AISSMS
COLLEGE OF ENGINEERING
ज्ञानम् सकलजनहिताय
An Autonomous Institute Affiliated with
Savitribai Phule Pune University
Accredited by NAAC with "A+" Grade | NBA - 7 UG Programmes

Savitribai Phule Pune University

All India Shri Shivaji Memorial Society's

COLLEGE OF ENGINEERING, PUNE

(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)

Faculty of Science and Technology

National Education Policy (NEP) Compliant Curriculum

S.Y. B. Tech. Electronics and Telecommunication Engineering (2025 Pattern)

(With effect from Academic Year 2026-27)

www.aissmscoe.com

Institute Vision & Mission

Vision:

- Service to society through quality education

Mission:

- Generation of national wealth through education and research
- Imparting quality technical education at the cost affordable to all strata of the society
- Enhancing the quality of life through sustainable development
- Carrying out high-quality intellectual work
- Achieving the distinction of the highest preferred engineering college in the eyes of the stakeholders

Department Vision & Mission

Vision:

- Society Growth and Welfare through Competent Electronics and Telecommunication Engineering Graduates

Mission:

- To facilitate E and TC graduates with sight of innovation.
- To provide stimulating learning environment with modern tools and technologies.
- To produce dynamic graduates with ethics and moral values.
- To impart quality education in the field of E and TC engineering to solve societal and industrial problems

Knowledge and Attitude Profile (WK)

Knowledge & Attitude	Description
WK1	A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.
WK2	Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline
WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline
WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.
WK5	Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area
WK6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline
WK7	Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.
WK8	Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues
WK9	Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Program Outcomes (POs)

Program Outcomes (POs)	Description
PO1	Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
PO2	Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
PO3	Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
PO4	Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
PO5	Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
PO6	The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
PO7	Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
PO8	Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO9	Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PO10	Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PO11	Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Program Specific Outcomes (PSOs)

An E & TC engineering graduate will be able to:

- **PSO1**: **Systems Development**: Design and develop prototype or system using hardware and software skills for multi-disciplinary applications.
- **PSO2: Adaptability:** Demonstrate an ability to adapt emerging technologies in the field of Artificial Intelligence, Internet of things and Robotics to solve the real-life problems.
- **PSO3: Skill Development:** Develop technical skills in the field of communication engineering with industry support.

Program Educational Objectives (PEOs)

- **PEO1:** Excel as accomplished professionals to solve real life problems using modern tools and technologies.
- **PEO2**: Exhibit lifelong learning ability through professional growth, research, innovation and higher studies.
- **PEO3:** Showcase professional attitude, effective leadership skills and become responsible, cultured human being.

B.Tech. Degree Options as per NEP

(a) B.Tech. Degree with Multidisciplinary Minor (160-176 credits).

(b) B.Tech. Honours Degree in chosen Major Engg./ Tech. Discipline with Multidisciplinary Minor (180-194 credits):

- enables students to take up **five-six additional courses in the same Engg./ Tech.** discipline of 18 to 20 credits distributed over **semesters III to VIII.**
- The decision regarding the mechanism of distribution of these 18-20 credits over semesters III to VIII, which are **over and above the min.160-max.176 Credits** prescribed for Four Year Multidisciplinary Bachelor's Degree in Engg./ Tech., will be taken by Academic Authorities of University/ Autonomous Engineering Colleges.

(c) B.Tech. Honours with Research Degree in chosen Major Engg./ Tech. Discipline with Multidisciplinary Minor (180-194 credits):

- The students will work on **a research project or dissertation for 18 credits** in the fourth year in the respective Major Engg./ Tech. Discipline.
- The decision regarding the distribution of 18 credits for Research Project in **Semesters VII and VIII** of the Fourth Year will be taken by Academic Authorities of University/ Autonomous Engineering Colleges.
- **These 18 Credits will be over and above the min.160-max.176 Credits** prescribed for Four Year Multidisciplinary Bachelor's Degree in Engg./ Tech. Program.

