hours
Matrix operations, Matrix inversion, Characterization of invertible matrices, Subspaces of $\mathcal{R}^n$,(Null Space, Column Space, Basis of a subspace), Dimension and rank. Vector Spaces and Subspaces, Null Spaces, Column Spaces, and Linear Transformations, Linearly Independent Sets; Bases, Coordinate Systems, The Dimension of a Vector Space, Rank and change of basis.	
Case Study: Fourier Transforms as change of basis.	

Unit – III	Contact Hours = 9 Hours
Eigen values and Eigen vectors, Inner Product, Length and Orthogonality, Orthogonal Sets, Orthogonal Projections, Gram-Schmidt Process, Least Squares Problems, Inner Product Spaces. Diagonalization of Symmetric Matrices, Quadratic forms, Constrained Optimization and SVD.	
Case Study: Orthogonal Frequency Division Multiplexing (OFDM) system SVD based image reconstruction	

Unit – IV	Contact Hours = 9 Hours

Probability Theory:- Review of basic probability theory. Definitions of random variables and probability distributions, probability mass and density functions, expectation, moments, central moments, characteristic functions, probability generating and moment generating functions illustrations. Poisson, Gaussian and Erlang distributions-examples.
Case Study: Gaussian Mixture Models

Unit – V	**Contact Hours = 9 Hours**
Engineering Applications on Random Processes: - Classification. Stationary, WSS and ergodic random process. Autocorrelation function-properties, Gaussian random process.	
Case Study: Optimum filtering Weiner Filtering.	

Self-Study: After the end of each unit, the students have to review minimum two research papers on any topic covered in the unit and submit the report.

Books	
	Text Books:
1.	David C. Lay, "Linear Algebra and its Applications," 6th edition, Pearson Education (Asia) Pvt. Ltd, 2021.
2.	S. L. Miller and D. C. Childers, "Probability and Random Processes with Application to Signal Processing and Communication", 2nd edition, Academic Press/ Elsevier 2012 and onwards
	Reference Books:
1.	Gilbert Strang, "Linear Algebra and its Applications," 5th edition, Thomson Learning Asia, 2016 onwards.
2.	A. Papoullis and S. U. Pillai, "Probability, Random Variables and Stochastic Processes", McGraw- Hill, 2002 and onwards.
3.	Peyton Z. Peebles, "Probability, Random Variables and Random Signal Principles", 4th ed., TMH, 2007 and onwards.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	Prof. Aditya K. Jagannatham, Applied Linear Algebra for Signal Processing, Data Analytics and Machine Learning, IIT Kanpur, url:https://nptel.ac.in/courses/108104174

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
		3.	Open Book Tests (OBT)
		4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Understand the advanced concepts in linear algebra and probability theory.	Un	3	1
2.	Apply probability theory and linear algebra to model and solve dynamic systems.	Ap	3	1
3.	Analyze the given system using linear algebraic and probabilistic tools.	An	1,3	1,2

Scheme of Continuous Internal Evaluation (CIE) for Theory course (2-0-0, 3-0-0, 4-0-0):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:

1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:

-Student should score minimum 50% of 60 marks (i.e. 30 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE.
-Minimum score in CIE to be eligible for SEE: 50 OUT OF 100.

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)				**CO-PSO Mapping (Planned)**		
C	**PO1**	**PO2**	**PO3**	**PSO**	**PSO**	**PSO**

O				1	2	3
1			✓	✓		
2			✓	✓		
3	✓		✓	✓	✓	
Tick mark the CO, PO and PSO mapping						

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

Multirate Digital Signal Processing

Course Code	DCN12	Course type	IPCC	Credits L-T-P	3 – 0 – 1
Hours/week: L - T- P	3 – 0 – 2			Total credits	4
Total Contact Hours	L = 45 Hrs; T = 0 Hrs; P = 20 Hrs Total = 65 Hrs			CIE Marks	100
Flipped Classes content	0 Hours			SEE Marks	100

Course learning objectives	
1.	To review the fundamentals of discrete time systems.
2.	To explore various single rate filter design.
3.	To understand the basics of multirate systems.
4.	To introduce the concepts of filter banks and transmultiplexers.
5.	To explore maximally decimated filter banks and time frequency representations.

Required Knowledge of: Digital Signal Processing

Unit – I	Contact Hours = 9 Hours
Review of Sampling and Reconstruction of Continuous Time Signals: Periodic sampling, frequency domain representation of sampling, reconstruction of a bandlimited signal from its samples, Discrete time Processing of continuous time signals. Review of Frequency Domain Analysis using Discrete Fourier Transform (DFT) and Fast Fourier Transforms (FFT) algorithms: Decimation in time (DIT) FFT and Decimation in Frequency (DIF) FFT. **Case Study: Digital Audio Streaming Services** Understanding how DSP techniques like sampling, reconstruction, and FFT are applied to digitize, transmit, and process high-quality audio in real-time for platforms like Spotify and VoIP services.	

Unit – II	Contact Hours = 9 Hours
Fixed Rate Filter Design and Realization: Design of FIR Filters: Symmetric and Antisymmetric FIR Filters, Design of linear phase FIR filters using windows. FIR Filter Realization using direct form and lattice structures. Design of IIR Filters using Bilinear Transformation: Butterworth Filters Realization of IIR Filters using Direct form, lattice and lattice ladder structures. **Case Study: Noise Reduction in Hearing Aids** FIR and IIR filters are crucial for designing adaptive noise reduction systems in hearing aids, ensuring clear sound processing for the user by filtering unwanted background noise while preserving speech signals.	

Unit – III	Contact Hours = 9 Hours

Multirate Digital Signal Processing Fundamentals:
Introduction, statement of the problem and definitions, analysis of down sampling and up sampling, sampling rate conversion by a rational factor, multi stage implementation of digital filters, efficient implementation of multirate systems

Case Study: Audio Compression in Streaming Services

Multirate signal processing techniques are used in audio compression algorithms for streaming services (e.g., Spotify, YouTube), where audio signals are downsampled to reduce data rates and then upsampled during playback to maintain high-quality sound without requiring excessive bandwidth.

Unit – IV	Contact Hours = 9 Hours

DFT Filter Banks and Transmultiplexers:
Introduction, DFT filter banks, maximally decimated DFT filter banks and transmultiplexers, transmultiplexers, application of transmultiplexers to digital communications modulation.

Case Study: OFDM (Orthogonal Frequency Division Multiplexing) in 4G/5G Communication

Unit – V	Contact Hours = 9 Hours

Maximally Decimated Filter Banks:
Introduction, vector spaces, two channel perfect reconstruction conditions, design of perfect reconstruction filter banks with real coefficients, lattice implementation of orthonormal filter banks, application to an audio signal
Time frequency expansion: Short time Fourier Transform (STFT), Gabor Transform (GT), wavelet transforms.

Case Study: Audio Compression Using Wavelet Transform

Maximally decimated filter banks, specifically through wavelet transforms, are utilized in audio compression technologies like MP3 and AAC.

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
2	2	Design and realize a digital crossover network using IIR Butterworth filters for music signal.
		Design and synthesize a 3 band digital equalizer by using FIR filters using windows.
3	2	Simulation of up-sampler and study of its frequency domain implication.
		Simulation of down-sampler and study of its frequency domain implication. Use the up-sampler and down-sampler thus designed in a multirate system containing a down-sampler filter and up-sampler to simulate a real world multirate system.
4	1	Obtain sub-band signals and reconstruct the original signal back from the sub-band signals, by designing QMF Filter bank.
5	1	Analyze speech or music signal by implementing STFT.

Unit No.	Self-Study Topics

4	Orthogonal frequency division multiplexing (OFDM)
5	Haar wavelets and filterbanks

Books	
	Text Books:
1.	A. V. Oppenheim, R. W. Schafer and J. R. Buck, Discrete Time Signal Processing, Pearson Publications, 2021 onwards.
2.	J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Pearson Publications, 2017 onwards.
3.	Roberto Cristi, "Modern Digital Signal Processing", Thomson Brooks/Cole Publishers, 2004 onwards.
	Reference Books:
1.	N. J. Fliege, "Multirate Digital Signal Processing", John Wiley & Sons, USA,2000.
2.	P. P. Vaidyanathan, "Multirate Systems and Filter Banks", Pearson Education (Asia) Pte.Ltd, 2004.
3.	Steven M. Kay, "Modern Spectral Estimation", Pearson Education, First edition (2017)
4	Sanjit K. Mitra, Digital Signal Processing: A Computer - Based Approach, McGraw Hill Education; 4th edition, 2013 onwards.
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	Multirate DSP By Prof. R. David Koilpillai, IIT Madras Link: https://onlinecourses.nptel.ac.in/noc20_ee21/preview
2.	Foundations of Wavelets and Multirate Digital Signal Processing by Prof. V.M.Gadre, IIT Bombay, Link: https://archive.nptel.ac.in/noc/courses/noc17/SEM1/noc17-ee05/

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Assignment (OA)/ Lab Project/ Industry assignment/Certification/ Course project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs (if present)		

Course Outcome (COs)
Learning Levels:
Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Explain the principles of sampling, reconstruction, and multirate digital signal processing, including the design and realization of FIR and IIR filters.	Un	1,3	1,2
2.	Apply multirate techniques to implement digital filters efficiently for a given signal processing application.	Ap	1,3	1,2
3.	Analyze and evaluate the performance of multirate systems and filter	An	1,3	1,2

	banks, including their applications in digital communication and signal modulation systems.			

Scheme of Continuous Internal Evaluation (CIE) for Integrated course (1-0-1, 2-0-1, 3-0-1):
For integrated courses, a lab test also will be conducted at the end of the semester. The lab test **(COMPULSORY)** will be part of the CIE. **No SEE for Lab**.

THEORY (60 marks)		LAB (40 marks)		Total
IA test 1	IA test 2	Conduction	Lab test	
30 marks	30 marks	10 marks	30 marks	100 marks
IA Test: 1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks). 2. Remaining 20 marks questions in Part B & C should be descriptive.				
Conduct of Lab: 1. Conducting the experiment and journal: 5 marks 2. Calculations, results, graph, conclusion and Outcome: 5 marks				
Lab test: (Batchwise with 15 students/batch) 1. Test will be conducted at the end of the semester 2. Timetable, Batch details and examiners will be declared by Exam section 3. Conducting the experiment and writing report: 5 marks 4. Calculations, results, graph and conclusion: 15 marks 5. Viva voce: 10 marks				
Eligibility for SEE: 1. Student should score minimum 50% of 60 marks (i.e. 30 marks) in IA tests. Lack of minimum score in IA test will make the student Not Eligible for SEE 2. Student should score minimum 50% of 30 marks (i.e. 15 marks) in Lab test & should score 50% of 40 marks (i.e. 20 marks) in Lab component. 3. Lab test is COMPULSORY 4. Minimum score in CIE to be eligible for SEE: 50 OUT OF 100. 5. Not eligible in any one of the two components will make the student **Not Eligible** for SEE				

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥ 40% &, however overall score of CIE+SEE should be ≥ 50%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)				**CO-PSO Mapping (Planned)**		
CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**	**PSO3**
1	✓		✓	✓	✓	
2	✓		✓	✓	✓	
3	✓		✓	✓	✓	

Tick mark (✓) the CO, PO and PSO mapping

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

Advanced Digital Communication

Course Code	DCN13	Course type	PCC	Credits L-T-P	3 – 0 – 0
Hours/week: L - T- P	3 – 0 – 0			Total credits	3
Total Contact Hours	L =40 Hrs; T = 0 Hrs; P = 0 Hrs Total = 40 Hrs			CIE Marks	100
Flipped Classes content	0 Hours			SEE Marks	100

Course learning objectives	
1.	Understand the principles of digital bandpass modulation techniques and analyze their performance in terms of bandwidth efficiency and power requirements.
2.	Apply link budget analysis by considering all relevant parameters such as transmission power, antenna gain, path losses, and noise contributions to ensure successful communication over the link.
3.	Analyze the concept of interleaving and concatenated codes for improving error correction performance, and implement these techniques to enhance data reliability in noisy communication environments.
4.	Understand and apply carrier and symbol synchronization techniques and adaptive equalization techniques.

Pre-requisites: Digital Signal Processing, Digital Communication

Unit – I	Contact Hours = 8 Hours
BANDPASS MODULATION AND DEMODULATION/DETECTION (text 1 chapter 4) Digital Bandpass Modulation Techniques, Detection of Signals in Gaussian Noise, Coherent Detection, Noncoherent Detection, Complex Envelope, Error Performance for Binary Systems, M-ary Signaling and Performance. **Self-study:** Review of BPSK, QPSK, MPSK, MQAM, Power Limited Schemes – FSK, MFSK, DPSK DQPSK	

Unit – II	Contact Hours = 8 Hours
COMMUNICATIONS LINK ANALYSIS (text 1 chapter 5) The Channel, Received Signal Power and Noise Power, Link Budget Analysis, Noise Figure, Noise Temperature, and System Temperature, Sample Link Analysis.	

Unit – III	Contact Hours =8 Hours
Channel Coding Part1: Linear Block Codes, Error-Detecting and Correcting Capability, Cyclic Codes (text 1 chapter 6) Convolutional Encoding, Formulation of the Convolutional Decoding Problem, (text 1 chapter 7)	

Unit – IV	Contact Hours =8 Hours

Channel Coding Part2: Reed-Solomon Codes Interleaving and Concatenated Codes, Coding and Interleaving Applied to the Compact Disc, Digital Audio System and Turbo Codes.

Unit – V	Contact Hours =8 Hours
Carrier and Symbol Synchronization: (Chapter 5 text 2) Signal Parameter Estimation, Carrier Phase Estimation, Symbol Timing Estimation, Joint Estimation of Carrier Phase and Symbol Timing, Performance Characteristics of ML Estimators. **Introduction to Adaptive Equalization** (Chapter 10 text 2) Adaptive Linear Equalizer	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	Bernard Sklar, Digital Communications: Fundamentals and Applications, Second Edition, Prentice Hall, 2001 onwards.
2.	John G. Proakis, Masoud Salehi, Digital Communications, Fifth Edition, McGraw Hill, 2018 onwards.
	Reference Books:
1.	Simon Haykin, Digital Communications Systems,1st edition, Wiley(2014), ISBN:978-8126542314
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	1. Prof. Suvra Sekhar Das, IIT Kharagpur, Modern digital communication techniques, **Link:** https://nptel.ac.in/courses/117/105/117105144 2. Prof. Abhishek Dixit, IIT Delhi, Principles of Digital Communications, **Link:** https://nptel.ac.in/courses/108/102/108102120
2.	

