Vidya Pratishthan's Kamalnayan Bajaj Institute of Engineering and Technology, Baramati

Department of Electronics and Telecommunication Engineering

Final Year B. Tech Syllabus 2026-27 (As per NEP 2020)

(2023 Pattern)

Preamble

The Department of Electronics and Telecommunication Engineering at Vidya Pratishthan's Kamalnayan Bajaj Institute of Engineering & Technology stands as a vibrant crucible of innovation, knowledge creation, and academic excellence. Since its inception over two decades ago, the department has consistently embodied a multifaceted commitment—fostering intellectual growth, nurturing technical acumen, and shaping a dynamic pool of engineers who contribute meaningfully across diverse sectors of society.

Guided by a progressive vision, the department places paramount emphasis on the holistic development of its students, instilling in them a spirit of lifelong learning, ethical responsibility, and societal consciousness. Backed by a team of highly experienced and dedicated faculty, the academic environment is thoughtfully curated to inspire curiosity, critical thinking, and innovation.

The department prides itself on a periodically enriched curriculum that seamlessly integrates foundational knowledge with contemporary technological advancements. This is further reinforced through state-of-the-art laboratories and an application-oriented learning ecosystem that bridges theory with practice. Students are actively encouraged to engage in technical forums such as paper presentations, workshops, and seminars, while also participating in cultural and co-curricular pursuits that ensure a well-rounded educational experience.

With a strong legacy of academic distinction and industry alignment, the department has earned the confidence of leading organizations for campus recruitment and consistently witnesses commendable success in competitive examinations like GATE. As it continues its journey of excellence, the Department of E&TC Engineering remains steadfast in its mission to empower future engineers who are not only technically proficient but also socially responsible and globally competent.

INSTITUTE VISION AND MISSION

VISION

To achieve Academic Excellence through Persistent and Synergic Collaborations amongst all Stakeholders.

MISSION

1. To ensure holistic development of students as lifelong learners and problem solvers through value-based quality education.
2. To motivate faculty to attain the state-of-the-art knowledge and wisdom in their domain and be a facilitator towards co creation of knowledge.
3. To frame and deploy conducive and empowering policies for multifaceted growth of students, faculty and staff to make them contributors towards excellence.
4. To partner with industry for mutually beneficial relations to generate employable and deployable workforce.
5. To fulfill the aspirations of alumni, parents, society, region and nation at large by generating technically competent and contributing manpower.

About E&TC Department

- ➔ Involvement of Experts from IITs, Govt. Colleges, Reputed Industries, Alumni and Students in development of curriculum.
- ➔ Automatic Bank Credit System (ABC)
- ➔ Choice of Electives
- ➔ Remedial Teaching
- ➔ Sponsorship for Publications and IPR
- ➔ Research Mentorship
- ➔ Industry Internship
- ➔ Provision of Credit Transfer Scheme (CTS)
- ➔ Peer Teaching Scheme
- ➔ Teacher Guardian Scheme (TGS)
- ➔ Proficiency Courses
- ➔ MOUs with Industries

DEPARTMENT VISION AND MISSION

VISION

To develop professionals in Electronics and Telecommunication Engineering to contribute in solving technological problems faced by society.

MISSION

1. To impart value added education for developing professional competencies and life skills.
2. To empower facilitators with knowledge, skills and conducive work culture.
3. To reciprocate with collaborating organizations and industries to ensure continual improvements.
4. To integrate efforts of all stakeholders for the benefit of society.

Programme Educational Objectives (PEOs)

A graduate in E&TC will be able to demonstrate:

PEO1: To apply the knowledge of Electronics and Telecommunication Engineering to build career in core and allied industries.

PEO2: To prepare students for higher studies, competitive exams and multidisciplinary work.

PEO3: To follow professional ethics and address social concerns.

PEO4: To be lifelong learner to engross newer technologies.

Program Specific Outcomes (PSOs)

At the end of the programme students will be able to demonstrate:

PSO1: To develop competencies to solve real-life problems in the Electronics and Telecommunication Engineering domain at the same time inculcate professional behavior imbibe with human values and ethics.

PSO2: To acquire the knowledge of embedded systems, communication, signal processing for hardware/software design and development.

PSO3: To demonstrate the competencies to use modern tools and techniques to design electronic systems in diverse fields as per societal needs.

Program Outcomes (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering and Technology
Board of Studies: E&TC Engineering
Syllabus: Final Year (B. Tech.) E&TC Engineering
2023 Pattern B.Tech. Sem VII A.Y. 2026-27

SEMESTER-VII

Course Type	Course Code	Course Name	Teaching Scheme			Examination Scheme and Marks							Credits			
			TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
PCC	ET23401PR	Internship	-	24	-	100	-	-	100	-	150	350	-	12	-	12
PCC	HS23401TH	Entrepreneurship Development	3	-	-	30	-	70	-	-	-	100	3	-	-	4
PCC	HS23401PR	Entrepreneurship Development	-	-	1	-	-	-	30	-	-	30	-	-	1	
PCC	ET23402TH	Research Methodology	3	-	-	30	-	70	-	-	-	100	3	-	-	4
PCC	ET23402PR	Research Methodology	-	-	1	-	-	-	30	-	-	30	-	-	1	
MDM	HS23404TH	Public Speaking and Aptitude	1	-	-	40	-	-	-	-	-	40	1	-	-	2
MDM	HS23404PR	Public Speaking and Aptitude	-	-	1	-	-	-	-	-	30	30	-	-	1	
	Total		7	24	3	200	0	140	160	0	180	680	7	12	3	22

HOD E&TC
Dr. J. S. Rangole

Dean Academics
Dr. S. M. Bhosle

Controller of Examination
Dr. A. H. Kolekar

Principal
Dr. S. B. Lande

Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering and Technology
Board of Studies: E&TC Engineering
Syllabus: Final Year (B. Tech.) E&TC Engineering
2023 Pattern B.Tech. A.Y. 2026-27

SEMESTER-VIII

Course Type	Course Code	Course Name	Teaching Scheme			Examination Scheme and Marks							Credits			
			TH	PR	TUT	CA A	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
PCC	ET23411TH	Deep Learning and Applications	3		-	10	30	60	-	-	-	100	3	-	-	4
PCC	ET23411PR	Deep Learning and Applications	-	2	-	-	-	-	30	-	-	30	-	1	-	
PEC	ET23412XTH	Programme Elective IV Course	3		-	10	30	60	-	-	-	100	3	-	-	4
PEC	ET23412XPR	Programme Elective IV Course	-	2	-	-	-	-	30	-	-	30	-	1	-	
PEC	ET23413XTH	Programme Elective V Course	2	-	-	10	-	60	-	-	-	70	2	-	-	3
PEC	ET23413XPR	Programme Elective V Course	-	2	-	-	-	-	-	-	30	-	-	1	-	
MDM	MD230XXTH	Multidisciplinary Minor	2	-	-	20	20	50	-	-	-	90	2	-	-	3
MDM	MD230XXPR	Multidisciplinary Minor	-	2	-	-	-		20	-	-	20	-	1	-	
PROJ	ET23414	Project	-	8	-	-	-	-	80	-	50	130	-	4	-	4
OE	OE230XX	Open Elective	2	-	-	-	-	50	-	-	-	50	2	-	-	2
	Total		12	16	0	50	80	280	130	0	110	650	12	8	0	20