(d) B.Tech. Degree in chosen Major Engg./ Tech. Discipline with Double Minor (Multidisciplinary and Specialisation Minor, 180-194 credits):

- Students would take **up five-six additional courses of 18 to 20 credits in another Engg./ Tech. discipline/ Emerging Areas** Specialization.
- Distributed over **semesters III to VIII**.
- The decision regarding the mechanism of distribution of these 18-20 credits over semesters III to VIII, which are **over and above the min.160-max.176 Credits** prescribed for Four Year Multidisciplinary Bachelor's Degree in Engg./Tech., will be taken by Academic Authorities of University/ Autonomous Engineering Colleges.

A. Definition of Credit:

1Hr.Lecture(L) per week	1credit
1Hr.Tutorial(T) per week	1credit
2 Hours Practical (Lab)/week	1credit

B. Range of credits:

A range of credits from 160 to 176 for a student to be eligible to get Undergraduate degree in Engineering. A student will be eligible to get Undergraduate degree with Honors 18 to 20 credits, Double Minor for 18 to 20 credits and/or Multidisciplinary Minors for 18 to 20credits, if he/she completes additional credits.

C. Exit:

A student will be eligible to get Diploma in E&TC Engineering after completing an internship of 8 Credit during summer vacation in relevant Discipline.

D. General Guidelines for Examination:

The examination shall be conducted in THREE parts viz. Continues Comprehensive Assessment (CCA), In Semester Examination (ISE) and End Semester Examination (ESE).

(i) Continuous Comprehensive Assessment (CCA): 20 Marks (Any TWO)

CCA focuses on continuously assessing a student's performance throughout the semester. Apart from classroom and laboratory learning, CCA activities can be undertaken to accelerate the attainment of the various outcomes in the course: The significance of CCA lies in its ability to provide a more accurate and all-round understanding of a student's abilities, skills, and knowledge. CCA promotes experiential learning, participatory learning, collaborative learning, active learning, self-learning, peer to peer learning, etc. As part of the CCA framework, students are required to undertake ANY TWO ACTIVITIES from the prescribed set Guidelines: To be evaluated based on rubrics.

(ii) In-semester Examination (ISE): 30 Marks

In-semester examination will be of 30 marks based on Unit I and II.

Course Content	Questions	Marks	Total Marks	Duration
Unit I	Q. 1 or Q.2	15	30	1 Hour
Unit II	Q. 3 or Q.4	15		

(iii) END Semester Examination (ESE): 50 Marks

Examination will be carried out on unit 3,4 and 5 carrying following marks weightage:

Course Content	Questions	Marks	Total Marks	Duration
Unit III	Q. 1 or Q.2	16	50	2 Hours
Unit IV	Q. 3 or Q.4	17		
Unit V	Q. 5 or Q.6	17		

S.Y.B. Tech. Electronics & Telecommunication Engineering (2025 Pattern)

ABBRAVIATIONS

Abbreviation	Title	Abbreviation	Title
BSC	Basic Science courses	AEC	Ability Enhancement Course
ESC	Engineering Science courses	HSM	Humanities Social Science and Management
PCC	Programme Core Courses	IKS	Indian Knowledge System
PEC	Programme Elective courses	VEC	Value Education Course
MDM	Multidisciplinary Minor	ELC	Experiential Learning Courses
OEC	Open Elective other than particular Programme	CCC	Liberal Learning Courses
VSE	Vocational and Skill Enhancement Course		