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Assignment (OA)/ Certification
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)			
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create	Learning Level	PO(s)	PSO(s)

1.	*Explain* the fundamental concepts of digital communication techniques and their performance under various noisy conditions.	Un	1,3	1,2
2.	*Implement* modulation, coding, and synchronization techniques to solve practical communication system problems.	Ap	1,3	1,2
3.	*Evaluate* the effectiveness of different communication schemes and error correction methods in improving system reliability and performance.	An	1,3	1,2

Scheme of Continuous Internal Evaluation (CIE) for Theory course (2-0-0, 3-0-0, 4-0-0):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:
1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive
-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:
-Student should score minimum 50% of 60 marks (i.e. 30 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE.
-Minimum score in CIE to be eligible for SEE: 50 OUT OF 100.

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)													CO-PSO Mapping (Planned)		
CO	PO1	PO2	PO3										PSO 1	PSO 2	PSO 3
1	✓		✓										✓	✓	
2	✓		✓										✓	✓	
3	✓		✓										✓	✓	
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

High Speed Communication Networks

Course Code	DCN14	Course type	PCC	Credits L-T-P	3 – 0 – 0
Hours/week: L - T- P	3 – 0 – 0			Total credits	3
Total Contact Hours	L = 45 Hrs; T = 0 Hrs; P = 0 Hrs Total = 45 Hrs			CIE Marks	100
Flipped Classes content	0 Hours			SEE Marks	100

Course learning objectives	
1.	To overview depth in computer communication systems and networks topics that may have been covered at undergraduate level.
2.	To introduce students to some of the latest systems and technologies, and how they are used today.
3.	To discuss some of the key emerging systems and technologies, including research issues and challenges, and their impact on current and future systems.
4.	To understand the impact of block chain technology and software defined networking in computer communication.

Pre-requisites: Digital Communication, Information theory coding.

Unit – I	Contact Hours = 09 Hours
Foundation: Overview Of Communication Networks And Internet, Nuts And Bolts Description, Services Description, Protocol Description, Network Edge, Access Networks, Network Core, Performance Parameters, Layered Architecture, Delay Tolerant Networks. **Case study:** Implementing Network Software, IEEE 802.3 and 802.11 standards.	

Unit – II	Contact Hours = 09 Hours
Internetworking-I: Reliable Transmission, Stop-and-Wait, Sliding Window, Switching and Forwarding, Virtual Circuit Switching, Source Routing. **Internetworking-II**: Datagram Forwarding in IP, IP addressing, IPv6, Datagram Fragmentation and Delays, ARP configuration, Numerical relevant to the topic. **Case study:** Subnetting, Error Reporting (ICMP), Virtual Networks and Tunnels.	

Unit – III	Contact Hours = 09 Hours
Resource Allocation in Networks: Challenges, Taxonomy, Mismatch Multi Link Model And Evaluation Criteria. Quality Of Service, Application Requirements, Integrated Services (RSVP), Differentiated Services (EF, AF), Equation-Based Traffic Control. **Networks Attacks**: Types, Firewall, Zone Based Firewall, Firewall Methodologies, HTTP Non-Persistent & Persistent Connection. **Case study:** LZW (Lempel–Ziv–Welch) Compression technique. RC4 and RC5 Encryption Algorithm.	

Unit – IV	Contact Hours = 09 Hours

Switches and Control Planes: Evolution of Switches And Control Planes, Cost, SDN Implications For Research And Innovation, Data Center Innovation, Data Center Needs. **Software Defined Networking**: Abstract, Fundamental Characteristics of SDN, SDN operation, SDN Devices, SDN Controller, SDN Applications.

Unit – V	**Contact Hours = 09 Hours**
Block chain Technology: Origin of block chain technology, The birth of block chain, Revolutionizing the Traditional Business Network, Exploring a block chain application, Recognizing the key business benefits, Building trust with block chain, What Makes a Block chain Suitable for Business, Identifying Participants and Their Roles, Use of Block chain in Internet of Things. **Case study:** Uses of Block chain for Network Engineers.	

Books	
	Text Books:
1.	Larry Peterson and Bruce S Davis, "Computer Networks: A System Approach" 5th Edition, Elsevier, 2014.
2.	Computer Networking: A Top-Down Approach Hardcover – by Kurose Ross. Student Edition, 26 April 2016.
3.	Jean Wairand and Pravin Varaiya, "High Performance Communications Networks", 2nd edition, 2010.
	Reference Books
1.	Anurag Kumar, D. Manjunath and Joy Kuri, "Communication Networking: An Analytical Approach" , Morgan Kaufman Publishers, 2004
2.	Manav Gupta, Blockchain For Dummies, IBM Limited Edition, John Wiley & Sons, Inc.
	E- Resource
1.	https://www.blockchain-council.org/blockchain/uses-of-blockchain-for-network-engineers/
2.	Habib, G.; Sharma, S.; Ibrahim, S.; Ahmad, I.; Qureshi, S.; Ishfaq, M. Blockchain Technology: Benefits, Challenges, Applications, and Integration of Blockchain Technology with Cloud Computing. *Future Internet* 2022, *14*, 341. https://doi.org/10.3390/fi14110341

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

	Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create	**Learning Level**	**PO(s)**	**PSO(s)**
1.	Identify and explain current technology trends for the implementation and deployment of communication network.	L2	1,2	1

2.	Design and develop protocols for reliable communication Networks	L3	1,2	1
3.	Design a network with appropriate protocols selected according to performance requirement.	L4	2,3	2
4.	Optimize the Network Design with use of block chain technology and software defined network.	L4	2,3	2

Scheme of Continuous Internal Evaluation (CIE): Theory course

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:

1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:

-Student should score minimum 50% of 60 marks (i.e. 30 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE.
-Minimum score in CIE to be eligible for SEE: 50 OUT OF 100.

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)				**CO-PSO Mapping (Planned)**		
CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**	**PSO3**
1	✓	✓		✓		
2	✓	✓		✓		
3		✓	✓		✓	
4		✓	✓		✓	
Tick mark (✓) the CO, PO and PSO mapping						

Wireless Sensor Networks

Course Code	DCN15	**Course type**	PCC	**Credits L-T-P**	3 – 0 – 0
Hours/week: L - T- P	3 – 0 – 0			**Total credits**	3
Total Contact Hours	L = 45 Hrs; T = 0 Hrs; P = 0 Hrs Total = 45 Hrs			**CIE Marks**	100
Flipped Classes content	0 Hours			**SEE Marks**	100

Course learning objectives	
1.	Grasp the core characteristics, requirements, and challenges of Wireless Sensor Networks.
2.	Study the architecture, components, and energy requirements of various sensor nodes.
3.	Explore WSN network architectures, optimization goals, and design principles.
4.	Use tools like TinyOS and TOSSIM to program and simulate WSNs effectively.
5	Identify and evaluate WSN applications across fields such as automation, healthcare, and environmental monitoring.

Pre-requisites: Embedded systems, Computer Networks

Unit – I	**Contact Hours = 9 Hours**

CHARACTERISTICS OF WSN:

Characteristic requirements for WSN - Challenges for WSNs – WSN vs Adhoc Networks -Sensor node architecture – Commercially available sensor nodes –Imote, IRIS, Mica Mote, EYES nodes, BTnodes, TelosB, Sunspot -Physical layer and transceiver design considerations in WSNs, Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations.

Case Study: Wildlife Monitoring

Learn how WSNs are used to monitor animal movements and environmental changes on the Great Duck Island, show casing the challenges of energy efficiency and node deployment.

Unit – II	**Contact Hours = 9 Hours**

Single node Architecture: Hardware Components, Energy Consumption of Sensor nodes, Examples of Sensor Nodes, Network Architecture: WSN Scenarios, Optimization Goals and figures of Merits, Design principles for WSNs, Service Interfaces for WSNs, Gateway Concepts.

Case Study: Smart Home Systems

Explore how WSNs are used in smart homes for controlling lights, temperature, and security, focusing on energy-efficient hardware and network design.

Unit – III	**Contact Hours = 9 Hours**

Sensor Tasking and Control: Information-Based Sensor Tasking, Joint Routing Information, Aggregation, Sensor Network Databases, Challenges, Query Interfaces, In-Network Aggregation, Data Centric Storage, Data Indices and Range queries, Distributed Hierarchical Aggregation, Temporal Data, WSN Design Issues, Performance Modelling of WSNs and Traffic Management Issues.

Case Study: Flood Monitoring Systems

Understand how WSNs are deployed for real-time flood detection, emphasizing data storage, aggregation, and quick alerts.

Unit – IV	Contact Hours = 9 Hours
Operating Systems for Sensor Networks: Examples of Operating Systems, Node Level Simulators, Introduction to Tiny OS – NesC – Interfaces and Modules- Configurations and Wiring - Generic Components -Programming in Tiny OS using NesC, Emulator TOSSIM, Kali Linux, Contiki cab, **Case Study: Agriculture Monitoring with Contiki OS** Understand how Contiki OS powers WSNs for monitoring soil and crop health in smart farming. Highlight its energy-efficient protocols and support for IoT devices.	

Unit – V	Contact Hours = 9 Hours
APPLICATIONS OF WSN WSN Applications - Home Control, Building Automation, Industrial Automation, Medical Applications, Reconfigurable Sensor Networks, Highway Monitoring, Military Applications, Civil and Environmental Engineering Applications, Wildfire Instrumentation, Habitat Monitoring, Nanoscopic Sensor Applications. **Case Study: Traffic Management in Smart Cities** Learn how WSNs help monitor traffic and reduce congestion in cities, applying standards like IEEE 802.15.4 for efficient operation.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions					

Books	
	Text Books:
1.	Kazem Sohraby,Daniel Minoli,Taieb Znati, "Wireless Sensor Networks: Technology, Protocols, and Applications", John wiley, 2007.
2.	Holger Karl, Andreas Willig, "Protocols and architectures for wireless sensor networks", John wiley,2005
3.	Waltenegus Dargie , Christian Poellabauer, "Fundamentals of Wireless Sensor Networks Theory and Practice", John Wiley & Sons Publications, 2011
4.	Wireless and Mobile Networks, Concepts and Protocols, Sunilkumar S. Manvi, Mahabaleshwar S. Kakkasageri, 2nd edition, 2016
	Reference Books:
1.	Feng Zhao & Leonidas J.Guibas, "Wireless Sensor Networks An Information Processing Approach", Elsevier, 2007
2.	Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://nptel.ac.in/courses/106/105/106105160/
2.	https://onlinecourses.swayam2.ac.in/arp19_ap52/preview
3.	https://cse.iitkgp.ac.in/~smisra/course/wasn.html

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Assignment (OA)/ Certification
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the action verb representing the learning level.)

	Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create	**Learning Level**	**PO(s)**	**PSO(s)**
1.	Comprehend the foundational principles, characteristics, and challenges of Wireless Sensor Networks.	Un	1, 3	1
2.	Develop and simulate WSN architectures and protocols using appropriate tools and software.	Ap	1,3	1,2
3.	Evaluate and optimize WSN protocols, energy efficiency, and data management techniques across applications.	An	1,2,3	1,2,3
4.				

Scheme of Continuous Internal Evaluation (CIE) for Theory course (2-0-0, 3-0-0, 4-0-0):

Components	**Addition of two IA tests**	**Two Assignments – (Open**	**Course project (CP)/ Case study etc**	**Total Marks**
Marks	**30+30 = 60**	**10 + 10 = 20**	**20 marks (with report & presentation)**	**100**

IA Test:

1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:

-Student should score minimum 50% of 60 marks (i.e. 30 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE.
-Minimum score in CIE to be eligible for SEE: 50 OUT OF 100.

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	Minimum marks required in SEE to pass: Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%.
3.	Question paper contains three parts A,B and C. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks.

	2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**										**PSO 1**	**PSO 2**	**PSO 3**
1	✓		✓										✓		
2	✓		✓										✓	✓	
3	✓	✓	✓										✓	✓	✓
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

COMMUNICATION NETWORKS LABORATORY

Course Code	DCNL16	**Course type**	PCCL	**Credits L-T-P**	0 – 0 – 4
Hours/week: L-T-P	0 – 0 – 4			**Total credits**	2
Total Contact Hours	L = 0 Hrs; T = 0 Hrs; P = 48 Hrs Total = 48 Hrs			**CIE Marks**	100
				SEE Marks	100

Course learning objectives	
1.	To understand the working principle of various communication protocols.
2.	To analyze the various routing algorithms.
3.	To know the concept of data transfer between nodes.
4.	To design small enterprise networks

Required Knowledge of: Communication Engineering, Computer communication

Topics to be covered	**Contact Hours = 10 Hours**
Types of networks: LAN, WAN, MAN and PAN. IP addressing, Introduction to NS2. Need to go for ns2 simulation, Sample code for ns2 basics. Installation and introduction of simulation tool packet tracer. Object explore, Node Configuration, interface types, channel selection, IP configuration. Introduction to Wire shark, Packet Capturing and Analyzing, Data packets on Wire shark, Wire shark filters.	
Orientation session on open ended experiment and course project	**Contact Hours = 02 Hours**

List of Experiments

No. of Experiments	Topic(s) related to Experiment
	The following experiments shall be conducted using NS2/ NS3 Network Simulator
1.	Simulate a point-to-point network with N nodes and duplex links between them.
2.	Implement extended service set in multiple node communication scenarios and determine the performance of the network with respect to transmission of packets.
3.	Implement an enterprise network using N nodes and plot the congestion window.
4.	Simulate mobile network with wireless LAN.
5.	Implement network of N nodes with random delay and bandwidth. Using drop tail queue of 10, show the packet flow under i) Simplex link ii) Duplex links
	The following experiments shall be conducted using wireshark/ Packet Tracer (analyzer tool/configure tool)
6.	Simulation of home/office LAN network using N nodes.
7.	Design and Simulate the DHCP server configuration.
8.	Design and simulate the IOT home automation application.
9.	Simulate the soil sensing and control using IOT application.
10.	Implement and simulate the Routing Information Protocol.
11.	Implement and simulate the Border gateway routing protocol.
12.	Open ended experiment: Implementation of Information exchange between moving vehicles.