List of Electives, Multi-Disciplinary Minor and Open Elective

Code	Program Elective Course IV	Code	Multi-Disciplinary Minor	Code	Open Elective
ET23412A	Broadband Communication	ET23052	Drone Technology	OE23016	Accounting and Finance
ET23412B	5G and MIMO	ET23053	Internet of Things	OE23001	Digital Marketing
ET23412C	Wireless Sensor Networks	CO23051	Cloud Computing	OE23002	Professional Leadership
		CO23053	Computer Graphics and gaming	OE23003	Organizational Behavior
Code	**Program Elective Course V**	IT23051	Cyber Security	OE23004	Industrial Management
ET23413A	Drone Technology and Applications	IT23052	Full stack Development	OE23009	Cyber Laws
ET23413B	Introduction to Quantum Computing	CE23052	Green building & smart cities	OE23015	Design Thinking
ET23413C	High Speed PCB Design	ME23052	Introduction to Robotics and Automation	OE23005	Disaster Management
		BS23052	Linear algebra and Statistics		
		EL23051	Fundamentals of Solar Technology		
		ME23051	Introduction to 3D Printing Technologies		

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DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING
VPKBIET BARAMATI

Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering and Technology
Board of Studies: E&TC Engineering
Syllabus: Honor / Double Minor Program
2023 Pattern B.Tech. A.Y. 2026-27
SEMESTER-VIII

Semester	Course Code	Course Name	Teaching Scheme			Examination Scheme and Marks							Credits			
			TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
VIII	ET23481 TH	Advanced CMOS VLSI Technology	3	-	-	10	30	60	-	-	-	130	3	-	-	4
	ET23481 PR	Advanced CMOS VLSI Technology	-	2	-	-	-	-	-	30	-	30	-	1	-	
	Total		3	2	-	10	30	60	-	30	-	130	3	1	-	4

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ET23401 Internship/On job Training
Credits: 00 (Theory) and 12 (Practical)

Teaching Scheme:	**Examination Scheme:**		
	CAA	:	100 Marks
Theory: 00 hrs./week	In-semester	:	-----
Practical: 24 hrs./week	End semester	:	-----
	TW	:	100 Marks
	OR	:	150 Marks

Students should have successfully completed Semester VI of the Engineering program.

Course Objectives:

1. To learn and practice hands-on technical skills.
2. To provide opportunities for acquiring, comprehending, and refining practical technical proficiencies.
3. To gain exposure to professional industrial practices and environments.
4. To understand how real-world factors like cost, society, and management affect a company.
5. To cultivate ethical principles aligned with professional and societal standards.

Course Outcomes:

CO 1. Understand how people in the industry approach and solve problems.

CO 2. Learn how to write clear and effective technical reports.

CO 3. Work effectively and professionally as part of a team.

CO 4. Learn to pick the right tools and technology to solve a given problem.

CO 5. Analyze various career opportunities and decide career goals.

CO 6. Demonstrate abilities of a responsible professional and use ethical practices in day-to-day life.

Internship work Identification:

Student may choose to undergo Internship at Industry/ Govt. organizations/ NGO/ MSME/ Rural Internship/ Innovation/IPR/Entrepreneurship. Student may choose either to work on innovation or Entrepreneurial activities resulting in start-up or undergo internship with industry/NGO's/Government organizations/ Micro/ Small/ Medium enterprises to make themselves ready for the industry. Internship work identification process should be initiated in the VI semester in coordination with training and placement cell/ industry institute cell.

This will help students to start their internship work on time.

Student can take internship work in the form of the following but not limited to:

1. Working for consultancy/ research project,
2. Contribution in Incubation/ Innovation/ Entrepreneurship Cell/ Institutional Innovation
3. Council/ startups cells of institute /
4. Learning at Departmental Lab/ Institutional workshop,
5. Development of new product/ Business Plan/ registration of start-up,
6. Industry / Government Organization Internship,
7. Internship through Internshala,
8. In-house product development, intercollegiate, inter department research internship under

9. research lab/group, micro/small/medium enterprise/online internship,
10. Research internship under professors, IISC, IIT's, Research organizations,
11. NGOs or Social Internships, rural internship,
12. Participate in open-source development.

Duration:

Internship is to be completed after semester 6 and before commencement of semester 8 of at least 14 to 20 weeks; and it is to be assessed and evaluated in semester 7.

Guidelines for students

1. All B. Tech students are required to undergo an internship for a minimum duration of 14–16 weeks. Students must obtain a Final Year - Bonafide Certificate through the college office, which is mandatory for commencing the internship.

2. Student must submit application form with all documents and Undertaking forms to department IIIC Coordinator through mentor

3. Students can take mini projects, assignments, case studies by discussing it with concerned authority from industry and can work on it during internship.

4. All students should compulsorily follow the rules and regulations as laid by industry.

5. Every student should take prior permissions from concerned industrial authority if they want to use any drawings, photographs or any other document from industry.

6. Student should follow all ethical practices and SOP of industry.

7. Students have to take necessary health and safety precautions as laid by the industry.

8. Student should contact his /her academic guide from college on weekly basis to communicate the progress.

9. Each student has to prepare internship report in consultation with the academic guide.

Internship Diary / Internship Workbook

1. Students must maintain a daily diary in the format prescribed by the college, documenting observations, tasks performed, information gathered, and any suggestions.

2. The diary should include relevant sketches, drawings, or diagrams based on daily observations.

3. The industry supervisor or section in-charge must verify and sign the diary every week.

4. Students must present the diary to the Faculty Mentor during each industry visit for

verification and ratification.

5. Upon completion of the internship, students must submit the following to the Institute:

- Student's Daily Diary (as per college format)
- Internship Report
- Attendance Record
- Evaluation Sheet duly signed and stamped by the industry

6. The diary will be evaluated based on regularity of entries, completeness, and adherence to the prescribed format.

Internship Report

1. Students must prepare a comprehensive internship report in the format prescribed by the department, covering observations, tasks performed, and key learning outcomes.

2. Students may consult the Industry Supervisor and Faculty Mentor to obtain specific topics or problem statements to be included in the report.

3. Students should use the daily diary as a reference while preparing the report, as it already contains detailed information recorded during the internship.

4. The completed report must be signed by the Industry Supervisor and Faculty Mentor before submission to the department.

5. The internship report will be evaluated based on the following criteria:

- Originality of content
- Adequacy and purposefulness of the write-up
- Organization, formatting, quality of sketches/drawings, writing style, and language
- Variety and relevance of the learning experiences documented
- Linkage of practical applications with theoretical concepts learned in coursework

Evaluation Guidelines:

Every student is required to prepare and maintain documentary proofs of the activities done by him/her as internship diary or as workbook. The evaluation of these activities will be done by Department IIIC Coordinator / faculty mentor or Industry Supervisor/Appointed External Examiner based on- Overall compilation of internship activities, sub-activities, the level of achievement expected, evidence needed to assign the points and the duration for certain activities. Assessment and Evaluation is to be done in consultation with internship supervisor (Internal and External – a supervisor from place of internship.)

Component	**Marks**
A. Continuous Assessment Activity	100
B. Term-Work (Internship Report)	100
C. Oral Examination / Viva	150
Total	350

1. Continuous Assessment (100 Marks): Evaluation includes attendance, discipline, workplace behaviour, and the quality of the learning diary or logbook. Mid-semester progress presentations and structured industry supervisor feedback form an integral part of the continuous review process.

2. Term-Work (100 Marks): Assessment covers the structure and completeness of the internship report, technical depth, problem-solving ability, and reflection on skills developed. Supporting evidence—drawings, screenshots, certificates, and attendance records—is verified, along with a plagiarism check to ensure originality.

3. Oral Examination / Viva (150 Marks): Evaluation focuses on understanding of tasks performed, application of engineering concepts, clarity of communication, industry relevance, and the ability to respond logically during interaction with examiners. Joint assessment by internal and external examiners ensures transparency and fairness.

Component	Marks	Evaluation Basis	Mode of Assessment / Evaluator
A. Continuous Assessment (100 Marks)			
Attendance, Discipline & Professionalism	20	Regularity, punctuality, adherence to workplace culture	Attendance record + Industry Supervisor note
Diary / Logbook	20	Weekly reflection of tasks, learning outcomes, challenges	Logbook review by Faculty Mentor
Mid-Semester Progress Presentation	20	Presentation on tasks performed, tools/technologies learned, contributions	Faculty review
Industry Supervisor Feedback	40	Attitude, initiative, teamwork, professional conduct	Structured feedback form
Subtotal (A)	**100**		
B. Term-Work (Internship Report) – 100 Marks			
Internship Report (Structure & Completeness)	20	Cover page, acknowledgement, organization profile, objectives, methodology, tasks, outcomes, conclusion	Faculty Panel Evaluation
Technical Content & Problem Solving	30	Depth of technical work, relevance to discipline, engineering application	Faculty Panel
Skill Development Reflection	20	Technical/professional skills, tools learned, employability skills	Faculty Panel
Evidence & Annexures	15	Screenshots, codes, drawings, certificates, datasheets, attendance logs	Faculty Panel
Plagiarism / Originality	15	Minimum 80% originality; no copy-paste	Plagiarism check + Faculty review
Subtotal (B)	**100**		
C. Presentation & Oral Examination / Viva – 150 Marks			
Understanding of Work Done	30	Explanation of tasks performed, process understanding, technical depth	Internal + External Examiners
Application of Knowledge	30	Linkage with curriculum, application of engineering concepts	Viva Panel
Soft Skills & Communication	30	Presentation skills, clarity, professional conduct	Viva Panel
Industry Relevance & Employability	30	Awareness of industry practices, teamwork, adaptability	Viva Panel

Q&A Interaction	30	Logical reasoning and accuracy of responses	Viva Panel
Subtotal (C)	**150**		
Total (A+B+C)	**350**		

Feedback from internship supervisor

Post internship, faculty coordinator/Mentor should collect feedback about student with recommended parameters include as- Technical knowledge, Discipline, Punctuality, Commitment, Willingness to do the work, Communication skill, individual work, Team work, Leadership.

Reference:

1. https://internship.aicte-india.org/
2. Circular No. 29-2024 Internship Cell- BOD Link_15022024.pdf
3. https://www.aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf2

HS23401: Entrepreneurship Development
Credits: 03 (Theory) and 01 (Tutorial)

Teaching Scheme:		**Examination Scheme:**		
		CAA	:	30 Marks
Theory:	03 hrs./week	In-semester	:	-----
Tutorial:	01 hrs./week	End semester	:	70 Marks
		TW	:	30 Marks

Course Objectives:

1. To develop a strong foundation in entrepreneurship by understanding the entrepreneurial mindset, key traits, and the role of entrepreneurs in economic and societal development.
2. To provide insights into the evolution of entrepreneurship in India, including the role of institutional support systems and government initiatives in fostering startups.
3. To equip students with design thinking and innovation skills for identifying opportunities and developing viable products and services.
4. To enable students to perform market analysis and feasibility studies, and to prepare structured and comprehensive business plans.
5. To build competencies in enterprise management, including strategies for risk management, funding acquisition, and leveraging incubation support systems.
6. To develop analytical skills to evaluate startup ecosystems and real-world case studies, fostering informed entrepreneurial decision-making.

Course Outcome:

1. Understand the fundamentals of entrepreneurship, the entrepreneurial mindset, traits, and the role of entrepreneurs in economic development.
2. Explain the growth of entrepreneurship in India and analyze the role of institutional support systems and government initiatives.
3. Apply design thinking principles and innovation strategies in product/service selection and development.
4. Conduct market and feasibility studies and prepare a comprehensive business plan.
5. Develop strategies for enterprise management, risk handling, funding acquisition, and incubation support.
6. Analyze the startup ecosystem and evaluate real-world entrepreneurial case studies.

Unit 1: Introduction to Entrepreneurship [CO1]

Introduction to Entrepreneurship, Concept and Definitions of Entrepreneur and Entrepreneurship, Objectives of Entrepreneurship Development, Phases of Entrepreneurship Development, Role of Entrepreneurship in Economic Development, The Entrepreneurial Mindset, Characteristics and Traits of Entrepreneurs, Entrepreneurship Skills

Unit 2: Entrepreneurial Growth in India [CO2]

Sources of Entrepreneurship in India, Entrepreneurial Development Programmes (EDPs): Concept, Need and Phases, Institutions Conducting EDPs in India, Role of Key Institutions: Maharashtra Centre for Entrepreneurship Development, National Institute for Micro, Small and Medium Enterprises, Prime Minister Employment Generation Programme, Directorate of Industries, Khadi and Village Industries Commission

Unit 3: Design Thinking and Product Selection [CO3]

Design Thinking, Technology Readiness Levels (TRL), Product/Service Selection Process Product/Service Life Cycle, New Product/Service Development Process, Mortality Curve, Creativity and Innovation in Product/Service Development and Modification

Unit 4: Market Study and Business Plan Preparation [CO4]

Market Study Procedures: Questionnaire Design, Sampling Techniques, Market Survey, Data Analysis. Feasibility Study, Forms of Ownership, Capital and Budgeting, Feasibility Report Preparation and Evaluation Criteria, Business Plan Preparation

Unit 5: Managing Enterprise [CO5]

Unique Selling Proposition (USP), Identification and Development of Marketing Plan, Policy Making and Strategic Planning, Risk Management and Calculated Risk-Taking, Angel Investors and Venture Capitalists, Incubation Centers: Role and Procedure

Unit 6: Startup Ecosystem and Case Studies [CO6]

Concept of Startup Ecosystem, Components of Startup Ecosystem, Role of Government, Investors, Incubators, and Accelerators, Case Studies of Successful Startups/Entrepreneurs, Lessons from Startup Success and Failures

Text Books

1. Entrepreneurship Development – Dr. K. Natarajan & Prof. E. Gordon, Himalaya Publishing House.
2. Introduction to Entrepreneurship Development – Abhik Kumar Mukherjee & Shaunak Roy, Oxford University Press.
3. Entrepreneurship Development – Dr. J. Ravi, Manglam Publications.
4. The Dynamics of Entrepreneurial Development and Management – Vasanth Desai, Himalaya Publishing House.

Reference Books

1. Entrepreneurship – Robert D. Hisrich, Michael P. Peters & Dean A. Shepherd, McGraw-Hill.
2. Entrepreneurship Development and Small Business Enterprises – Poornima M. Charanthimath, Pearson Education.
3. Entrepreneurship Development – S. L. Gupta & Arun Mittal, International Book House.
4. Management and Entrepreneurship Development – Sudha G. S., Indus Valley Publication.

Swayam/MOOC course

Entrepreneurship By Prof. C Bhaktavatsala Rao, IIT Madras

ET23402: Research Methodology
Credits: 03 (Theory) and 01 (Tutorial)

Teaching Scheme:		Examination Scheme:		
		CAA	:	30 Marks
Theory:	03 hrs./week	In-semester	:	-----
Tutorial:	01 hrs./week	End semester	:	70 Marks
		TW	:	30 Marks

Prerequisites:

Project based learning of all subjects, Fundamental laws and principles of all subjects, Soft and communication skills.

Course Objectives:

1. The course has been developed with orientation towards research related activities and recognizing the ensuing knowledge as property.
2. It will create consciousness for Intellectual Property Rights and its constituents.
3. Learners will be able to perform documentation and administrative procedures relating to IPR in India as well as abroad.

Course Outcomes:

On completion of the course, the students will be able to:

1. Formulate a research problem for engineering and technology domain.
2. Analyze the available literature for given research problem and understand different techniques of data collection.
3. Investigate the statistical and reliability methods of preliminary data analysis and present the results in graphical form.
4. Understand the importance of technical writing and presentation skills.
5. Comprehend the various forms of the intellectual property, its relevance and business impact in the changing global business environment.
6. Realize the importance of patents, trademark and copyright and follow research ethics.

Course Contents

Unit 1: Introduction

Introduction, Meaning of research, Objectives of research, Types of research, Research approaches, Significance of research, Research methods versus methodology, Research and scientific method, Research process, Criteria of good research, Problems encountered in India for good research, Formulation of research hypotheses, Search for causation, Format for research proposal, Funding for the proposal, Different funding agencies, Framework for the planning.