Books	
	Text Books:
1.	Larry Peterson and Bruce S Davis, "Computer Networks: A System Approach" 5th Edition, Elsevier, 2014.
	E-resourses (NPTEL/SWAYAM. Any Other)- mention links
1.	https://onl.kmi.open.ac.uk/
2.	https://www.wireshark.org/
3.	https://www.isi.edu/nsnam/ns/

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs (if present)		

Course Outcome (COs)				
Learning Levels: **Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create**				
At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Evaluate the performance of computer networks with n nodes.	Ev	1,3	2
2.	Identify and explain current technology trends for the implementation and deployment of wireless network routing.	Ap	1,3	2
3.	Design a network with appropriate protocols selected according to requirement.	An	1,2	2
4.	Analyze performance of various communication protocols.	An	1,2	2

Scheme of Continuous Internal Evaluation (CIE):

Conduction of experiments & viva-voce	Journal	Lab project/ Open ended expt	Lab Test	Total
20 marks	5 marks	10 marks	15	50 marks

Conduct of Lab:
1. Conduction of the experiment: 15 marks + Viva voce: 5 marks
2. Calculations, results, graph, conclusion and Outcome recorded in Journal: 5 marks
3. Lab project/ Open ended expt: 10 marks
3. Lab Test: 15 marks

Eligibility for SEE:
1. 50% and above (25 marks and above)
2. **Lab test is COMPULSORY**

Scheme of Semester End Examination (SEE):			
1.	It will be conducted for 50 marks of 3 hours duration.		
2.	**Minimum marks required in SEE to pass:** Score should be ≥40% , however overall score of CIE+SEE should be ≥50%.		
2.	One or Two experiments to be conducted.		
3.	Minimum marks required in SEE to pass: 20 out of 50		
4.	Initial write up	10 marks	50 marks
	Conduct of experiments, results and conclusion	20 marks	
	One mark question	10 marks	
	Viva- voce	10 marks	
5.	Viva-voce shall be conducted for individual student and not in a group.		

CO-PO Mapping (Planned)				**CO-PSO Mapping (Planned)**		
CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**	**PSO3**
1	✓		✓		✓	
2	✓		✓		✓	
3	✓	✓			✓	

4	✓	✓			✓	
Tick mark (✓) the CO, PO and PSO mapping						

KLS GOGTE INSTITUTE OF TECHNOLOGY BELGAUM

Antenna Theory and Design

Course Code	DCN21	Course type	IPCC	Credits L-T-P	3 – 0 – 2
Hours/week: L - T- P	3 – 0 – 2			Total credits	4
Total Contact Hours	L =40 Hrs; T = 0 Hrs; P = 20 Hrs Total = 60 Hrs			CIE Marks	100
Flipped Classes content				SEE Marks	100

Course learning objectives	
1.	To introduce important parameters of antenna and develop EM equations of dipole and loop.
2.	To explore the arrays of antenna and array synthesis techniques.
3.	To understand the operation of resonant and antennas and broadband antennas.
4.	To introduce aperture antennas and Microstrip patch antenna.

Required Knowledge of: Electromagnetics and Antenna basics

Unit – I	Contact Hours = 8 Hours
Antenna Fundamentals and Definitions: Radiation Mechanisms, Overview, EM Fundamentals, Solution of Maxwell's Equations for Radiation Problems, Ideal Dipole, Radiation patterns, Directivity and Gain, Antenna impedance, Radiation efficiency, Antenna polarization.	

Unit – II	Contact Hours = 8 Hours
Arrays: Array factor for linear arrays, uniformly excited equally spaced linear arrays, Pattern multiplication, Directivity of linear arrays, Nonuniformly excited equally spaced linear arrays, Mutual coupling, Multidimensional arrays, phased arrays and array feeding techniques. **Antenna Synthesis:** Formulation of the synthesis problem, Synthesis principles, Line sources shaped beam synthesis, Linear array shaped beam synthesis, Fourier series, Woodward - Lawson sampling method, Comparison of shaped beam synthesis methods, low side lobe narrow main beam synthesis methods, Dolph Chebyshev linear array, Taylor line source method.	

Unit – III	Contact Hours = 8 Hours
Resonant Antennas: Wires and Patches, Dipole antenna, Yagi-Uda antennas, Micro-strip antenna **Broadband antennas:** Traveling wave antennas Helical antennas, Biconical antennas, Sleeve antennas, and Principles of frequency independent antennas, Spiral antennas, and Log - periodic antennas.	

Unit – IV	Contact Hours = 8 Hours
Aperture antennas: Techniques for evaluating gain, Reflector antennas- Parabolic reflector antenna principles, Axi-symmetric parabolic reflector antenna, offset parabolic reflectors, Dual reflector antennas, Gain calculations for reflector antennas, Feed antennas for reflectors, Field representations, Matching the feed to the reflector, General feed model, Feed antennas used in practice.	

Unit – V	Contact Hours = 8 Hours
Microstrip antenna: Introduction, Rectangular patch, circular patch, Quality factor, Bandwidth and efficiency, input impedance, coupling, circular polarization, arrays, and feed network.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	-	-	-	-	-

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
1	1	Measurement of directivity and gain of microstrip antennas: a. Dipole **b.** Patch
3	2	Design and Simulation of Dipole antenna and measurement of characteristics of the same.
3	3	Design and Simulation of Loop antenna and measurement of characteristics of the same.
3	4	Design and Simulation of Helical antenna and measurement of characteristics of the same.
3	5	Design and Simulation of Patch antenna and measurement of characteristics of the same.
2	6	Design and Simulation of N element linear array of dipole and loop – using array factor and principle of pattern multiplication.
2	7	Design and Simulation of NxN planar arrays of isotropic point sources.
2	8	Antenna array synthesis using Dolph Chebyshev method.
5	9	Design and simulation of an antenna for a given application.

Books	
	Text Books:
1.	Stutzman and Thiele, 'Antenna Theory and Design', John Wiley, 2nd Edition, 2010
2.	C. A. Balanis, 'Antenna Theory Analysis and Design', John Wiley, 2nd Edition, 2007
	Reference Books:
2.	J. D. Krauss, 'Antennas and Wave Propagation', McGraw Hill TMH, 4th Edition, 2010
3	A. R. Harish, M. Sachidanada, 'Antennas and propagation', Pearson Education, 2015

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Assignment (OA)/ Lab Project/ Industry

			assignment/Certification/ Course project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs (if present)		

Course Outcome (COs) Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create				
At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	**Understand** the basic parameters of various types of antennas and computational electromagnetic techniques applied to antennas.	Un	1,3	1
2.	**Design** various antennas for the specified application or for given design constraints.	Ap	1,3	1,2
3.	**Analyze** the designed antenna for various performance parameters.	An	1,3	1,2

Scheme of Continuous Internal Evaluation (CIE) for Integrated course (1-0-1, 2-0-1, 3-0-1):
For integrated courses, a lab test also will be conducted at the end of the semester. The lab test **(COMPULSORY)** will be part of the CIE. **No SEE for Lab**.

THEORY (60 marks)		LAB (40 marks)		Total
IA test 1	IA test 2	Conduction	Lab test	
30 marks	30 marks	10 marks	30 marks	100 marks
IA Test: 1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks). 2. Remaining 20 marks questions in Part B & C should be descriptive.				
Conduct of Lab: 1. Conducting the experiment and journal: 5 marks 2. Calculations, results, graph, conclusion and Outcome: 5 marks				
Lab test: (Batchwise with 15 students/batch) 1. Test will be conducted at the end of the semester 2. Timetable, Batch details and examiners will be declared by Exam section 3. Conducting the experiment and writing report: 5 marks 4. Calculations, results, graph and conclusion: 15 marks 5. Viva voce: 10 marks				
Eligibility for SEE: 1. Student should score minimum 50% of 60 marks (i.e. 30 marks) in IA tests. Lack of minimum score in IA test will make the student Not Eligible for SEE 2. Student should score minimum 50% of 30 marks (i.e. 15 marks) in Lab test & should score 50% of 40 marks (i.e. 20 marks) in Lab component. 3. Lab test is COMPULSORY 4. Minimum score in CIE to be eligible for SEE: 50 OUT OF 100. 5. Not eligible in any one of the two components will make the student **Not Eligible** for SEE				

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.

2.	**Minimum marks required in SEE to pass:** Score should be ≥ 40% &, however overall score of CIE+SEE should be ≥ 50%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (planned)													CO-PSO Mapping (planned)		
CO	PO 1	PO2	PO3										PSO 1	PSO 2	PSO 3
1	✓		✓										✓		
2	✓		✓										✓	✓	
3	✓		✓										✓	✓	
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

Cyber Security

Course Code	**DCN22**	**Course type**	**PCC(PB)**	**Credits L-T-P**	2 – 0 – 1
Hours/week: L - T- P	2 – 0 – 2			**Total credits**	3
Total Contact Hours	L = 30 Hrs; T = 0 Hrs; P = 20 Hrs Total = 50 Hrs			**CIE Marks**	100
Flipped Classes content	0 Hours			**SEE Marks**	100

Course learning objectives	
1.	To understand the basics of cybersecurity and get familiar with cybersecurity analysis tools.
2.	To acquire knowledge regarding types of security threats, attacks and countermeasures.
3.	To explore secure coding practices.

Pre-requisites : Basic understanding of internet

Unit – I	**Contact Hours = 4 Hours**

Cybersecurity System Fundamentals

Introduction to Digital data, its types and information,Introduction to information system, Introduction to management information systems (MIS) and its functions. Introduction to Data Centre and its infrastructure

Introduction to virtualization, its benefits and virtual machines

Components of Virtual Machines, its hardware and its benefits, Application and Desktop Virtualization and their techniques

Introduction to Cyber Security

CIA Triad-3 pillars of information security architecture, CIA components and its importance, Cyber security threats and best practices, Access controls and its types, Types of Reconnaissance, Types of Cyber Attack, Vulnerability Assessment and its features, Concept and types of Scanning Methodology, Penetration Tests

Unit – II	**Contact Hours = 4 Hours**

Network Security Threats and countermeasures

Network Security Devices, Types of Network Securities, Network Access Control, Characteristics of Network Access Control, Application Security, Application Security Tools, Firewalls and its types, virtual private network, Tunnelling protocol and types IDS, IPS and their Types, Introduction to Web Application Vulnerabilities

Basic Practices of Web Application Security

Common Cyberattacks on Web Applications, Mobile Application Vulnerabilities, Mobile Security Threats, Mobile Application Security, Fundamentals of Mobile Device Management, Overview of Mobile Device Management

Cloud Computing Threats and Solutions

Clouds Computing – Threats and Vulnerabilities, Cloud Computing Risks and Threats, Introduction to Cloud Security, Cloud Security and its Practices

Unit – III	Contact Hours = 4 Hours

Firewall and its types

Types of Firewalls and its benefits, Packet Filtering Firewall, Application Firewall, Inspection Techniques, Stateful and Stateless Application, Internet protocol, TCP Header, Well-known UDP and TCP Ports, Client Server Model, DNS and DHCP, SSL and TSL, VPN and how it protects your IP address and privacy

Network Analysis

Information and view specific packets being sent and received on the network, Security Configuration Checklist, Monitoring Network Bandwidth, Network Analyzers, Wireshark and its use cases

Case Study: NMAP tool

Unit – IV	Contact Hours = 4 Hours

Cryptography

Cryptography and Cryptanalysis, Types of cryptography, Symmetric encryption, Asymmetric encryption, Understanding digital certificates and signatures, introduction to signatures, introduction to digital certificates, introduction to cryptographic attacks, types of cryptographic attacks, Traditional cryptographic attacks, Counter measures to cryptographic attacks

Case Study: Cryptool

Unit –V	Contact Hours = 4 Hours

Web Server & Application Security

Concept and overview of 3 tier Architecture, Web Application Basics, Working of Domain Name System (DNS), Working of DNS and its vulnerabilities, Web Server Vulnerabilities, Web Application Security, Web Application Attacks, Working of HTTP, Configuring Chrome to work with Burp, HTTP Request Methods, HTTP Status Messages, HTTP – Responses.

Secure Coding Techniques

OWASP Secure Coding Practices, Quick Reference Guide, , Nikto and its features, CMSeek, its features and detection tools, WPScan and its uses

Case Study: Burp Suite and its tools

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
1	**2**	1. Virtual lab environment setup for cybersecurity 2. Introduction to Kali Linux and its significance in cybersecurity
2	**2**	1. Fundamentals of Network Security protocols, firewalls, and encryption 2. Introduction to Penetration Testing: Conducting a basic penetration test on a vulnerable system
3	**2**	1. Conduction of network scanning and host enumeration using tools like Nmap 2. Network Scanning and Host Discoverywith Nmap
4	**2**	1. Data Encryption and decryption the data using RSA and secure key exchange using Diffie-Hellman Key exchange protocol. 2. Securing email communication with GnuPG
5	**2**	1. Creating strong passwords and managing them 2. Testing Password Strength with John-the-riper and Hashcat

Unit No.	Self-Study Topics
1	Case study: Green Data Centre
2	Case study: Google Data Centre
3	Internet Control Message Protocol
4	Hash Cryptography
5	Case study: Web Application Vulnerability Scanning Tools

Books	
	Text Books:
1.	William Stallings, Cryptography and Network Security, Pearson 6th edition, 2005 onwards
2.	Michael E. and Herbart J.: Principles of Information Security, 2nd Edition 2005onwards
3.	Michael Gregg, Omar Santos, Certified Ethical Hacker (CEH) Version 10 Cert Guide, Pearson IT Certification, 3rd Edition, 2019 onwards
4.	Shankar Kambhampaty, Infrastructure Architecture Essentials for Data Center and Cloud, 2022 onwards (ISBN 979-8786300469)
	Reference Books:
1.	Matt Walker, CEH Certified Ethical Hacker All-in-One Exam Guide, Fourth Edition, McGraw-Hill, 4th Edition, 2019 onwards
2.	Wes Noonan , Firewall-Fundamentals, Cisco-Press, 1st Edition, 2006 onwards

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Assignment (OA)/ Certification
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Examine the vulnerabilities at different parts of the networks and deign secured services	L3	1,2,3	1,2,3
2.	Analyze various types of attacks and compare the performance of various countermeasure tools.	L4	1,2,3	1,2,3
3.	To evaluate the secure systems in various web applications	L5	1,2,3	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test **(COMPULSORY)** will be part of the CIE. **No SEE for Lab**.

THEORY (40 marks)		**PROJECT (60 marks)**			Total
IA test (Theory)	IA test (Lab)	Project Phase 1	Project Phase 2	Project report	

25 marks	15 marks	25 marks	25 marks	10 marks	100 marks
Theory IA test should be of one-hour duration. Lab IA test should be of two/three-hour duration. Project batch will ideally consist of 2 students (maximum of 3). Project Phase 1 presentation will be conducted after 6 weeks and Project Phase 2 presentation will be conducted after 13 weeks from the start of the semester. Submitting Project report is compulsory.					
Eligibility for SEE: 1. 50% and above (20 marks and above) in theory component 2. 50% and above (30 marks and above) in project component 3. Not eligible in any one of the two components will make the student **Not Eligible** for SEE					

Semester End Examination (SEE):

1.	It will be conducted for 100 marks having 3 hours duration.		
2.	**Lab Open ended program/problem/experiment** Write-up & execution (1 open ended expt)- (20 marks write-up + 20 marks algorithm/flowchart + 10 marks execution)	50 marks	100 marks
	Project evaluation a. Initial write up stating the objectives, methodology and the outcome b. Hardware project: Exhibiting and demonstration of working of project. Software project: Demonstration of the programming capabilities by writing flowchart, algorithm and codes related to a section of the project. c. Viva-voce	10 marks 30 marks 10 marks	
3.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 45%, however overall score of CIE + SEE should be $\geq$ 50%.		
4.	SEE will be conducted in project batches by **Internal & External examiners** together.		

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**										**PSO 1**	**PSO 2**	**PSO 3**
1	✓	✓	✓										✓	✓	✓
2	✓	✓	✓										✓	✓	✓
3	✓	✓	✓										✓	✓	✓
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

ADAPTIVE SIGNAL PROCESSING

Course Code	DCN23	Course type	PCC	Credits L-T-P	3 – 0 – 0
Hours/week: L - T- P	3 – 0 – 0			Total credits	3
Total Contact Hours	L = 45 Hrs; T = 0 Hrs; P = 0 Hrs Total = 45 Hrs			CIE Marks	100
Flipped Classes content	5 Hours			SEE Marks	100

Course learning objectives	
1.	To demonstrate the basic concepts and scope of random variables and random processes in adaptive signal processing.
2.	To solve the problems of minimizing mean square error and optimize weights of adaptive Systems such as adaptive linear combiner.
3.	To examine the performance Adaptive systems using the concept of error surface under stationary and non-stationary conditions.
4.	To study and examine the existing adaptive systems and apply the concepts to develop desired adaptive systems for given application.

Required Knowledge of: Signals and Systems, Digital Signal Processing

Unit – I	Contact Hours: 9
Introduction to random variables: random processes, characteristics of random variables, mean, variance, standard deviation, moments, moment generating functions, functions of random variables, covariance, correlation coefficient, numericals as applicable.	

Unit – II	Contact Hours: 9
Adaptive systems: Definitions and characteristics - applications - properties-examples - adaptive linear combiner input signal and weight vectors - performance function-gradient and minimum mean square error - introduction to filtering-smoothing and prediction linear optimum filtering-orthogonality Wiener Hopf equation- Performance Surface. (Text 1)	

Unit – III	Contact Hours: 9
Searching performance surface-stability and rate of convergence: learning curve-gradient search - Newton's method - method of steepest descent - comparison - gradient estimation - performance penalty - variance - excess MSE and time constants misadjustments. (Text 1)	

Unit – IV	Contact Hours: 9
LMS algorithm convergence of weight vector: LMS/Newton algorithm - properties – sequential regression algorithm adaptive recursive filters - random-search algorithms - lattice structure - adaptive filters with orthogonal signals. (Text 1)	

Unit – V	Contact Hours: 9

Applications-adaptive modelling: Z-Transform in Adaptive Signal Processing, Multipath communication channel, geophysical exploration, FIR digital filter synthesis. (Text 2) System identification-adaptive modelling: Inverse adaptive modelling, equalization, and deconvolution adaptive equalization of telephone channels-adapting poles and zeros for IIR digital filter synthesis.

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	1	1	1	1	1

Unit No.	Self-Study Topics
1	Characteristic function, Tchebyshev Ineqaulity, Central limit theorem
2	Orthogonality, Automatic Gain Control System
3	Study of Learning Curves of Simple Adaptive Systems
4	Adaptive Recursive and Non-Recursive Filter Structures
5	Adaptive Equalization and Deconvolution.

Books	
	Text Books:
1.	Simon Haykin, Adaptive Filter Theory, Pearson Education, 2003 edition and onwards.
2	Bernard Widrow and Samuel D. Stearns, Adaptive Signal Processing, Person Education, 2005.
	Reference Books:
1	John R. Treichler, C. Richard Johnson, Michael G. Larimore, Theory and Design of Adaptive Filters Prentice-Hall of India,2002
2	S. Thomas Alexander, Adaptive Signal Processing Theory and Applications - Springer-Verlag.
	E-resourses (NPTEL/SWAYAM.. Any Other)-
	Introduction To Adaptive Signal Processing, By Prof. Mrityunjoy Chakraborty, IIT Kharagpur https://onlinecourses.nptel.ac.in/noc23_ee138/preview

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs (if present)		

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Use Wiener Hopf Equation to compute the values of optimum	Un	1,3	1,2

	weight vectors for any given Adaptive Linear Combiner			
2.	Apply Adaptive Algorithms for the Adaptive Signal Processing to improve the performance of Adaptive Systems.	Ap	1,3	1,2
3.	Design and Analyse Basic Adaptive Systems and Adaptive Linear Combiner for a given application.	An	1,3	1,2

Scheme of Continuous Internal Evaluation (CIE) for Theory course (2-0-0, 3-0-0, 4-0-0):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100
IA Test: 1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks). 2. Remaining 20 marks questions in Part B & C should be descriptive -Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.				
Eligibility for SEE: -Student should score minimum 50% of 60 marks (i.e. 30 marks) in IA tests. -Lack of minimum score in IA test will make the student Not Eligible for SEE. -Minimum score in CIE to be eligible for SEE: 50 OUT OF 100.				

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	Minimum marks required in SEE to pass: Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%.
3.	Question paper contains three parts A,B and C. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (planned)				CO-PSO Mapping (planned)		
CO	PO1	PO2	PO3	PSO1	PSO2	PSO3
1	✓		✓	✓	✓	
2	✓		✓	✓	✓	
3	✓		✓	✓	✓	
4	✓		✓	✓	✓	
Tick mark the CO, PO and PSO mapping						

Advanced Digital Communication Lab

Course Code	**DCNL27**	**Course type**	**PCCL**	**Credits L-T-P**	0 – 0 – 2
Hours/week: L - T- P	0 – 0 – 4			**Total credits**	2
Total Contact Hours	L = 0 Hrs; T = 0 Hrs; P = 40 Hrs Total = 40 Hrs			**CIE Marks**	50
Flipped Classes content	-			**SEE Marks**	50

Course learning objectives	
1.	Understand binary and M-ary modulation and demodulation schemes and assess BER performance of the same.
2.	Simulate channel encoding techniques and synchronization techniques
3.	Implement various channel equalization techniques.

Required Knowledge of: Digital Signal Processing, Digital Communication

Lab Experiment – I	**Contact Hours = 4 Hours**
Implementation (MATLAB) of Binary Modulation and Demodulation: ASK, FSK, PSK	
Lab Experiment – 2	**Contact Hours = 4 Hours**
Implementation (MATLAB) of M-ary Modulation and Demodulation: QPSK, QAM - 16	
Lab Experiment – 3	**Contact Hours = 4 Hours**
BER Analysis of Binary and M-ary Modulation Schemes.	
Lab Experiment – 4	**Contact Hours = 4 Hours**
Implementation (MATLAB) of Linear Block Codes	
Lab Experiment – 5	**Contact Hours = 4 Hours**
Implementation (MATLAB) of Cyclic Codes	
Lab Experiment – 6	**Contact Hours = 4 Hours**
Implementation (MATLAB) of Convolutional Coding and Viterbi Decoding	
Lab Experiment – 7	**Contact Hours = 4 Hours**
Simulation of timing synchronization, carrier synchronization and frame synchronization.	
Lab Experiment – 8	**Contact Hours = 4 Hours**

Implementation of LMS (Least Mean Squares) Algorithm	
Lab Experiment – 9	**Contact Hours = 4 Hours**
Implementation of RLS (Recursive Least Squares) Algorithm	
Lab Experiment – 10	**Contact Hours = 4 Hours**
Implementation of Decision Feedback Equalizer (DFE) Algorithm	

Books	
	Text Books:
1.	Bernard Sklar, Digital Communications: Fundamentals and Applications, Second Edition, Prentice Hall, 2001 onwards.
2.	John G. Proakis, Masoud Salehi, Digital Communications, Fifth Edition, McGraw Hill, 2018 onwards.
3.	Travis F. Collins, Robin Getz, Di Pu and Alexander M. Wyglinski, Software-Defined Radio for Engineers, Artech House Publishers, Unabridged edition, 2018 onwards.

Course delivery methods		**Assessment methods**	
1.	Practice session/Demonstrations in Labs	1.	Conduction of Experiments
2.	Virtual Labs	2.	Journal writing
		3.	Lab project/ Open ended experiment
		4.	Lab Test
		5.	Semester End Examination

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Understand and implement binary and M-ary modulation/demodulation schemes for digital communication systems.	Ap	1,3	1,2
2.	Analyze the error performance of coding techniques such as block codes, cyclic codes, and convolutional codes in real-world communication scenarios.	An	1,3	1,2
3.	Apply and analyze adaptive equalization algorithms, including LMS and RLS, to enhance communication link performance in the presence of channel impairments.	An	1,3	1,2

Scheme of Continuous Internal Evaluation (CIE):

Conduction of experiments & viva-voce	Journal	Lab project/ Open ended expt	Lab Test	Total
20 marks	5 marks	10 marks	15	50 marks

Conduct of Lab: 4. Conduction of the experiment: 15 marks + Viva voce: 5 marks 5. Calculations, results, graph, conclusion and Outcome recorded in Journal: 5 marks 6. Lab project/ Open ended expt: 10 marks 3. Lab Test: 15 marks
Eligibility for SEE: 2. 50% and above (25 marks and above) 2. **Lab test is COMPULSORY**

Scheme of Semester End Examination (SEE):			
1.	It will be conducted for 50 marks of 3 hours duration.		
2.	**Minimum marks required in SEE to pass:** Score should be ≥40% , however overall score of CIE+SEE should be ≥50%.		
2.	One or Two experiments to be conducted.		
3.	Minimum marks required in SEE to pass: 20 out of 50		
4.	Initial write up	10 marks	50 marks
	Conduct of experiments, results and conclusion	20 marks	
	One mark question	10 marks	
	Viva- voce	10 marks	
5.	Viva-voce shall be conducted for individual student and not in a group.		

CO-PO Mapping (planned)													**CO-PSO Mapping (planned)**		
CO	**PO 1**	**PO 2**	**PO 3**										**PSO 1**	**PSO 2**	**PSO 3**
1	✓		✓										✓	✓	
2	✓		✓										✓	✓	
3	✓		✓										✓	✓	
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

SDN and NFV

Course Code	**DCN241**	**Course type**	**PEC**	**Credits L-T-P**	3 – 0 – 0
Hours/week: L - T- P	3 – 0 – 0			**Total credits**	3
Total Contact Hours	L = 45 Hrs; T = 0 Hrs; P = 0 Hrs Total = 45 Hrs			**CIE Marks**	100
Flipped Classes content	0 Hours			**SEE Marks**	100

Course learning objectives	
1.	To Understand the fundamentals of software defined networks and its architecture.
2.	To explore the significance of the data plane and the control plane to develop data exchange network.
3.	To study and analyze the open flow specifications to implement effective SDN Programming.
4.	To design and implement the SDN networks using APIs.

Pre-requisites: Computer Communication Networks, Digital Communication

Unit – I	**Contact Hours = 9 Hours**
INTRODUCTION: Understanding the SDN, Understanding the SDN technology, Control Plane, Data Plane, moving information between planes, separation of the control and data planes, Distributed control planes, Load Balancing, Creating the MPLS Overlay, Centralized control planes **Case study:** Literature survey on SDN with minimum 10 research papers.	

Unit – II	**Contact Hours = 9 Hours**
WORKING OF SDN: Evaluation of Switches and Control planes, SDN Implications, Data centre Needs, Forerunner of SDN, Software Defines Networks is Born, Sustain SDN interoperability, Open-source contribution, Fundamental Characteristics of SDN, SDN Operations, SDN Devices, SDN Controllers, SDN Applications, Alternate SDN methods. **Case study:** Future of SDN: Trends and Predictions.	

Unit – III	**Contact Hours = 9 Hours**
THE OPEN FLOW SPECIFICATIONS: Open Flow Overview, Open Flow Basics, How OpenFlow Works, Open Flow 1.1, Open Flow 1.2, Open Flow 1.5 additions, Open Flow limitations. Application Scenarios of OpenFlow. Multitenant and Virtualized Multitenant Data Center – SDN Solutions for the Data Center Network – VLANs – EVPN – VxLAN – NVGRE. **Case study:** Literature survey on open flow software's with minimum 10 research papers.	

Unit – IV	**Contact Hours = 9 Hours**
SDN via APIS, SDN via Hypervisor-Based Overlays, SDN via Opening up the device, Network function virtualization, Alternative Overlap and Ranking, Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Illustration of Inband Network Telemetry (INT), SDN enabled broadband access.	

Case study: List the SDN APIs which minimizes the complexity in programming SDN.

Unit – V	**Contact Hours = 9 Hours**
Data centers definition, Data centers demand, tunnelling technologies for Data centers Path technologies in data centers, Ethernet fabrics in Data centers, SDN use case in Data centers. Juniper SDN Framework – IETF, SDN Framework, Future of SDN. Secure Enterprise SDN (SES) solution: User onboard system and end point security check module. Sustainable model for data center (Green data center). **Case study:** Impact of SDN in international telecom provider activities.	

Unit No.	**I**	**II**	**III**	**IV**	**V**
No. for Flipped Classroom Sessions	**1**	**1**	**1**	**1**	**1**

Books	
	Text Books:
1.	Software Defined Networking by Thomas D Nadeau and Ken Gray.
2.	Software Define Networks, A Comprehensive Approach, Paul Goransson, Chuck Black. MK Publications.
3.	Paul Goransson and Chuck Black, ―Software Defined Networks: A Comprehensive Approach, First Edition, Morgan Kaufmann, 2014.
	Reference Books
1.	Software Defined Networking for Dummies brought you by cisco, Brian Underdahl and Gary Kinghorn
	E- Resource
1.	Software Defined networking by Prof. Sandeep Chakraborty, IIT Kharagpur. https://www.youtube.com/watch?v=CaukSKg_sI0
2.	Introduction to Computer Networks and Internet protocols by Prof. Bhushan Trivedi. https://onlinecourses.swayam2.ac.in/cec21_cs19/preview

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Illustrate the basics of Software Defined Networks Operations and	Un	3	1

	Data flow.			
2.	Classify different Software Defined Network Operations in real world problem	Ap	3	1,2
3.	Contrast different Software Defined Network Operations and Analyse alternative implementations of Software Defined Networks	An	2,3	1,2

Scheme of Continuous Internal Evaluation (CIE): Theory course

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:

1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:

-Student should score minimum 50% of 60 marks (i.e. 30 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE.
-Minimum score in CIE to be eligible for SEE: 50 OUT OF 100.