Unit 2: Literature Review

Definition of literature and literature survey, Significance of literature survey, Sources of literature, Elements and objectives of literature survey, Styles of literature survey, Strategies of literature survey, Searching the existing literature, Reviewing the selected literature, Writing about the literature reviewed and gap identified, literature analysis, data collection, and interpretation.

Unit 3: Preliminary Data Analysis

Testing of hypothesis- concepts and testing, Review of theory of reliability, Hazard models, System reliability. Data presentation skills, Features of statistical analysis, Histogram, bar charts, Pie charts, 2D & 3D plots, Interpolation & extrapolation techniques, Curve fitting.

Unit 4 Technical Writing and Presentation

Effective technical writing, thesis writing, research proposal writing, research paper writing. Significance of report writing, Different steps in writing report, Layout of the research report, Types of reports, Mechanics of writing a research report, Precautions for writing research reports, Presentation skills, tools for technical writing and presentation. Plagiarism, avoiding plagiarism, Research ethics, Tools for plagiarism checking, technical writing and presentation.

Unit 5: Intellectual Property Rights

Introduction and significance of intellectual property rights, Types of Intellectual Property Rights, Copyright and its significance, Introduction to patents and its filing, Introduction to patent drafting, Best practices in national and international patent filing, Copyrightable work examples.

Unit 6: Patent Rights

Patents and its basics, Patentable items, Designs, Process of filing patent at national and international level, Process of patenting and development, Technological research and patents, innovation, Patent and copyright international intellectual property, Procedure for grants of patents, Need of specifications, Types of patent applications, Provisional and complete specification, Patent specifications and its contents, Trade and copyright.

Text books:

1. Ranjit Kumar (2005), 2nd edition, Research Methodology: A Step by Step Guide for beginners (Pearson Education).
2. C. K. Kothari (2004), 2nd edition, Research Methodology Methods & Techniques (New Age International, New Delhi).
3. T. Ramappa (2016), 2nd edition, Intellectual Property Rights-Law in India (Asia Law House, Hyderbad).

Reference Books:

1. Louis Cohen, Manion, Morrison and Routledge (2017), 8th edition, Research Methods in Education (Taylor & Francis Group- Cambridge University Press India Pvt. Ltd.).
2. John Best and James Kahn (1998), 8th edition, Research in Education (Prentice Hall of India Pvt. Ltd.).
3. Stuart Melville and Wayne Goddard (2001), Research Methodology: An Introduction for Science and Engineering Students. (Juta & Co Ltd.).
4. Benjamine Niebel and Alan Draper (1974), Product Design and Process Engineering, (McGraw Hill International Publishers).
5. Halbert D. J. (2007), 2nd edition, Resisting Intellectual Property (Taylor and Francis Ltd.).
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley (2016), Intellectual Property in New Technological Age (Stanford Public Law Working Paper No. 2780190, Elsevier Publishers).

The term work should consist of following assignments.

1. **Literature Review:** Collect the existing literature on any research idea in engineering/technology and identify the research gap. (Performed in a group of **three or four students**)
2. **Report and Seminar Presentation:** Prepare a research proposal based on the identified research gap, which may serve as a basis for the project work. The report should be checked for plagiarism and language quality (e.g., using Grammarly or

equivalent tools), and the idea should be presented. (Performed in a group of **three or four students**)

3. **Blank Format of Research Proposal:** Identify national and international funding agencies and prepare/print the blank format of a research proposal of any one agency, for understanding proposal structuring relevant to research work. (Performed in a group of **three or four students**)
4. **Citation and Referencing Styles:** Write a report on different citation and referencing styles adopted by various publishers, facilitating proper documentation of the research work.
5. **IPR Case Study:** Write a report on a case study of any existing patent/copyright/trademark, providing insight into intellectual property aspects related to project development.
6. **Journal Study:** Collect information on any one peer-reviewed journal and write a report covering abstracting and indexing, H-index, SJR rating, impact factor, aims and scope, and submission guidelines.

HS23404: Public Speaking and Aptitude
Credits: 01 (Theory) and 01 (Tutorial)

Teaching Scheme:		**Examination Scheme:**	
Theory:	01 hrs./week	CAA	: 40 Marks
Tutorial:	1 hrs./week	OR	: 30 Marks

Course Objectives:

1. To develop effective public speaking styles through conversational and communication skills and also enhance speaking skills by focusing on body language and understanding the situational requirements for effective public speaking
2. To develop students' quantitative, logical and analytical abilities required to solve aptitude-based problems commonly encountered in competitive examinations and also enhance their problem-solving speed, decision-making ability and logical reasoning skills

Course Outcomes:

On the completion of the course, students will be able to:

1. Communicate effectively in various public speaking situations and deliver organised and engaging speeches with appropriate body language, voice modulation and confident speech techniques
2. Apply appropriate quantitative, logical, and reasoning strategies to efficiently solve numerical aptitude, data interpretation, and logical reasoning problems with improved speed and accuracy in placement and competitive examination contexts and apply rapid analytical, logical and decision-making strategies to solve time-bound problems with improved accuracy and efficiency

Course Contents:

Unit 1: Essentials and Art of Public Speaking (6 Hours)

Sentence Mastery (Sentence Structure + Subject–Verb Agreement), Verb Tense Control (Past / Present / Future Tenses), Functional Usage (Prepositions + Common Errors & Correct Usage), Verbal & Non-Verbal Communication, Active Listening Skills, Public Speaking & Presentation Skills, Confidence Building, Interpersonal Skills & Relationship Building, Teamwork & Collaboration, Body Language & First Impression, Professional Email, Message & Business Writing, Time Management & Prioritization, Interview Skills & Group Discussion, Workplace Etiquette & Professional Behavior, Emotional Intelligence & Anxiety Control, Stress Management & Work-Life Balance, LinkedIn Profile & Resume Writing, Mock Interviews & Feedback

Unit 2: Quantitative Aptitude (6 Hrs)

Number System, Percentages, Ratio & Proportion, Profit, Loss & Discount, Averages, Time, Speed & Distance, Time & Work + Pipes, Simple & Compound Interest (Basic), Data Interpretation (DI), Data Sufficiency, Seating Arrangement (Linear & Circular), Blood Relations, Coding–Decoding, Syllogisms, Statement–Assumption / Argument

Textbooks & Other Resources:

1. King, Dale. Effective Communication Skills: The Nine-Keys Guidebook for Developing the Art of Persuasion through Public Speaking, Social Intelligence, Verbal Dexterity, Charisma, and Eloquence, Hamatea Publishing Studio, 2020
2. King, Patrick. How to Speak Effectively: Master Communication Skills, Public Speaking and Influence | Improve Conversations, Confidence, and Social and Professional Presentations, and Making an Impact on People, Penguin, 2024

3. Tuhovsky, Tuhovsky. Communication Skills: A Practical Guide to Improving Your Social Intelligence, Presentation, Persuasion and Public Speaking: 9 (Positive Psychology Coaching), Createspace Independent Publishing, 2015
4. Aggarwal. R.S., Quantitative Aptitude for Competitive Examinations, S Chand and Company Ltd. 2025

ET23411 Deep Learning and Applications

Credits: 03 (Theory) and 01 (Practical)

Teaching Scheme:	**Examination Scheme:**		
	CAA	:	10 Marks
Theory: 03 hrs./week	In-semester	:	30 Marks
Practical: 02 hrs./week	End semester	:	60 Marks
	TW	:	30 Marks

Prior knowledge of

Machine Learning, Any Programming Knowledge (Python/Matlab).