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)				**CO-PSO Mapping (Planned)**		
CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**	**PSO3**
1	✓	✓		✓		
2	✓	✓		✓		
3		✓	✓		✓	
4		✓	✓		✓	
Tick mark (✓) the CO, PO and PSO mapping						

STATISTICAL SIGNAL PROCESSING

Course Code	DCN242	Course type	PEC	Credits L-T-P	3 – 0 – 0
Hours/week: L - T- P	3 – 0 – 0			Total credits	3
Total Contact Hours	L = 45 Hrs; T = 0 Hrs; P = 0 Hrs Total = 45 Hrs			CIE Marks	100
Flipped Classes content	0 Hours			SEE Marks	100

Course learning objectives	
1.	Study the statistical modelling techniques for modelling real-world signals and systems.
2.	Understand the spectrum estimation and optimal filtering techniques.
3.	Study the concepts of adaptive filtering and array processing with applied to real-world signals and systems.

Pre-requisites: Basic knowledge of Advanced Engineering Mathematics, Signals and Systems and Digital Signal Processing is required.

Unit – I	Contact Hours = 9 Hours
Random Processes: Random variables, random processes, white noise, filtering random processes, spectral factorization, ARMA, AR and MA processes (Text 1).	

Unit – II	Contact Hours = 9 Hours
Signal Modeling: Least squares method, Padé approximation, Prony's method, finite data records, stochastic models, Levinson-Durbin recursion; Schur recursion; Levinson recursion (Text 1).	

Unit – III	Contact Hours = 9 Hours
Spectrum Estimation: Nonparametric methods, minimum-variance spectrum estimation, maximum entropy method, parametric methods, frequency estimation, principal components spectrum estimation (Text 1).	

Unit – IV	Contact Hours = 9 Hours
Optimal and Adaptive Filtering: FIR and IIR Wiener filters, Discrete Kalman filter, FIR Adaptive filters: Steepest descent, LMS, LMS-based algorithms (Text 1).	

Unit – V	Contact Hours = 9 Hours
Array Processing: Array fundamentals, beam-forming, optimum array processing, performance considerations, adaptive beamforming, linearly constrained minimum-variance beam-formers, side-lobe cancellers (Text 2).	

Books	
	Text Books:
1.	Monson H Hayes, 'Statistical Digital Signal Processing and Modeling', John Wiley & Sons (Asia) Pvt. Ltd., 2002.
2.	Dimitris G. Manolakis, Vinay K. Ingle, and Stephen M. Kogon, 'Statistical and Adaptive Signal Processing: Spectral Estimation, Signal Modeling, Adaptive Filtering and Array Processing', McGraw Hill International Edition, 2000.

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Apply the concepts of random processes for the modelling of signals and systems.	Ap	1,3	1,2
2.	Apply various spectrum estimation techniques for the spectral analysis of real-world signals.	Ap	1,3	1,2
3.	Apply optimal filtering and array processing techniques for analysis of real-world signals.	Ap	1,3	1,2

Scheme of Continuous Internal Evaluation (CIE) for Theory course (2-0-0, 3-0-0, 4-0-0):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:

1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:

-Student should score minimum 50% of 60 marks (i.e. 30 marks) in IA tests.

-Lack of minimum score in IA test will make the student Not Eligible for SEE.

-Minimum score in CIE to be eligible for SEE: 50 OUT OF 100.

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)				**CO-PSO Mapping (Planned)**		
CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**	**PSO3**
1	✓		✓	✓	✓	
2	✓		✓	✓	✓	
3	✓		✓	✓	✓	
Tick mark (✓) the CO, PO and PSO mapping						

MACHINE LEARNING ALGORITHMS

Course Code	**DCN243**	**Course type**	**PEC**	**Credits L-T-P**	3 – 0 - 0
Hours/week: L - T- P	3 – 0 – 0			**Total credits**	3
Total Contact Hours	L =45 Hrs; T = 0 Hrs; P = 0 Hrs Total = 45 Hrs			**CIE Marks**	100
Flipped Classes content	05 Hours			**SEE Marks**	100

Course learning objectives	
1.	To understand the fundamental concepts of machine learning and its applications
2.	To master the concepts of classification and clustering techniques.
3.	To develop a deep understanding of convolutional neural networks (CNNs) and their architecture.
4.	To apply deep learning techniques to large-scale datasets and real-world problems.

Pre-requisites : Fundamentals of statistics, Probability theory

Unit – I	**Contact Hours = 9 Hours**
Introduction and Regression: Introduction, Types of Learning, Simple Linear Regression: Hypothesis, Cost Function, Learning Rate, Gradient Descent for Linear Regression, Multivariate Linear regression, Polynomial Linear Regression.	

Unit – II	**Contact Hours = 9 Hours**
Classification and Clustering : Naïve Bayes Classification, Decision tree Classification, Clustering: K-means Clustering, Association Rules **Neural Networks** : Logistic Regression, Hypothesis, Cost Function, Gradient Descent Learning, Multiclass Classification, Back propagation of Error	

Unit – III	**Contact Hours = 9 Hours**
Convolutional Neural Networks : The operation, Pooling, Convolution and Pooling as an infinitely strong prior, Variants of the basic functions, efficient algorithms, Random or Unsupervised Features, Neuroscientific Basis for Convolutional Networks	

Unit – IV	**Contact Hours = 9 Hours**

Recurrent Neural Networks : RNN, Bidirectional RNN, Encoder-Decoder Sequence to sequence architecture, Deep Recurrent Networks, Recursive Neural Networks, the Long Short Term Memory and other Gated RNNs, Optimization for Long Term Dependencies.

Unit – V	**Contact Hours =9 Hours**
Applications: Study and Implementation of ML algorithms for Large-Scale Deep Learning, Computer Vision, Speech Recognition, Natural Language Processing.	

Flipped Classroom Details

Unit No.	**I**	**II**	**III**	**IV**	**V**
No. for Flipped Classroom Sessions	**1**	**1**	**1**	**1**	**1**

Books	
	Text Books:
1.	Kevin Murphy, “Machine Learning - a Probabilistic Perspective”, MIT Press, 2012
2.	Goodfellow, Bengio and Courville, “Deep Learning”, MIT Press, 2016
	Reference Books:
1.	Christopher Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006
2.	Sudharsan Ravichandran, “Hands-on Deep Learning Algorithms with Python”
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	Introduction To Machine Learning, By Prof. Sudeshna Sarkar, IIT Kharagpur https://onlinecourses.nptel.ac.in/noc22_cs97/preview
2.	Machine Learning And Deep Learning - Fundamentals And Applications, By Prof. Manas Kamal Bhuyan, IIT Guwahati. https://onlinecourses.nptel.ac.in/noc23_ee87/preview

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Assignment (OA)/ Certification
4.		4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Demonstrate** a comprehensive understanding of machine learning and deep learning fundamentals and their applications.	Understanding	1	1
2.	**Apply** various machine learning algorithms and deep learning	Applying	1,2,3	1,2

	architectures to solve complex problems.			
3.	**Develop** machine learning models using appropriate programming languages and tools.	Analyzing	1,2,3	1,2

Scheme of Continuous Internal Evaluation (CIE) for Theory course (2-0-0, 3-0-0, 4-0-0):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:

1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:

-Student should score minimum 50% of 60 marks (i.e. 30 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE.
-Minimum score in CIE to be eligible for SEE: 50 OUT OF 100.

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)				**CO-PSO Mapping (Planned)**		
CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**	**PSO3**
1	✓			✓		
2	✓	✓	✓	✓	✓	
3	✓	✓	✓	✓	✓	
Tick mark (✓) the CO, PO and PSO mapping						

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

ASIC Design

Course Code	**DCN244**	**Course type**	**PEC(PB)**	**Credits L-T-P**	**2-0-1**
Hours/week: L - T- P	**2 – 0 – 2**			**Total credits**	**3**
Total Contact Hours	**L = 30 Hrs; T = 0 Hrs; P = 20 Hrs Total = 50 Hrs**			**CIE Marks**	**100**
Flipped Classes content	**5 Hours**			**SEE Marks**	**100**

Course learning objectives	
1.	**To learn ASIC methodologies and programmable logic cells to implement a function on IC.**
2.	**To Analyse back-end physical design flow, including partitioning, floor-planning, placement, and routing.**
3.	**To Gain sufficient theoretical knowledge for carrying out FPGA and ASIC designs.**

Required Knowledge of :

Unit – I	**Contact Hours = 6 Hours**
Introduction to ASICs: Full custom, Semi-custom and Programmable ASICs, ASIC Design flow, ASIC cell libraries. [T1 Chapter 1] **CMOS Logic: Data path Logic Cells: Data Path Elements, Adders: Carry skip, Carry bypass, Carry save, Carry-select, Conditional sum, Multiplier (Booth encoding), Data path Operators, I/O cells, Cell Compilers.[T1 Chapter 2]**	

Unit – II	**Contact Hours = 6 Hours**
ASIC Library Design: Logical effort: Predicting Delay, Logical area and logical efficiency, Logical paths, Multi stage cells, Optimum delay and number of stages, library cell design. [T1 Chapter 3] **Programmable ASIC Logic Cells: MUX as Boolean function generators, Acted ACT: ACT 1, ACT 2 and ACT 3 Logic Modules, Xilinx LCA:XC3000 CLB, Altera FLEX and MAX, Programmable ASIC I/O Cells: Xilinx and Altera I/O Block. [T1 Chapter 5]**	

Unit – III	**Contact Hours = 6 Hours**
Low-level design entry: Schematic entry: Hierarchical design, The cell library, Names, Schematic Icons & Symbols, Nets, Schematic Entry for ASICs, Connections, vectored instances & buses, Edit in place, attributes, Netlist screener. [T1 Chapter 9] **ASIC Construction: Physical Design, CAD Tools System partitioning, Estimating ASIC size. Partitioning: Goals and objectives, Constructive Partitioning, Iterative Partitioning Improvement, KL, FM and Look Ahead algorithms. [T1 Chapter 15]**	

Unit – IV	**Contact Hours = 6 Hours**
Floor planning and placement: **Goals and objectives, Measurement of delay in Floor planning, Floor planning tools, Channel definition, I/O and Power planning and Clock planning. Placement: Goals and Objectives, Min-cut Placement algorithm, Iterative Placement Improvement, Time driven placement methods, Physical Design Flow. [T1 Chapter 16]**	

Unit – V	Contact Hours = 6 Hours
Routing: Global Routing: Goals and objectives, Global Routing Methods, Global routing between blocks, Back- annotation. Detailed Routing: Goals and objectives, Measurement of Channel Density, Left-Edge Algorithm, Area-Routing Algorithms, Multilevel routing, Timing –Driven detailed routing, Final routing steps, Special Routing, Circuit extraction and DRC. [T1 Chapter 17]	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	1	1	1	1	1

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
Develop and verify a verilog code, exercise a testbench, synthesize, and do the initial timing verification with gate level simulation. Experiments to be done using suitable CAD tools. For the set of experiments listed below, students can make the following flow as a study: - Core Constrained flow - Creation of I/O pad frame - Use the created I/O pad frame for Pad constrained design. - CTS flow Only for designs which have clock		
1	**1**	**Inverter**
1	**1**	**4-bit binary comparator composed of 2-bit comparators**
2	**1**	**3:8 decoder**
2	**1**	**Flip flop - RS, D, JK, MS, T**
3	**1**	**4-bit counter [Synchronous & Asynchronous counter]**
3	**1**	**4·bit universal shift register**
4	**1**	**4-bit adder/subtractor**
4	**1**	**12-bit register that stores an unsigned integer value**

Books	
	Text Books:
1.	Michael John Sebastian Smith, “Application - Specific Integrated Circuits”, Addison-Wesley Professional, 2005
2.	Neil H.E. Weste, David Harris, and Ayan Banerjee, “CMOS VLSI Design: A Circuits and Systems Perspective”, Addison Wesley/ Pearson education 3rdedition, 2011
3.	Vikram Arkalgud Chandrasetty, “VLSI Design: A Practical Guide for FPGA and ASIC Implementations” Springer, ISBN: 978-1-4614-1119-2. 2011
4.	Rakesh Chadha, Bhasker J, “An ASIC Low Power Primer”, Springer, ISBN: 978-14614-4270-7.
	Reference Books:
1.	Peter J. Ashenden Digital Design (Verilog): An Embedded Systems Approach Using Verilog,1st Edition, Kindle Edition
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://www.youtube.com/watch?v=oZSv68esbgI
2.	https://www.youtube.com/watch?v=4cPkr1VHu7Q
3	https://nptel.ac.in/courses/106105161

Course delivery methods	Assessment methods

1.	Chalk and Talk	1.	IA tests- Theory & Lab based
2.	PPT and Videos	2.	Project phase 1 & 2
3.	Flipped Classes	3.	SEE- Project evaluation
4.	Practice session/Demonstrations in Labs	4.	SEE- Solving an Open ended problem
5.	Virtual Labs (if present)		

Course Outcome (COs)

Learning Levels:
Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	**Describe the concepts of ASIC design methodology, data path elements, logical effort .**	L2	1,3	1,2
2.	**Analyze the design of ASICs suitable for specific tasks, perform design entry and explain the physical design flow.**	L3	1,3	1,2
3.	**Design data path elements for ASIC cell libraries and compute optimum path delay.**	L3	1,3	1,2
4	**Create floor plan including partition and routing with the use of CAD algorithms**	L4	1,3	1,2
5	**Design CAD algorithms and explain how these concepts interact in ASIC design.**	L3	1,3	1,2

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test **(COMPULSORY)** will be part of the CIE. **No SEE for Lab**.

THEORY (40 marks)		**PROJECT (60 marks)**			Total
IA test (Theory)	IA test (Lab)	Project Phase 1	Project Phase 2	Project report	
25 marks	15 marks	25 marks	25 marks	10 marks	100 marks

Theory IA test should be of one-hour duration.
Lab IA test should be of two/three-hour duration.
Project batch will ideally consist of 2 students (maximum of 3).
Project Phase 1 presentation will be conducted after 6 weeks and Project Phase 2 presentation will be conducted after 13 weeks from the start of the semester.
Submitting Project report is compulsory.

Eligibility for SEE:
1. 50% and above (20 marks and above) in theory component
2. 50% and above (30 marks and above) in project component
3. Not eligible in any one of the two components will make the student **Not Eligible** for SEE

Semester End Examination (SEE):

1.	It will be conducted for 100 marks having 3 hours duration.		
2.	**Lab Open ended program/problem/experiment** Write-up & execution (1 open ended expt)- (20 marks write-up + 20 marks algorithm/flowchart + 10 marks execution)	50 marks	100 marks
	Project evaluation a. Initial write up stating the objectives, methodology and the outcome b. Hardware project: Exhibiting and demonstration of working	10 marks	

	of project. Software project: Demonstration of the programming capabilities by writing flowchart, algorithm and codes related to a section of the project. c. Viva-voce	30 marks 10 marks	
3.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%.		
4.	SEE will be conducted in project batches by **Internal & External examiners** together.		

CO-PO Mapping (planned)				**CO-PSO Mapping (planned)**		
CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**	**PSO3**
1	✓		✓	✓	✓	
2	✓		✓	✓	✓	
3	✓		✓	✓	✓	

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

Pattern Recognition and Classification

Course Code	**DCN251**	**Course type**	**PEC**	**Credits L-T-P**	3 – 0 - 0
Hours/week: L - T- P	3 – 0 – 0			**Total credits**	3
Total Contact Hours	L = 45 Hrs; T = 0 Hrs; P = 0 Hrs Total = 45 Hrs			**CIE Marks**	100
Flipped Classes content	5 Hours			**SEE Marks**	100

Course learning objectives	
1.	Provide knowledge of models, methods and tools used to solve regression, classification, feature selection and density estimation problems.
2.	Provide knowledge of current research topics and issues in Pattern Recognition and Machine Learning.
3.	Provide knowledge of learning and adaptation in supervised modes of learning.
4.	Provide experience in conducting and presenting a literature review on a research topic.

Pre-requisites: It is assumed the students have a working knowledge of calculus, linear algebra, and probability theory. It is also assumed the students have some experience in programming in a scientific computing environment.

Unit – I	**Contact Hours = 9 Hours**
Introduction to Pattern Recognition: Introduction to Pattern Recognition - Definitions, Datasets for Pattern Recognition, Different Paradigms of Pattern Recognition., Tree Classifiers - Decision Trees: CART, C4.5, ID3, Random Forests, Bayesian Decision Theory.	

Unit – II	**Contact Hours = 9 Hours**
Parameter Estimation Methods: Maximum Likelihood Estimation (MLE), Maximum A Posteriori Estimation (MAP), Bayes Estimator for multivariate Gaussian density with unknown covariance matrices. Sequential Pattern Recognition: Hidden Markov Models (HMM), Discrete HMM.	

Unit – III	**Contact Hours = 9 Hours**
Dimensionality Reduction: Introduction to Data Reduction, Principal Component Analysis (PCA) – Its relation to Eigen Analysis. Fisher Discriminant Analysis (FDA) – Generalized Eigen Analysis. Dictionary Learning Methods – Sparse Coding.	

Unit – IV	Contact Hours = 9 Hours
Classification Techniques: Introduction to Data Classification, Unsupervised classification methods: k Means and k Nearest Neighborhood, Supervised classification methods: Neural Networks, Support Vector Machine.	

Unit – V	Contact Hours = 9 Hours
Applications of Pattern Recognition: Overview of applications of Pattern Recognition - Text Classification, Image Classification and Speech recognition and classification.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	1	1	1	1	1

Books	
	Text Books:
1.	R. O. Duda, P. E. Hart and D. Stork, "Pattern Classification", (2nd. Edition), Wiley 2002,
2.	C. Bishop, "Pattern Recognition and Machine Learning", Springer 2006.
	Reference Books:
1.	S. Theodoris and K. Koutroumbas, "Pattern Recognition", 4th Edition, Academic Press 2009 onwards.
2.	Simon Haykin, "Neural Networks and Learning Machines", 3rd Edition, Prentice Hall, 2008 onwards.
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	Pattern Recognition and Application By Prof. Prabir Kumar Biswas, IIT Kharagpur Link: https://onlinecourses.nptel.ac.in/noc19_ee56/preview
2.	Pattern Recognition, IISc Bangalore, Prof. P.S. Sastry Link: https://nptel.ac.in/courses/117108048

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Assignment (OA)/ Certification
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)			
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create	**Learning Level**	**PO(s)**	**PSO(s)**

1.	Understand the role of information as a pattern and apply classification techniques to make decisions.	Ap	1,3	1,2
2.	Apply dimension reduction techniques to reduce feature of any pattern to classify accurately.	Ap	1,3	1,2
3.	Develop mathematical models for pattern analysis and classification.	Ap	1,3	1,2

✓

Scheme of Continuous Internal Evaluation (CIE) for Theory course (2-0-0, 3-0-0, 4-0-0):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:

1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:

-Student should score minimum 50% of 60 marks (i.e. 30 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE.
-Minimum score in CIE to be eligible for SEE: 50 OUT OF 100.

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**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**
1	✓		✓										✓	✓	
2	✓		✓										✓	✓	
3	✓		✓										✓	✓	
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

High Performance Computing

Course Code	DCN252	Course type	PEC	Credits L-T-P	3 – 0 – 0
Hours/week: L - T- P	3 – 0 – 0			**Total credits**	3
Total Contact Hours	L = 45 Hrs; T = 0 Hrs; P = 0 Hrs Total = 45 Hrs			**CIE Marks**	100
Flipped Classes content	0 Hours			**SEE Marks**	100

Course learning objectives	
1.	Understand High Performance Computing (HPC) system architectures and various computational models.
2.	Learn basics of CUDA programming.
3.	Apply parallel execution models and methodologies for parallel programming and parallel applications development.
4.	Design and implement compute intensive applications on HPC platform.

Pre-requisites : Operating System, Computer Organization and Architecture, Microprocessor

Unit – I	**Contact Hours = 9 Hours**
Parallel Programming & Computing – Introduction, Era of Computing, Parallel Computing, Multiprocessors and Multicomputer Architectures, Scalar VS Vector Processing, Multi-vector and Superscalar Machines, Pipelined Processors, SIMD Computers, Conditions of parallelism, Program flow mechanisms, Types of Parallelism – ILP, PLP, LLP, Program Partitioning and scheduling.	

Unit – II	**Contact Hours = 9 Hours**
Introduction to High Performance Computing - Era of Computing, Scalable Parallel Computer Architectures, towards low-cost computing, Network of Workstations project by Berkeley, Cluster Computing Architecture, Components, Cluster Middleware and SSI, Need of Resource Management and Scheduling, Programming Environments	

Unit – III	**Contact Hours = 9 Hours**
Cluster Computing - Clustering Models, Clustering Architectures, Clustering Architectures key factors, types of clusters, Mission critical Vs Business Critical Applications, Fault Detection and Masking Algorithms, Check pointing, Heartbeats, Watchdog Timers, Fault recovery through Failover and Failback Concepts	

Unit – IV	**Contact Hours = 9 Hours**
High Speed Networks & Message Passing - Introduction to High-Speed Networks, Lightweight Messaging Systems, Xpress Transport Protocol, Software RAID and Parallel File systems, Load Balancing Over Networks – Algorithms and Applications, Job Scheduling approaches and Resource Management in Cluster**.**	

Unit – V	Contact Hours = 9 Hours
CUDA Programming - Introduction to CUDA architecture for parallel processing, CUDA Parallelism Model, Foundations of Shared Memory, Introduction to CUDA-C, Parallel programming in CUDA-C, Thread Cooperation and Execution Efficiency, Constants memory and events, memory management, CUDA C on multiple GPUs, Hashing and Natural Parallelism, Scheduling and Work Distribution, Atomics, Barriers and Progress, Transactional Memory.	

Books	
	Text Books:
1.	Rajkumar, High Performance Cluster Computing: Architectures and Systems, Vol. 1 Pearson Education.
2.	Georg Hager and Gerhard Wellein, Introduction to High Performance Computing for Scientists and Engineers, CRC Press.
	Reference Books:
1.	Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw Hill International Editions
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	High Performance Computing by Prof. Mathew Jacob, Department of Computer Science and Automation, IISC Bangalore Link: https://nptel.ac.in/courses/106/108/106108055/
2.	Course Name: High Performance Computing Architecture by Prof. Ajit Pal, IIT Kharagpur Link: https://nptel.ac.in/courses/106/105/106105033/

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Assignment (OA)/ Certification
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Understand High Performance Computing (HPC) system architectures and various computational models.	Understand	1,3	1,2
2.	Learn basics of CUDA programming.	Understand	1,3	1,2
3.	Apply parallel execution models and methodologies for parallel programming and parallel applications development.	Apply	1,3	1,2
4.	Apply parallel execution models and methodologies for parallel programming and parallel applications development.	Apply	1,3	1,2

Scheme of Continuous Internal Evaluation (CIE) for Theory course (2-0-0, 3-0-0, 4-0-0):

Components	Addition of two IA tests	Two Assignments – (Open	Course project (CP)/ Case study etc	Total Marks
Marks	**30+30 = 60**	**10 + 10 = 20**	**20 marks (with report & presentation)**	**100**

IA Test:

1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:

-Student should score a minimum of 50% of 60 marks (i.e. 30 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE.
-Minimum score in CIE to be eligible for SEE: 50 OUT OF 100.

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO1**	**PO2**	**PO3**										**PSO 1**	**PSO 2**	**PSO3**
1	✓		✓										✓	✓	
2	✓		✓										✓	✓	
3	✓		✓										✓	✓	
4	✓		✓										✓	✓	
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

OPTICAL NETWORKS

Course Code	DCN253	Course type	PEC	Credits L-T-P	3 – 0 – 0
Hours/week: L - T- P	3 – 0 – 0			Total credits	3
Total Contact Hours	L = 45 Hrs; T = 0 Hrs; P = 0 Hrs Total = 45 Hrs			CIE Marks	100
Flipped Classes content	0 Hours			SEE Marks	100

Course learning objectives	
1.	Learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
2.	Understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors.
3.	Learn the various optical source materials, LED structures, quantum efficiency, Laser diodes.
4.	Learn the fiber optical network components, variety of networking aspects, FDDI, SONET/SDH and operational principles of WDM.
5.	Acquire knowledge about fault and congestion management.

Pre-requisites: Optic Fiber Communication and Computer Communication Networks

Unit – I	Contact Hours = 9 Hours
Client Layers of the Optical Layer: SONET/SDH: Multiplexing, CAT and LCAS, Sonnet/SDH Layers, SONET Frame Structure, SONET/SDH Physical Layer, Elements of a SONET/SDH Infrastructure. **Optical Transport Network:** Hierarchy, Frame Structure, Multiplexing, Generic Framing **Procedure** **Ethernet:** Frame Structure, Switches, Ethernet Physical Layer, Carrier Transport IP: Routing and Forwarding, Quality of Service. **Multiprotocol Label Switching:** Labels and Forwarding, Quality of Service, Signaling and Routing, Carrier Transport, Resilient Packet Ring: Quality of Service, Node Structure, Fairness**.** **Storage-Area Networks:** Fiber Channel.	

Unit – II	Contact Hours = 9 Hours
WDM Network Elements: Optical Line Terminals, Optical Line Amplifiers, Optical Add/Drop Multiplexers: OADM Architectures, Reconfigurable OADMs Optical Cross connects: All-Optical OXC Configurations.	

Unit – III	Contact Hours = 9 Hours
Control and Management Network Management Functions: Management Framework, Information Model, Management Protocols. Optical Layer Services and Interfacing, Layers within the Optical Layer, Multivendor Interoperability. **Performance and Fault Management:** The Impact of Transparency, BER measurement, Optical	

Trace, Alarm Management, Data Communication Network (DCN) and Signaling, Policing, Optical Layer Overhead, Client Layers.
Configuration Management: Equipment Management, Connection Management, Adaptation Management. Optical Safety: Open Fiber Control Protocol.

Unit – IV	**Contact Hours = 9 Hours**
Protection in SONET/SDH: Point-to-Point Links, Self-Healing Rings, Unidirectional Line-Switched Rings, Bidirectional Line-Switched Rings, Ring Interconnection and Dual Homing, Protection in the Client Layer: Protection in Resilient Packet Rings, Protection in Ethernet, Protection in IP, Protection in MPLS, Why Optical Layer Protection: Service Classes Based on Protection. Optical Layer Protection Schemes: 1+1 OMS Protection, 1:1 OMS Protection, OMS-DPRing, OMS-SPRing, 1:N Transponder Protection, 1+1 OCh Dedicated Protection, OCh-SPRing, OCH-Mesh Protection, GMPLS Protection, Interworking between Layers.	

Unit – V	**Contact Hours = 9 Hours**
WDM Network Design: Cost Trade-OFFS: A Detailed Ring Network Example LTD and RWA Problems, Light path Topology Design, Routing and Wavelength Assignment, Wavelength Conversion. Dimensioning Wavelength- Routing Networks, Statistical Dimensioning Models: First-Passage Model, Blocking Model, Maximum Load Dimensioning Models: Offline Light Path Requests, Online RWA in Rings.	

Books	
	Text Books:
1.	Rajeev Ramaswamy, Kumar N Sivarajan and Galen H Sasaki, "Optical Networks", Elsevier Publication 3rd Edn. (onwards), 2009.
	Reference Books:
1.	Uyless Black, "Optical Networks-Third generation transport system", Pearson, 2013 and onwards.

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

	Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create	**Learning Level**	**PO(s)**	**PSO(s)**
1.	Understand the architecture of SONET/SDH in optical networks.	Un	1,3	1
2.	Apply WDMs in optical network for appropriate utilization of network resources.	Ap	1,3	1,2
3.	Apply secured algorithms to protect data over SONET/SDH	Ap	1,3	1,2

	optical networks.			

Scheme of Continuous Internal Evaluation (CIE) for Theory course (2-0-0, 3-0-0, 4-0-0):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:

1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:

-Student should score minimum 50% of 60 marks (i.e. 30 marks) in IA tests.