Course Objectives:

1. The objectives of this course are to:
2. To introduce the fundamental concepts of artificial intelligence, machine learning, and deep learning.
3. To understand the architecture and training mechanisms of deep neural networks.
4. To study deep learning models such as convolutional neural networks and recurrent neural networks.
5. To explore modern architectures including attention mechanisms and transformers.
6. To apply deep learning techniques to solve real-world problems in areas such as computer vision, speech recognition, and natural language processing.

Course Outcomes:

On completion of the course, learner will be able to:

CO1: Explain the fundamentals of neural networks and deep learning models.

CO2: Analyze optimization and regularization techniques used in training deep neural networks.

CO3: Design and implement convolutional neural networks for image processing tasks.

CO4: Apply sequence models such as RNN, LSTM, and GRU for sequential data analysis.

CO5: Understand attention mechanisms and transformer architectures used in modern deep learning systems.

CO6: Apply deep learning techniques to solve real-world applications in vision, speech, and natural language processing.

Course Contents

UNIT I – Foundations of Deep Learning (6 Hours)

Introduction to Artificial Intelligence, Machine Learning, and Deep Learning, Biological neuron vs Artificial neuron, Perceptron model, Activation functions, Forward propagation, Backpropagation algorithm, Gradient Descent (Batch, Mini-batch, Stochastic).

UNIT II – Improving Deep Neural Networks (6 Hours)

Bias-Variance trade-off, Regularization (L1, L2, Dropout), Weight initialization techniques (Xavier, He), Vanishing and exploding gradient problem, Optimization algorithms (Momentum, RMSProp, Adam), Batch normalization, Hyper parameter tuning.

UNIT III – Convolutional Neural Networks (6 Hours)

Introduction to Convolutional Neural Networks, Convolution layer, pooling layer, Padding and stride; CNN architectures (LeNet, AlexNet, VGG, ResNet, DenseNet); Transfer Learning, Applications of CNNs in image, speech, and video analysis.

UNIT IV – Sequence Models (6 Hours)

Sequence modelling concepts, Recurrent Neural Networks (RNN), Vanishing gradient problem in RNN, LSTM and GRU architectures, Applications: Sentiment analysis, Time series forecasting, Language modelling.

UNIT V – Attention and Transformers (6 Hours)

Attention mechanisms, Queries, keys, and values, Multi-head attention, Self-attention, Transformer architecture Large language models overview.

Unit VI: Deep Learning and Applications (6 Hours)

Applications of deep learning in computer vision, speech recognition, natural language processing, healthcare, and autonomous systems.

Recommended Books/Resources

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville – Deep Learning (MIT Press).

2. François Chollet – Deep Learning with Python.

3. Andrew Ng – Deep Learning Specialization (Coursera).

4. Stanford CS231n – Convolutional Neural Networks for Visual Recognition.

MOOC / NPTEL Courses:

Deep Learning By P K Biswas, Link of the Course: https://nptel.ac.in/courses/106105215.

Deep Learning by IIT Ropar Prof. Sudarshan Iyengar, Link of the Course: https://nptel.ac.in/courses/106106184.

Deep Learning For Visual Computing, IIT Kharagpur Prof. Debdoot Sheet , Link of the Course: https://nptel.ac.in/courses/108105103

Andrej Karpathy – Neural Networks: Zero to Hero (YouTube Series).

List of Practical's

Perform any 8 experiments.

1. Study of Python libraries for Deep Learning: Introduction to Tensor Flow/Keras/PyTorch environment setup and basic operations.
2. Implementation of Perceptron Learning Algorithm: Train a perceptron for a simple binary classification problem.
3. Implementation of Multilayer Neural Network: Design and train a basic feedforward neural network using backpropagation.
4. Experiment on Activation Functions and Gradient Descent: Analyze the effect of different activation functions and learning rates on model performance.
5. Implementation of Convolution Operation and CNN: Build a simple CNN model for handwritten digit recognition using MNIST dataset.

6. Experiment on Transfer Learning: Use a pre-trained CNN model for image classification on a small dataset.
7. Implementation of Recurrent Neural Network (RNN): Train an RNN model for sequence prediction or text classification.
8. Implementation of LSTM/GRU Model: Apply LSTM or GRU network for time-series forecasting or sentiment analysis.
9. Implementation of Attention Mechanism / Transformer Model: Demonstrate self-attention for a simple text processing task.
10. Mini Project: Develop a deep learning application such as image classification, speech recognition, or natural language processing.

ET23412A Broadband Communication

Credits: 03 (Theory) and 01 (Practical)

Teaching Scheme:	**Examination Scheme:**		
	CAA	:	10 Marks
Theory: 03 hrs./week	In-semester	:	30 Marks
Practical: 02 hrs./week	End semester	:	60 Marks
	OR	:	30 Marks

Course Objectives:

· To comprehend the three primary components of a fiber optic communication system. · To understand the system design issues and the role of WDM components in advanced light wave systems.

· To understand the basics of orbital mechanics and the look angles from ground stations to the satellite.

· To apply subject understanding in Link Design.

Course Outcomes:

After successfully completing the course students will be able to:

1. Perform Link power budget and Rise Time Budget by proper selection of components and check its viability.

2. Perform Satellite Link design for Up Link and Down Link.

UNIT I: Light wave System Components 7 Hrs

Key Elements of optical fiber system, Optical fibers as a communication channel: Optical fiber modes and configurations, Single mode fibers, Graded index fiber structure, Signal degradation in optical fibers. Optical sources: Basic concepts and characteristics of LEDs and LASERs. Photo detectors: Basic concepts, Common photo detectors.

UNIT II: Light wave Systems 6 Hrs

System architectures, Point to point links: System considerations, Design guidelines: Optical power budget, Rise time budget, Long - Haul systems.

UNIT III: Multichannel Systems 6 Hrs

Overview of WDM, WDM Components: 2 x 2 Fiber coupler, Optical isolators and circulators, Multiplexers and De-multiplexers, Fiber Bragg Grating, FBG applications for multiplexing and de multiplexing function, Overview of optical amplifiers: SOA, EDFA and RFA in brief.

UNIT IV: Orbital Mechanics and Launchers 7 Hrs

History of Satellite communication, Orbital mechanics, Look angle determination, Orbital perturbations, Orbital determination, Launchers and launch vehicles, Orbital effects in communication system performance.

UNIT V: Satellite sub systems 6 Hrs

Satellite Subsystems, Attitude and Control Systems (AOCS), Telemetry, Tracking, Command and monitoring, Power systems, Communication subsystems, Satellite antennas, Equipment reliability and space qualification.

UNIT VI: Satellite communication link design 8 Hrs

Introduction, Basic transmission theory, System noise temperature and G/T Ratio, Design of downlinks, Satellite systems using small earth stations, Uplink design, Design of specified C/N: Combining C/N and C/I values in satellite links system design examples.

Text Books:

1. Gerd Keiser, ―Optical fiber Communications‖, Tata McGraw Hill, 4th edition.

2. Timothy Pratt, Charles Bostian, Jeremy Allnutt, ―Satellite Communications‖, John Wiley & Sons.

Reference Books:

1. Govind P. Agrawal, ―Fiber -Optic Communication Systems‖, Wiley, 3rd edition.

2. Dennis Roody, ―Satellite Communications‖, McGraw Hill

Broadband Communication Laboratory Practice, Credits: 01

List of the Experiments: Minimum 8 experiments are to be performed.

1. Estimation of Numerical aperture of fiber.

2. Plot the characteristics of various sources and detectors.

3. Measure attenuation of MMSI and SMSI fiber and comment on the result based on attenuation due to increase in length as well as loss due to bend.

4. Set up a digital link and analyze.

5. Tutorial on Power budget and time budget analysis of optical fiber systems.

6. Establishing a direct communication link between Uplink Transmitter and Downlink Receiver using tone signal.

7. To set up an Active Satellite link and demonstrate Link Fail Operation.

8. To establish an AUDIO-VIDEO satellite link between Transmitter and Receiver.

9. To communicate VOICE signals through satellite link.

10. To transmit and receive three separate signals (Audio, Video, Tone) simultaneously through satellite Link.

11. To transmit and receive PC data through satellite link.

12. Tutorial on satellite link design

13. Students, as a part of their term work, should visit satellite earth station and submit a report of visit. (Optional).

ET23412B 5G and MIMO

Credits: 03 (Theory) and 01 (Practical)

Teaching Scheme:	**Examination Scheme:**		
	CAA	:	10 Marks
Theory: 03 hrs./week	In-semester	:	30 Marks
Practical: 02 hrs./week	End semester	:	60 Marks
	OR	:	30 Marks

Course Objectives

1. To introduce the evolution and architecture of Fifth Generation (5G) wireless communication systems.
2. To explain the fundamental principles and advantages of Multiple Input Multiple Output (MIMO) communication systems.
3. To describe waveform design and radio access technologies used in 5G wireless networks.
4. To develop understanding of MIMO channel modeling and signal processing techniques.
5. To present the concepts of Massive MIMO and millimeter-wave communication technologies used in modern wireless systems.
6. To discuss applications and emerging trends of 5G-enabled communication systems.

Course Outcomes: On completion of the course, learner will be able to–

CO1: Analyze the architecture, key requirements, and enabling technologies of Fifth Generation (5G) wireless communication systems.

CO2: Evaluate the performance improvements achieved using Multiple Input Multiple Output (MIMO) communication systems in wireless networks.

CO3: Analyze waveform design and radio access technologies employed in Fifth Generation (5G) wireless networks.

CO4: Evaluate channel modeling approaches and signal processing techniques used in Multiple Input Multiple Output (MIMO) communication systems.

CO5: Analyze the operational principles and system-level benefits of Massive Multiple Input Multiple Output (Massive MIMO) and millimeter-wave communication technologies used in 5G networks.

CO6: Assess emerging applications and future developments enabled by Fifth Generation (5G) wireless communication systems.

Course Contents

Module I: Evolution and Architecture of 5G Networks (6 Hours)

Evolution of wireless communication systems from 1G to 5G, limitations of Long-Term Evolution (LTE) and LTE-Advanced, requirements and key drivers of 5G networks, service categories including Enhanced Mobile Broadband (eMBB), Ultra-Reliable Low-Latency Communications (URLLC), and Massive Machine Type Communications (mMTC), overview of 5G network architecture, introduction to network slicing and edge computing.

Module II: Fundamentals of Multiple Input Multiple Output (MIMO) Communication (6 Hours)

Introduction to Multiple Input Multiple Output (MIMO) communication systems, comparison of Single Input Single Output (SISO), Single Input Multiple Output (SIMO), Multiple Input Single Output (MISO), and MIMO systems, diversity gain and spatial multiplexing gain, channel capacity improvement using MIMO techniques.

Module III: Fifth Generation (5G) Radio Access Technologies (6 Hours)

Waveform design for 5G communication including Orthogonal Frequency Division Multiplexing (OFDM), Filter Bank Multi-Carrier (FBMC), and Universal Filtered Multi-Carrier (UFMC), multiple access techniques such as Orthogonal Frequency Division Multiple Access (OFDMA) and Non-Orthogonal Multiple Access (NOMA), resource allocation principles in 5G networks.

Module IV: MIMO Channel Modeling and Signal Processing Techniques (6 Hours)

Wireless propagation and fading channels, Rayleigh and Rician channel models, Multiple Input Multiple Output (MIMO) channel models, channel estimation techniques, detection algorithms, linear detection methods including Zero Forcing (ZF) and Minimum Mean Square Error (MMSE), introduction to space-time coding techniques.

Module V: Massive MIMO and Millimeter-Wave Communication (6 Hours)

Concept of Massive Multiple Input Multiple Output (Massive MIMO) systems, large antenna array architectures, beamforming techniques, pilot design in massive MIMO systems, characteristics of millimeter-wave spectrum, propagation challenges and advantages of millimeter-wave communication.

Module VI: Applications of 5G and MIMO Systems (6 Hours)

Device-to-Device communication in wireless networks, industrial Internet of Things (IoT) applications, smart city infrastructure, autonomous vehicles, integration of 5G with edge computing and cloud computing, overview of future wireless communication technologies beyond 5G.

Text Books:

1. Afif Osseiran, Jose.F. Monserrat, Patrick Marsch, “Fundamentals of 5G Mobile Networks”, Cambridge University Press
2. Ezio Biglieri et al., MIMO Wireless Communications, Cambridge University Press.

Reference Books:

1. Jonathan Rodriguez, “Fundamentals of 5G Mobile Networks”, John Wiley & Sons.
2. Amitabha Ghosh and Rapeepat Ratasuk “Essentials of LTE and LTE-A”, Cambridge University Press.
3. Theodore S. Rappaport, Robert W. Heath, Robert C. Danials, James N. Murdock “Millimeter-Wave Wireless Communications”, Prentice Hall Communications.

4. Athanasios G. Kanatos, Konstantina S. Nikita, Panagiotis Mathiopoulos, “New Directions in Wireless Communication Systems from Mobile to 5G”, CRC Press
5. Martin Sauter “From GSM From GSM to LTE–Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband”, Wiley-Blackwell.

NPTEL:

1. Fundamentals of MIMO Wireless Communication
2. https://onlinecourses.nptel.ac.in/noc26_ee46/preview
3. Signal Processing for Millimeter Wave Communication for 5G and Beyond https://onlinecourses.nptel.ac.in/noc25_ee161/preview
4. Principles of Modern CDMA / MIMO / OFDM Wireless Communications
5. https://onlinecourses.nptel.ac.in/noc24_ee151/preview

List of Experiments (Any 8)

1. The laboratory experiments shall be implemented using MATLAB. Open-source tools such as GNU Octave, Python, or GNU Radio may also be used for simulation and analysis.
2. Simulation of Rayleigh and Rician fading channels.
3. Performance comparison of SISO and MIMO communication systems.
4. Simulation of MIMO channel capacity improvement.
5. Implementation of Space-Time Block Coding (STBC).
6. Performance analysis of ZF and MMSE detection techniques.
7. Beamforming simulation using antenna arrays.
8. Implementation of OFDM waveform for 5G systems.
9. Simulation of OFDMA and NOMA multiple access techniques.
10. Performance analysis of massive MIMO systems.
11. Simulation of millimeter-wave communication propagation.
12. Study of 5G NR frame structure and numerology.
13. Simulation of Device-to-Device communication in 5G networks.

ET23412C Wireless Sensor Networks

Credits: 03 (Theory) and 01 (Practical)

Teaching Scheme:	**Examination Scheme:**		
	CAA	:	10 Marks
Theory: 03 hrs./week	In-semester	:	30 Marks
Practical: 02 hrs./week	End semester	:	60 Marks
	OR	:	30 Marks

Course Objectives:

1. To learn basic concepts of Wireless sensor networks
2. To be familiar with architecture and protocols used in Wireless sensor networks.
3. To provide knowledge of deployment and security issues of Wireless sensor networks

Course Outcomes:

On completion of the course, student will be able to

1. Explain the fundamental concepts and terminologies used in Wireless Sensor Networks (WSN).
2. Describe the role and effectiveness of radio communication and link management techniques in ensuring reliable and energy-efficient WSN performance.
3. Compare and assess various wireless standards and protocols associated with WSN based on performance metrics such as power consumption, scalability, and reliability.
4. justify the importance of localization and routing techniques in WSN for optimizing network efficiency and accuracy.
5. Evaluate suitable data aggregation techniques while assessing security challenges and proposing solutions in WSN environments.
6. Examine and formulate solutions for issues involved in the design and deployment of WSN, considering real-world constraints such as cost, energy, and scalability.