-Lack of minimum score in IA test will make the student Not Eligible for SEE.

-Minimum score in CIE to be eligible for SEE: 50 OUT OF 100.

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)				**CO-PSO Mapping (Planned)**		
CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**	**PSO3**
1	✓		✓	✓		
2	✓		✓	✓	✓	
3	✓		✓	✓	✓	
Tick mark (✓) the CO, PO and PSO mapping						

MEMS AND SENSORS

Course Code	**DCN254**	**Course type**	**PEC**	**Credits L-T-P**	3 – 0– 0
Hours/week: L-T-P	3 – 0 – 0			**Total credits**	3
Total Contact Hours	L = 45Hrs; T = 0Hrs; P = 0Hrs Total = 45Hrs			**CIE Marks**	100
Flipped Classes content	5 Hours			**SEE Marks**	100

Course learning objectives	
1.	To understand the fabrication and machining techniques of MEMS devices.
2.	To familiarize with the concepts of MEMS switches, relays.
3.	To study the RF-MEMS applications.
4.	To analyze the specifications and types of sensors for different applications

Pre-requisites: Electric and electronic circuits, physics basics

Unit – I	**Contact Hours: 9**
MEMS: Introduction, MEMS, micro fabrications for MEMS, electromechanical transducers piezoelectric transducers, electrostrictive transducers, electrostatic actuators, electro thermal actuators, microsensing for MEMS, materials for MEMS, metal and metal alloys for MEMS, polymers for MEMS.	

Unit – II	**Contact Hours: 9**
MEMS SWITCHES AND MICRO RELAYS: Introduction, switch parameters, basics of switching, actuation mechanisms for MEMS devices, MEMS switch design, modeling and evaluation, RF design, MEMS switch design considerations.	

Unit – III	**Contact Hours: 9**
RF-MEMS APPLICATIONS: Introduction, brief History of MEMS and RF-MEMS from the perspective of Technology, RF-MEMS lumped components, variable capacitors, inductors, Ohmic and capacitive switches, MEMS complex networks, reconfigurable impedance-matching networks, reconfigurable RF power attenuators.	

Unit – IV	**Contact Hours: 9**
PRESSURE SENSORS: Pressure sensor specifications, dynamic pressure sensing, pressure sensor types, traditional pressure sensors, manometer, aneroid barometers, bourdon tube, vacuum sensors, diaphragm-based pressure sensors. **Case study: applications using pressure sensor.**	

Unit –V	Contact Hours: 9
INERTIAL SENSORS: Introduction, micromachined accelerometer, principle of operation, research prototype of micromachined accelerometers, commercial micromachined accelerometer, micromachined Gyroscopes, principle of operation, commercial micromachined Gyroscopes.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	1	1	1	1	1

Books	
	Text Books:
1.	Vijay K. Varadan K.J. Vinoy K.A. Jose "RF MEMS and Their Applications", John Wiley & Sons Ltd, 2003
2.	Jacopo Iannacci "Practical Guide to RF-MEMS", June 2012.
3.	Stephen Beeby, Graham Ensell, Michael Kraft,Neil White, "MEMS Mechanical Sensors",
	Reference Books:
1.	Héctor J. De Los Santos "RF MEMS Circuit Design for Wireless Communications", 2002

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		Learning Level	PO(s)	PSO(s)
1.	Illustrate the MEMS technology, materials, fabrication and devices.	Un	1,3	1,2
2.	Examine the MEMS and sensors for different applications.	Ap	1,3	1,2
3.	Characterize different MEMS devices, sensors principles and operations to find the advancements.	An	1,3	1,2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OAs or Course Project	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100

OBA- Open Book Assignment
Minimum score to be eligible for SEE: 50 OUT OF 100

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%.
3.	Question paper contains 3 parts - A,B& C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

CO-PO Mapping (Planned)				**CO-PSO Mapping(Planned)**		
CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**	**PSO3**
1	✓		✓	✓	✓	
2	✓		✓	✓	✓	
3	✓		✓	✓	✓	
Tick mark the CO, PO and PSO mapping						

Image Processing and Machine Vision

Course Code	**DCN261**	**Course type**	**MDC**	**Credits L-T-P**	**3 – 0 – 0**
Hours/week: L - T- P	3 – 0 – 0			**Total credits**	3
Total Contact Hours	L = 45 Hrs; T = 0 Hrs; P = 0 Hrs Total = 45 Hrs			**CIE Marks**	100
Flipped Classes content	0 Hours			**SEE Marks**	100

Course learning objectives	
1.	Understand the Digital Image fundamentals
2.	Study image enhancement algorithms
3.	Explore computer vision techniques

Pre-requisites:

Unit – I	**Contact Hours = 9 Hours**
Introduction and Digital Image Fundamentals: Motivation & Perspective, Applications, Components of Image Processing System, Fundamentals Steps in Image Processing, Image Sampling and Quantization, Some basic relationships like Neighbors, Connectivity, Distance Measures between pixels	

Unit – II	**Contact Hours = 9 Hours**
Image Enhancement in the Spatial and Frequency Domain: Image enhancement by point processing, Image enhancement by neighborhood processing, Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic and Logic operations, Zooming, Basics of Spatial Filters, Smoothening and Sharpening Spatial Filters, Combining Spatial Enhancement Methods. Introduction to Fourier Transform and the frequency Domain, Smoothing and Sharpening Frequency Domain Filters, Homomorphic Filtering	

Unit – III	**Contact Hours = 9 Hours**
Image Restoration and Image Compression Model of The Image Degradation / Restoration Process, Noise Models, Restoration in the presence of Noise Only Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear Position-Invariant Degradations, Estimation of Degradation Function, Inverse filtering, Wiener filtering, Constrained Least Square Filtering, Geometric Mean Filter, Geometric Transformations. Data Redundancies, Image Compression models, Elements of Information Theory, Lossless and Lossy compression, Huffman Coding, Shanon-Fano Coding, Arithmetic Coding, Golomb Coding, LZW Coding, Run Length Coding, Loss less predictive Coding, Bit Plane Coding, Image compression standards.	

Unit – IV	**Contact Hours = 9 Hours**
Image Segmentation and Morphological Image Processing: Discontinuity based segmentation, similarity-based segmentation, Edge linking and boundary detection, 20% Threshold, Region based Segmentation Introduction to Morphology, Dilation, Erosion, Some basic Morphological Algorithms	

Unit – V	Contact Hours = 9 Hours
Object Representation and description and Computer Vision Techniques: Introduction to Morphology, Some basic Morphological Algorithms, Representation, Boundary Descriptors, Regional Descriptors, Chain Code, Structural Methods. Review of Computer Vision applications; Fuzzy-Neural algorithms for computer vision applications	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions					

Books	
	Text Books:
1.	Rafael C. Gonzalez & Richard E. Woods, Digital Image Processing, 4th edition, Pearson Education, 2018 onwards.
2.	David A. Forsyth and Jean Ponce, Computer Vision: A Modern Approach, Prentice Hall India Learning Private Limited, 2003 onwards.
	Reference Books:
1.	A.K. Jain, Fundamental of Digital Image Processing, Pearson Education India, 2015 onwards.
2.	W K Pratt, Digital Image Processing: PIKS Scientific Inside, 4th edition, John Wiley & Sons, 2007 onwards.
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	Digital Image Processing by Prof. Prabir Kumar Biswas , IIT Kharagpur. Link: https://onlinecourses.nptel.ac.in/noc22_ee116/preview

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Assignment (OA)/ Certification
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		Learning Level	PO(s)	PSO(s)
1.	Understand the fundamentals of digital image processing and computer vision tasks.	Un	1,3	1,2
2.	Apply image enhancement, segmentation, restoration, compression, computer vision tasks to a given image processing application.	Ap	1,3	1,2
3.	Analyze the given problem and select appropriate image	An	1,3	1,2

	processing and computer vision technique to solve the same.			

Scheme of Continuous Internal Evaluation (CIE) for Theory course (2-0-0, 3-0-0, 4-0-0):

Components	**Addition of two IA tests**	**Two Assignments – (Open**	**Course project (CP)/ Case study etc**	**Total Marks**
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100
IA Test: 1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks). 2. Remaining 20 marks questions in Part B & C should be descriptive -Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.				
Eligibility for SEE: -Student should score minimum 50% of 60 marks (i.e. 30 marks) in IA tests. -Lack of minimum score in IA test will make the student Not Eligible for SEE. -Minimum score in CIE to be eligible for SEE: 50 OUT OF 100.				

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO1**	**PO2**	**PO3**										**PSO1**	**PSO2**	**PSO3**
1	✓		✓										✓	✓	
2	✓		✓										✓	✓	
3	✓		✓										✓	✓	
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

KLS GOGTE INSTITUTE OF TECHNOLOGY BELGAUM

CMOS RF Circuit Design

Course Code	DCN262	Course type	MDC	Credits L-T-P	3 – 0 - 0
Hours/week: L - T- P	3 – 0 – 0			Total credits	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 0 Hrs Total = 40 Hrs			CIE Marks	100
Flipped Classes content	3 Hours			SEE Marks	100

Course learning objectives	
1.	To Learn the RF Design, Wireless Technology and Basic Concepts.
2.	To understand the learn the Transceiver Architecture.
3.	To understand the Low Noise Amplifiers and Mixers.
4.	To study VCO and PLLs Oscillators.

Pre-requisites : CMOS VLSI, Design, Analog Communication.

Unit – I	Contact Hours = 8 Hours
Introduction to RF Design, Wireless Technology and Basic Concepts: A wireless world, RF design is challenging, The big picture. General considerations, Effects of Nonlinearity, Noise, Sensitivity and dynamic range, Passive impedance transformation. Scattering parameters, Analysis of nonlinear dynamic systems, conversion of gains and distortion.	

Unit – II	Contact Hours = 8 Hours
Communication Concepts: General concepts, analog modulation, digital modulation, spectral re-growth, coherent and non-coherent detection, Mobile RF communications, Multiple access techniques,Wireless standards, Appendix 1: Differential phase shift keying.	

Unit – III	Contact Hours = 8 Hours
Transceiver Architecture: General considerations, Receiver architecture, Transmitter architectures, Direct conversion and two-step transmitters, RF testing for heterodyne, Homodyne, Image reject, Direct IF and sub sampled receivers.	

Unit – IV	Contact Hours = 8 Hours
Low Noise Amplifiers and Mixers: General considerations, Problem of input matching, LNA topologies: common-source stage with inductive load, common-source stage with resistive feedback. Mixers-General considerations, passive down conversion mixers, Various mixers- working and implementation	

Unit – V	Contact Hours = 8 Hours
VCO and PLLs Oscillators: Basic topologies VCO and definition of phase noise, Noise power and trade off. Resonator VCO designs, Quadrature and single sideband generators. Radio frequency Synthesizers- PLLS, Various RF synthesizer architectures and frequency dividers, Power Amplifier design	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	1	1	1		

Books	
	Text Books:
1.	RF Microelectronics B. Razavi PHI second edition.
2.	CMOS Circuit Design, layout and Simulation R. Jacob Baker, H.W. Li, D.E. Boyce PHI 1998.
3.	Design of CMOS RF Integrated Circuits Thomas H. Lee Cambridge University press 1998 .
4.	
	Reference Books:
1.	Mixed Analog and Digital Devices and Technology Y.P. Tsividis TMH 1996.
2.	
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://www.youtube.com/watch?v=oL8SKNxEaHs&list=PLLy_2iUCG87Bdulp9brz9AcvW_TnFCUmM
2.	https://www.youtube.com/watch?v=57uTCtSQV50&list=PLHO2NKv71TvsSqYwVvUCZwNkY-jUyUHdS

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Assignment (OA)/ Certification
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the action verb representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		Learning Level	PO(s)	PSO(s)
1.	Analyse the effect of nonlinearity and noise in RF and microwave design.	Un	1,3	1,2
2.	Exemplify the approaches taken in actual RF products.	Ap	1,3	1,2
3.	Minimize the number of off-chip components required to design mixers, Low-Noise Amplifiers, VCO and PLLs.	An	1,3	1,2
4.	Demonstrate how the system requirements define the parameters of the circuits and the impact on the performance	Ap	1,3	1,2

Scheme of Continuous Internal Evaluation (CIE) for Theory course (2-0-0, 3-0-0, 4-0-0):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:
1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive
-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:
-Student should score minimum 50% of 60 marks (i.e. 30 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE.
-Minimum score in CIE to be eligible for SEE: 50 OUT OF 100.

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	Minimum marks required in SEE to pass: Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%.
3.	Question paper contains three parts A,B and C. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)													CO-PSO Mapping (Planned)		
C	PO	PO	PO										PSO	PSO	PSO

O	1	2	3										1	2	3
1	✓		✓										✓	✓	
2	✓		✓										✓	✓	
3	✓		✓										✓	✓	
4	✓		✓										✓	✓	
Tick mark the CO, PO and PSO mapping															

Dr. Sujata Bhavikatti
Mr. Praveen Kalkundri

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

Embedded Systems and IoT

Course Code	DCN263	**Course type**	**MDC(PBL)**	**Credits L-T-P**	2-0-1
Hours/week: L - T- P	2 – 0 – 2			**Total credits**	3
Total Contact Hours	L = 30 Hrs; T = 0 Hrs; P = 20 Hrs Total = 50 Hrs			**CIE Marks**	100
Flipped Classes content	Hours			**SEE Marks**	100

Course learning objectives	
1.	Understand the key concepts of embedded systems and IoT architectures.
2.	Explore the hardware and software aspects of embedded systems.
3.	Analyze communication protocols and IoT standards.
4.	Develop skills in integrating cloud platforms and device management tools for IoT.
5.	Design and implement practical IoT applications across various industries.

Required Knowledge of : Basic programming knowledge in C, Any microcontroller/ embedded C

Unit – I	**Contact Hours = 6 Hours**
Introduction Embedded IOT architectures Introduction to embedded systems, Application areas and categories of embedded systems, trends in embedded systems, Development and debugging Tools, Characteristics and Quality Attributes of Embedded Systems.	

Unit – II	**Contact Hours = 6 Hours**
Introduction to IOT: Introduction to IOT, Evolution of Internet of Things, Physical Design and Logical Design of IOT, Enabling Technologies, M2M Communication, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects, IOT Opportunities & Design Challenges.	

Unit – III	**Contact Hours = 6 Hours**
Hardware Overview of Xtensa L6 – Architecture, Sensors, transducers and actuators, Modular Approach to Design a System, Programming Assembly, Embedded C , API , Python , GUI.	