Unit1 : Introduction 6 Hrs

What are Wireless Sensor Networks, Wireless Sensor Node, Anatomy of a Sensor Node, architecture of WSN , Performance metrics in WSNs, types of WSN

Unit 2: Radio Communication And Link Management 7 Hrs

Radio Waves and Modulation/Demodulation, Properties of Wireless Communications, Medium Access Protocols, Wireless Links Introduction, Properties of Wireless Links, Error Control, Naming and Addressing, Topology Control

Unit 3: Wireless Standards And Protocol Stack 7 Hrs

WSN Standards- IEEE802.15.4 Low rate WPAN, Zigbee, WirelessHART, ISA 100.11a, 6LoWPAN,IEEE802.15.3, Wibree,BLE, Zwave, ANT, Insteon, Wavenis, Protocol stack of WSNs, Cross Layer Protocol Stack

Unit 4: Localization And Routing 7 Hrs

Localization : Localization Challenges and Properties, Deployment Schemes, Proximity Schemes. Ranging Schemes, Range-Based Localization, Range-Free Localization, Routing Basics, Routing Metrics, Routing Protocols, Full-Network Broadcast, Location-Based Routing, Directed Diffusion, Collection Tree Protocol, Zigbee, Multi-Hop Communications

Unit 5: Data Aggregation And Security 7 Hrs

Clustering Techniques, In-Network Processing and Data Aggregation, Compressive Sampling, Security Issues in Wireless Sensor Networks, Attacks, Defensive Measures, Security requirements and threat model.

Unit 6: Designing And Deploying WSN Applications 6 Hrs

Designing and Deploying WSN Applications, Early WSN Deployments, General Problems, General Testing and Validation, Requirements Analysis, The Top-Down Design Process, Bottom-Up Implementation Process.

List of the Experiments: Minimum 8 experiments are to be performed.

1. Study of Wireless Sensor Node Architecture.
2. Simulation of WSN Topologies (Star, Mesh, Tree).
3. Implementation of MAC Protocols (CSMA/CA vs TDMA).
4. Radio Link Quality and RSSI Measurement.
5. Implementation of IEEE 802.15.4 / ZigBee Network.
6. Localization Techniques in WSN.
7. Routing Protocols in WSN (LEACH, Directed Diffusion, CTP).
8. Data Aggregation and In-Network Processing.
9. Security in WSN: Attack Simulation and Defence.
10. Design and Deployment of WSN Application.

ET23413A Drone Technology and Applications

Credits: 02 (Theory) and 01 (Practical)

Teaching Scheme:	**Examination Scheme:**		
	CAA	:	10 Marks
Theory: 02 hrs./week	In-semester	:	- - - - - - -
Practical: 02 hrs./week	End semester	:	60 Marks
	OR	:	30 Marks

Course Objectives:

To introduce the fundamentals of drone systems and UAV architecture.

To understand electronics, sensors, and communication systems used in drones.

To study navigation, control, and flight stabilization mechanisms.

To explore real-world applications of drone technology in engineering domains.

Course Outcomes: On completion of the course, learner will be able to–

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

CO1: Describe the architecture and working principles of drone systems.

CO2: Explain electronic subsystems, sensors, and communication systems used in UAVs.

CO3: Analyze drone navigation and flight control mechanisms.

CO4: Evaluate drone-based data acquisition techniques and applications.

Course Content

Unit 1: Introduction to Drone Technology (6 Hours)

Evolution of unmanned aerial vehicles (UAVs), history and development of drone technology, classification of drones based on structure and operation such as fixed wing drones, rotary wing drones, multirotor drones and hybrid drones, basic drone architecture, components of a drone system including frame, motors, propellers, flight controller, battery and payload, working principles of drone flight, advantages and limitations of UAV system. Overview of civilian and industrial applications

Unit 2: Drone Electronics and Communication Systems (6 Hours)

Architecture and working of flight controller, role of microcontrollers and embedded systems in drones, sensors used in UAV systems, including accelerometer, gyroscope, inertial measurement unit (IMU), magnetometer, and barometric sensor. Electronic speed controller (ESC) and its working principle, brushless DC motors used in drones, power management and battery systems, radio frequency communication links used for drone control, telemetry systems and data communication between drone and ground control station, video transmission systems for real-time monitoring, basic communication protocols used in UAV systems.

Unit 3: Navigation and Control Systems (6 Hours)

Basics of drone flight dynamics, forces acting on drones including thrust, gravity and drag, stability and control of multirotor drones, feedback control systems used in UAVs, proportional integral derivative (PID) control for drone stabilization, GPS and GNSS based navigation systems, position estimation and localization techniques, waypoint navigation and autonomous flight planning, obstacle detection using sensors, role of navigation algorithms in autonomous UAV operation.

Unit 4: Drone Applications and Regulations (6 Hours)

Drone based data acquisition using cameras and imaging sensors, payload integration and aerial imaging systems, basics of photogrammetry and aerial mapping using drones, applications of drones in agriculture monitoring, infrastructure inspection, disaster response, surveillance and environmental monitoring, advantages of UAV based data collection, safety considerations in drone operation, regulatory framework for drone usage, licensing and operational guidelines, overview of drone regulations and policies in India, future trends and emerging applications of drone technology.

Text Books:

1. Fahlstrom, P. G., Gleason, T. J., & Sadraey, M. H., Introduction to UAV Systems, 5th ed., John Wiley & Sons, 2022.
2. Small Unmanned Aircraft: Theory and Practice – Randy Beard and Timothy McLain

Reference Books:

1. Sharma, S., Drone Development from Concept to Flight, 1st ed., Packt Publishing, 2024.
2. Yeswanth, I. V. S., & Sridhar Kumar, A. V. S., Fundamentals of Drone Technology, 1st ed., Authors Click Publishing, 2023.

NPTEL Courses:

Drone Surveying by Prof. Pradeep Kumar Garg, Prof. Prakhar Misra, IIT Roorkee

Virtual Labs:

IIT Delhi : https://drone-iitd.vlabs.ac.in/

Experiment No.	Experiment Title	Type	Software / Platform Used
1	Assembling of Electrical Components of Drone	Virtual Lab	Drone IITD Virtual Lab
2	Assembling of Software Based Components of Drone	Virtual Lab	Drone IITD Virtual Lab
3	Drone's Software Download, Installation and Calibration	Virtual Lab	Drone IITD Virtual Lab
4	Drone's Take-off, Flight and Landing Basics	Virtual Lab	Drone IITD Virtual Lab
5	Operation of Agricultural Drone	Virtual Lab	Drone IITD Virtual Lab

6	Study of Mission Planner Interface and Telemetry Monitoring	Simulation Practical	ArduPilot SITL + Mission Planner
7	Sensor Calibration Simulation in Mission Planner	Simulation Practical	ArduPilot SITL + Mission Planner
8	Autonomous Waypoint Mission Planning	Simulation Practical	ArduPilot SITL + Mission Planner
9	Telemetry Monitoring and Flight Log Analysis	Simulation Practical	ArduPilot SITL + Mission Planner
10	Study of DGCA Rules, No-Fly Zones, and Safety Practices	Study experiment	https://www.dgca.gov.in/digigov-portal/ +Digisky
Activity			
1	Visit to Drone Lab and Demonstrations	Field Visit	
2	NPTEL or other MOOC Certification	Online	

ET23413B Introduction to Quantum Computing

Credits: 02 (Theory) and 01 (Practical)

Teaching Scheme:	**Examination Scheme:**	
	CAA	: 10 Marks
Theory: 02 hrs./week	In-semester	: - - - - - - -
Practical: 02 hrs./week	End semester	: 60 Marks
	OR	: 30 Marks

Course Objectives:

1. To introduce students to the fundamental principles of quantum mechanics relevant to computing.
2. To explore quantum computation models, algorithms, and complexity.
3. To study applications of quantum computing in communication, cryptography, optimization, and AI/ML.
4. To provide hands-on exposure with IBM Quantum Experience and Qiskit Python libraries

Course Outcomes: On completion of the course, learner will be able to–
CO1: Explain the principles of quantum mechanics that form the basis of quantum computing.
CO2: Design and simulate basic quantum circuits using standard quantum gates.
CO3: Implement and analyze fundamental quantum algorithms and explain their computational advantages.
CO4: Analyze current quantum computing applications and assess their relevance to engineering problems.

Course Contents

Unit I: Foundations of Quantum Mechanics for Computing Linear algebra for quantum states, Dirac notation, Hilbert spaces, Qubits vs classical bits, Quantum superposition, Quantum entanglement, Measurement postulates, Probability amplitudes, Tensor products, Multi-qubit states.

Unit II: Quantum Gates and Circuits Single-qubit gates: Pauli-X, Pauli-Y, Pauli-Z, Hadamard, Phase, T-gate, Multi-qubit gates: CNOT, Toffoli, Swap, Unitary transformations, Reversibility, Universality of quantum gates, Circuit representation of quantum operations, Simple quantum circuit design.

Unit III: Quantum Algorithms: Quantum Fourier Transform (QFT), Deutsch–Jozsa algorithm, Grover's search algorithm, Shor's factoring algorithm, Amplitude amplification, Quantum speedup, Applications of quantum algorithms in search, factorization, and optimization.

Unit IV: Emerging Applications and Industry Trends Quantum machine learning: classification, clustering, optimization, Applications in signal and image processing, Industry use cases: IBM Quantum, Google Sycamore, Microsoft Azure Quantum, D-Wave systems, Future prospects of quantum technologies.

Books & Other Resources:

Text Books:

1. "Quantum Computing" – Dr. M. N. Doja, Dr. R. B. Mishra, Dr. P. K. Panigrahi Publisher: Universities Press / Narosa
2. "An Introduction to Quantum Computing: Algorithms and Circuits" – Dr. Arvind, N. Mukunda (IISc, Bangalore) Publisher: Universities Press

Reference Books:

1. "Quantum Mechanics and Quantum Computing" – Dr. V. K. Thankappan, Publisher: New Age International
2. "Quantum Computing: A Beginner's Guide" – Dr. S. Dasgupta, Publisher: Narosa Publishing House

NPTEL: Introduction to Quantum Computing: Quantum Algorithms and Qiskit https://onlinecourses.nptel.ac.in/noc21_cs103/preview

List of Laboratory Experiments/Assignments

1. Introduction to IBM Quantum Lab & Qiskit – Creating and visualizing single-qubit states.
2. Simulation of quantum superposition using Hadamard gate
3. Implementation of entanglement using CNOT gates.
4. Measurement of quantum states and probability distribution analysis.
5. Designing and simulating Shor's algorithm
6. Implementation of Grover's search algorithm for 2-qubit system.
7. Quantum Fourier Transform implementation in Qiskit.
8. Demonstration of quantum teleportation protocol.

ET23413C High Speed PCB Design

Credits: 02 (Theory) and 01 (Practical)

Teaching Scheme:	**Examination Scheme:**		
	CAA	:	10 Marks
Theory: 02 hrs./week	In-semester	:	- - - - - - -
Practical: 02 hrs./week	End semester	:	60 Marks
	OR	:	30 Marks

Course Objectives

1. Introduce the fundamental concepts of high-speed Printed Circuit Board (PCB) design, transmission-line effects, and characteristics of modern high-speed digital interfaces.
2. Familiarize students with PCB materials, multilayer stack-up design, and controlled-impedance interconnect structures used in high-speed PCB implementations.
3. Explain signal integrity and power distribution network considerations, including reflections, crosstalk, termination techniques, and decoupling strategies.
4. Develop understanding of high-speed PCB layout and routing techniques, along with basic simulation and electromagnetic interference and electromagnetic compatibility considerations.

Course Outcomes: On completion of the course, learner will be able to–

CO1: Explain the fundamental concepts of high-speed Printed Circuit Board (PCB) design, transmission-line behavior, and the characteristics of high-speed digital interfaces.

CO2: Analyze Printed Circuit Board materials, multilayer stack-up configurations, and controlled-impedance interconnect structures used in high-speed PCB design.

CO3: Evaluate signal integrity and power distribution network considerations, including reflections, crosstalk, termination methods, and decoupling strategies in high-speed circuits.

CO4: Apply high-speed PCB layout and routing techniques, and assess electromagnetic interference and electromagnetic compatibility considerations in practical PCB implementations.

Course Contents

Unit I: Fundamentals of High-Speed Printed Circuit Board Design

Introduction to high-speed Printed Circuit Board (PCB) design, criteria distinguishing high-speed and conventional PCB design, signal rise time and bandwidth, propagation delay, transmission-line behavior in PCB traces, impedance discontinuities and reflections. Overview of high-speed digital interfaces such as Double Data Rate (DDR), Peripheral Component Interconnect Express (PCI Express), Universal Serial Bus (USB), and Serializer/Deserializer (SerDes)

Unit II: PCB Materials, Stack-Up Design and Controlled Impedance

PCB dielectric materials including FR-4 and high-frequency laminates, dielectric constant and loss tangent, skin effect and conductor losses. Multilayer PCB stack-up design, signal and ground plane arrangement, microstrip and stripline structures, single-ended and differential impedance concepts, basic controlled-impedance design guidelines.

Unit III: Signal Integrity and Power Distribution Considerations

Signal integrity issues in high-speed PCBs including reflections and crosstalk, termination techniques such as series and parallel termination. Introduction to power integrity, power distribution network (PDN) concepts, decoupling and bypass capacitors, ground plane considerations and return current paths.

Unit IV: High-Speed Layout Techniques and Validation
High-speed component placement strategies and routing considerations, differential pair routing and matched-length routing techniques. Basic via structures and their impact on signal integrity, introduction to signal integrity simulation, electromagnetic interference (EMI) and electromagnetic compatibility (EMC) considerations in high-speed PCB design.

Text Books:

1. Printed Circuit Boards: Design and TechnologyWalter C Bosshart Tata McGraw-hill
2. Printed Circuit Boards: Design, Fabrication, Assembly & TestingR S Khandpur Tata McGraw-hill
3. Electronic Drafting And Printed Circuit Board Design James M. Kirk patrick Galgotia Publications
4. Handbook of Electronics Manufacturing Engineering Bernard Matisoff International Thomson Publishing
5. Handbook of Electronics Packaging Charles A. Harper McGraw- hill
6. Electronics Packaging Forum James E. Morris Van Nostrand

NPTEL:

1. Electronic Systems Design: Hands-on Circuits and PCB Design with CAD Software https://onlinecourses.nptel.ac.in/noc25_ee163/preview
2. ESim - EDA tool for circuit design, simulation, analysis and PCB design https://onlinecourses.swayam2.ac.in/aic20_sp59/preview

Virtual Labs for PCB / PCB Design

1. PCB Design & Fabrication – Virtual Lab (IIT / VLabs / FabLab COEP)
2. fab-coep.vlabs.ac.in+1
3. fab-coep.vlabs.ac.in
4. Virtual Lab – PCB Layout / Design vlab.amrita.edu

List of Practicals
Tools: KiCad (open-source PCB CAD), EasyEDA (online open-source PCB CAD), QUCS (Quite Universal Circuit Simulator), OpenEMS (open-source EM field solver), ngspice (SPICE simulator).

1. Introduction to KiCad or EasyEDA, design of simple PCB layout with signal integrity checks.
2. Simulation of transmission line behavior using QUCS/ngspice
3. Impedance calculation of microstrip and stripline structures
4. Stack-up design and verification with KiCad and online impedance calculators
5. Crosstalk simulation between two parallel traces
6. Design and simulation of decoupling capacitor network for stable PDN
7. Routing of differential pairs with controlled impedance in KiCad
8. Eye diagram analysis using open-source simulation tools