Unit – IV	**Contact Hours = 6 Hours**
Embedded and IOT Communication Protocols: Study of basic communication protocols like UART, SPI, SCI (RS232, RS485), I2C, CAN, Field-bus (Profibus), **Wireless connectivity standards for IoT:** Wi-Fi standards, IoT application layer protocols-MQTT. Open source and commercial cloud for IoT, Device management platform.	

Unit – V	**Contact Hours = 6 Hours**
Embedded & IoT Applications: Precision Agriculture, Green House Monitoring and Control System Using IoT, Smart pillbox, Connected Cars & Tracking. Applications of UAVs in Industries, Elevator Control Design, Milk Processing and Packaging Industries.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions					

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
3	**1**	**ADC,DAC PWM**
3	**1**	**Connect DHT11 Sensor using Digital one wire communication and read Temp & Humidity values**
3	**1**	**Connect Accelerometer Sensor using I2C and read X,Y,Z values**
3	**1**	**Create / Write / Read / Delete data in SD Card using SPI**
4	**1**	**MQTT(Message Queue Telemetry Transport)**
4	**1**	**Wi-Fi**
5	**1**	**Working with ThingSpeak Cloud Server**

Unit No.	Self-Study Topics
1	**Python basics, Embedded C**
2	**MSP430,ESP32, LORA**

	Books
	Text Books:
1.	Internet of Things (A Hands-on-Approach), Vijay Madisetti, Arshdeep Bahga
2.	Shibu K. V. Introduction to Embedded Systems, 2nd Edition, McGraw Hill Education, 2009
3.	Raj Kamal, Embedded Systems Architecture, Programming, and Design. (2/e), Tata McGraw Hill, 2008.
4.	Dav id E. Simon An Embedded Software Primer, Pearson Education
	Reference Books:
1.	James K. Peckol, "Embedded systems- A contemporary design tool", John Wiley, 2008.
2.	ARM System on Chip Architecture by Steve Furber, Pearson Education.
3.	Designing Embedded Systems and the Internet of Things (IoT) with the ARM Mbed, By Perry Xiao
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://drive.google.com/drive/folders/1Cwhf6frNoZzkoQAv_C3uRhp2nKuq6NZF?usp=sharing
2.	https://nptel.ac.in/courses/108/105/108105057/
3.	http://hi-robotics.blogspot.com/2014/02/embedded-c-code-program-for-line.html
4.	http://www.nptelvideos.in/2012/11/embedded-systems.html

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests- Theory & Lab based
2.	PPT and Videos	2.	Project phase 1 & 2
3.	Flipped Classes	3.	SEE- Project evaluation
4.	Practice session/Demonstrations in Labs	4.	SEE- Solving an Open ended problem
5.	Virtual Labs (if present)		

Course Outcome (COs) **Learning Levels:** **Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create**				
At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Understand the fundamentals of Embedded Systems and IoT**	**Un**	1,2,3	1,2,3
2.	**Develop Embedded IoT Solutions Using Hardware and Programming Tools**.	**Ap**	1,2,3	1,2,3
3.	**Analyze and develop real-world IoT applications**	**An**	1,2,3	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test **(COMPULSORY)** will be part of the CIE. **No SEE for Lab**.

THEORY (40 marks)		**PROJECT (60 marks)**			Total
IA test (Theory)	IA test (Lab)	Project Phase 1	Project Phase 2	Project report	
25 marks	15 marks	25 marks	25 marks	10 marks	100 marks
Theory IA test should be of one-hour duration. Lab IA test should be of two/three-hour duration. Project batch will ideally consist of 2 students (maximum of 3). Project Phase 1 presentation will be conducted after 6 weeks and Project Phase 2 presentation will be conducted after 13 weeks from the start of the semester. Submitting Project report is compulsory.					
Eligibility for SEE: 1. 50% and above (20 marks and above) in theory component 2. 50% and above (30 marks and above) in project component 3. Not eligible in any one of the two components will make the student **Not Eligible** for SEE					

Semester End Examination (SEE):

1.	It will be conducted for 100 marks having 3 hours duration.		
2.	**Lab Open ended program/problem/experiment** Write-up & execution (1 open ended expt)- (20 marks write-up + 20 marks algorithm/flowchart + 10 marks execution)	50 marks	100 marks
	Project evaluation d. Initial write up stating the objectives, methodology and the outcome e. Hardware project: Exhibiting and demonstration of working of project. f. Software project: Demonstration of the programming capabilities by writing flowchart, algorithm and codes related to a section of the project. g. Viva-voce	10 marks 30 marks 10 marks	
3.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%.		
4.	SEE will be conducted in project batches by **Internal & External examiners** together.		

CO-PO Mapping (planned)													CO-PSO Mapping (planned)		
CO	**PO1**	**PO2**	**PO3**										**PSO1**	**PSO2**	**PSO3**
1	✓	✓	✓										✓	✓	✓
2	✓	✓	✓										✓	✓	✓
3	✓	✓	✓										✓	✓	✓
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

Modern Communication System Development and Sensor Response Analysis

Course Code	**DCN281**	**Course type**	**SEC**	**Credits L-T-P**	0 – 0 – 1
Hours/week: L - T- P	0 – 0 – 2			**Total credits**	1
Total Contact Hours	L = 0 Hrs; T = 0 Hrs; P = 20 Hrs; Total = 20 Hrs			**CIE Marks**	50
Flipped Classes content	00 hours			**SEE Marks**	50

Course learning objectives	
1.	Analyze and Implement Digital Communication Systems
2.	Design and Calibrate Sensor-Based Systems
3.	Integrate sensors, control and communication systems for real world applications.

Required Knowledge of: Digital Communication Systems, sensors and control systems

Lab Experiment – 1	**Contact Hours = 2 Hours**
Spectrum Sensing and Occupancy Detection To Detect presence of signals in given frequency band using SDR	
Lab Experiment – 2	**Contact Hours = 2 Hours**
Digital Signal Transmission Over a Noisy Channel Performance evaluation of digital communication systems over a noisy channel	
Lab Experiment – 3	**Contact Hours = 2 Hours**
Channel Estimation and Equalization To perform channel estimation and equalization of digitally modulated signals	
Lab Experiment – 4	**Contact Hours = 2 Hours**
Error Correction Coding To evaluate the impact of error correction codes on communication reliability	
Lab Experiment – 5	**Contact Hours = 2 Hours**
Real-Time Data Transmission Real-time audio or video transmission using digital communication	
Lab Experiment – 6	**Contact Hours = 2 Hours**
PID Controller design and response analysis using Simulink Stabilizing an unstable closed loop system by using proper PID tuning	
Lab Experiment – 7	**Contact Hours = 2 Hours**
Monitoring of thermal system using RTD, thermistor and thermocouple Signal conditioning and calibration of system response (hardware experiment)	
Lab Experiment – 8	**Contact Hours = 2 Hours**
Measurement of stress and strain using strain gauge and load cell Generation of stress-strain graph and finding gauge factor (hardware experiment)	

Lab Experiment – 9	Contact Hours = 2 Hours
Measurement of liquid level (by pressure sensor) and liquid flow (by flow sensor) Finding the input output relationship and plotting the transfer characteristics (hardware experiment)	
Lab Experiment – 10	**Contact Hours = 2 Hours**
On-off and PID controller-based temperature control system Controller performance with and without environmental perturbations (hardware experiment)	

Books	
	Text Books:
1.	Philip D. Cha, James J. Rosenberg, Clive L. Dym, "Fundamentals of Modeling and Analyzing Engineering Systems," Cambridge University Press, 2nd Ed., Elsevier Academic Press 2000, ISBN: 0-521-67593-6 (paperback).
2.	Scott E. Page, "The Model Thinker – What You Need to Know to Make Data Work for You," Basic Books, Hachette Group Inc., NY, 1st edition, 2018, ISBN: 978-0-465-09463-9.
3.	W. Bolton, "Mechatronics – Electronics Control Systems in Mechanical and Electrical Engineering," Pearson Education Limited, 3rd edition, 2003, ISBN: 0-131-21633-3.
4.	Control Systems, "Principles and Design," M Gopal, McGraw Hill Edu; 2nd Edition.
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	

Course delivery methods		Assessment methods	
1.	Demonstrations of lab experiments	1.	Conduction of experiments
2.	PPT based presentations	2.	Viva-voce after experimentation
3.	Chalk and talk	3.	Journal writing
4.		4.	Lab project
5.		6.	Internal lab examination
		7.	Semester end lab examination

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	**Explain the principles of spectrum sensing, channel estimation, and sensor response characteristics in communication and control systems.**	Un	1,3	1,2
2.	**Implement digital communication techniques and sensor-based measurement systems using software and hardware tools.**	Ap	1,3	1,2
3.	**Evaluate the performance of communication systems and control strategies under varying conditions and environmental perturbations.**	An	1,3	1,2

Scheme of Continuous Internal Evaluation (CIE):

Conduction of experiments & viva-voce	Journal	Lab project / Open ended experiment	Lab Test	Total

20 marks	5 marks	10 marks	15	50 marks

Conduct of Lab:
7. Conduction of the experiment: 15 marks + Viva voce: 5 marks
8. Calculations, results, graph, conclusion and Outcome recorded in Journal: 5 marks
9. Lab project/ Open ended expt: 10 marks
3. Lab Test: 15 marks

Eligibility for SEE:
3. 50% and above (25 marks and above)
2. **Lab test is COMPULSORY**

Scheme of Semester End Examination (SEE):			
1.	It will be conducted for 50 marks of 2/3 hours duration.		
2.	**Minimum marks required in SEE to pass:** Score should be ≥45% , however overall score of CIE+SEE should be ≥50%.		
2.	One or Two experiments to be conducted.		
3.	Minimum marks required in SEE to pass: 20 out of 50		
4.	Initial write up	10 marks	50 marks
	Conduct of experiments, results and conclusion	20 marks	
	One mark question	10 marks	
	Viva- voce	10 marks	
5.	Viva-voce shall be conducted for individual student and not in a group.		

CO-PO Mapping (planned)													**CO-PSO Mapping (planned)**		
CO	**PO 1**	**PO 2**	**PO 3**										**PSO 1**	**PSO 2**	**PSO 3**
1	✓		✓										✓	✓	
2	✓		✓										✓	✓	
3	✓		✓										✓	✓	
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

PCB Design and Fabrication for High Speed Communication Systems

Course Code	**DCN282**	**Course type**	**SEC**	**Credits L-T-P**	**0 – 0 – 1**
Hours/week: L-T-P	**0 – 0 – 2**			**Total credits**	**1**
Total Contact Hours	**L = 0 Hrs; T = 0 Hrs; P = 24 Hrs Total = 24 Hrs**			**CIE Marks**	**50**
				SEE Marks	**50**

Course learning objectives
1. **Understand CAD tool usage required for PCB design.**
2. **Design PCB for given requirements.**
3. **Fabricate the PCB for given requirements.**

Course Content

No	**Topic**	**Contact Hours**
1	**Schematic entry using custom components and inbuild library components.**	**4**
2	**Layout design using custom components and inbuild library components.**	**4**
3	**Design rules for high frequency circuit design**	**4**
4	**Fabrication steps and assembly**	**8**
5	**Course Project Orientation**	**4**

List of Experiments:
Perform following experiments using any CAD tool/fabrication assembly.

Expt No	**Title of Experiment**	**Contact Hours**
1	**For given requirements perform schematic entry and layout design for regulated power supply. Run DRC and generate gerber file.**	**3**
2	**For given requirements perform schematic entry and layout design for an active mixer circuit. Run DRC and generate gerber file.**	**3**
3	**For given requirements perform schematic entry and layout design for a low noise amplifier. Run DRC and generate gerber file.**	**3**
4	**For given requirements perform schematic entry and layout design for a power amplifier. Run DRC and generate gerber file.**	**3**
5	**Fabricate designed Mixer/LNA/PA on a PCB and test its performance.**	**4**
6	**For the given requirements, design a custom PCB and test its performance. (Course Project). Schematic – 2 Hours Layout – 2 Hours Fabrication – 4 Hours**	**8**

Reference Books:

No.	Title of Book
1	Charras, Jean-Pierre., Tappero, Fabrizio., Stambaugh, Wayne. KiCad Complete Reference Manual; 12th Media Services, 2018. (For KiCAD)
2	Mitzner, Kraig., Doe, Bob., Akulin, Alexander., Suponin, Anton., Müller, Dirk. Complete PCB Design Using OrCAD Capture and PCB Editor; Elsevier Science, 2019. (For OrCAD)
3	Bowick, Christopher., Ajluni, Cheryl J.., Blyler, John. RF Circuit Design; Elsevier Science, 2014. (For case study topics)
4	Razavi, Behzad. RF Microelectronics; Pearson Education, 2011. (For Theory Topics)

E-Resources:

No.	Description
1	Electronic Systems Design: Hands-on Circuits and PCB Design with CAD Software, IIT Delhi. Prof. Ankur Gupta https://nptel.ac.in/courses/108102481
2	KiCad Docs https://docs.kicad.org/8.0/

Course Delivery Methods	Assessment Methods
1. PPT and videos 2. Practice session/Demonstrations in Labs	1. Lab Test 2. Course Project

Course Outcome (COs)

Learning Levels:
Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Demonstrate the use of CAD tools.	Un	1,3	1,2
2.	design PCB for given requirements.	An	1,3	1,2
3.	fabricate the PCB for given requirements.	Cr	1,3	1,2

Scheme of Evaluation:

Lab IA	Journal submission	Conduction and Viva	Course Project
15	5	10	20

IA Test:
1. No objective part in IA question paper
2. All questions are experiments.

Conduct of Lab:
1. Lab IA: 15 marks
2. Lab Journal: 5 marks
3. Daily lab execution and viva (average): 10 marks
4. Submission of course project: 20 marks

Lab test: (Batchwise with 15 students/batch) 1. Test will be conducted at the end of the semester 2. Conducting the experiment and writing report: 8 marks 3. Calculations, results, graph and conclusion: 5 marks 4. Viva voce: 3 marks
Eligibility for SEE: 1. 50% and above (25 marks and above)

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 50 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass: 20 out of 50**
3.	One questions will be asked. Exam includes quiz and viva voce.

CO-PO/PSO Mapping:

CO-PO Mapping (Planned)				**CO-PSO Mapping (Planned)**		
CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**	**PSO3**
1	✓		✓	✓	✓	
2	✓		✓	✓	✓	
3	✓		✓	✓	✓	
Tick mark (✓) the CO, PO and PSO mapping						