B. Tech. Electronics & Telecommunication Engineering (2025 Pattern)
Distribution of Credits

Sr. No	Domains		Code	SEM-I	SEM-II	SEM-III	SEM-IV	SEM-V	SEM-VI	SEM-VII	SEM-VIII	Credits
1	Basic Science courses		BSC	8	8	0	0	0	0	0	0	16
2	Engineering Science courses		ESC	9	6	0	0	0	0	0	0	15
3	Programme Core Courses		PCC	0	3	12	12	8	8	8	0	51
4	Programme Elective courses		PEC	0	0	0	0	4	8	4	4	20
5	Multidisciplinary Minor	Multidisciplinary Courses	MDM	0	0	2	2	4	2	2	2	14
6	Open Elective other than particular Programme		OEC	0	0	2	2	2	0	0	0	6
7	Vocational and Skill Enhancement Course	Skill Courses	VSE	1	1	1	1	2	2	0	0	8
8	Humanities Social Science and Management	Ability Enhancement Course	AEC	2	0	0	2	0	0	0	0	4
		Entrepreneurship/Economics/ Management courses	HSM	0	0	2	2	0	0	0	0	4
		Indian Knowledge System	IKS	0	2	0	0	0	0	0	0	2
		Value Education Course	VEC	0	0	2	1	0	0	0	0	3
9	Experiential Learning Courses	Research Methodology	ELC	0	0	0	0	0	0	4	0	4
		CEP		0	0	1	0	0	0	0	0	1
		Project		0	0	0	0	0	2	2	0	4
		Internship		0	0	0	0	0	0	0	12	12
10	Co-curricular Courses (CC)	Liberal Learning Courses	CCC	2	2	0	0	0	0	0	0	4
Total				**22**	**22**	**22**	**22**	**20**	**22**	**20**	**18**	**168**

MDM: Computer Engineering

Semester	Course Code	Course Name	Hrs/Week			Examination Scheme and Marks							Credits			
			L	P	T	CCA	ISE	ESE	PR	OR	TW*	Total	L	P	T	Total
SEM-3	25COMDM201B	Data Structures	2	-	-	20	30	50	-	-	-	100	2	-	-	02
SEM-4	25COMDM202B	Object Oriented Programming	2	-	-	20	30	50	-	-	-	100	2	-	-	02
SEM-5	25COMDM301B	Database Management Systems	3	-	-	20	30	50	-	-	-	100	3	-	-	03
SEM-5	25COMDM301LB	Database Management Systems Lab	-	2	-	-	-	-	25	-	-	25	-	1	-	01
SEM-6	25COMDM302B	Fundamentals of Java Programming	2	-	-	20	30	50	-	-	-	100	2	-	-	02
SEM-7	25COMDM401B	Advanced Java Programming	2	-	-	20	30	50	-	-	-	100	2	-	-	02
SEM-8	25COMDM402B	Java Script	2	-	-	20	30	50	-	-	-	100	2	-	-	02
Total			**13**	**2**	**0**	**120**	**180**	**300**	**25**	**0**	**0**	**625**	**13**	**1**	**0**	**14**

Open Elective Baskets

BASKET	SEM-III	SEM-IV	SEM-V
Leadership, Management & Innovation	Principles of Management and Organizational Behaviour	Leadership and Team Dynamics	Supply Chain Management
Sustainability and Green Technologies	Circular Economy for Sustainable Development	Green Practices and ESG Frameworks	Sustainable Technologies and Carbon Management
Entrepreneurship & Business	Start-up Management and Venture Creation	Innovation and Business Strategy	Digital Marketing
Holistic Development & Well-Being	Health and Nutrition for Professionals	Stress Management and Mental Well-Being	Lifestyle Management and Preventive Healthcare
Global Languages	French Language Module – I	French Language Module – II	French Language Module – III
	German Language Module – I	German Language Module – II	German Language Module – III
	Japanese Language Module -I	Japanese Language Module -II	Japanese Language Module -III

Honors: Internet of Things

Semester	Course Code	Course Name	Hrs/Week			Examination Scheme and Marks							Credits			
			L	P	T	CCA	ISE	ESE	PR	OR	TW*	Total	L	P	T	Total
SEM-3	25ETHNR201	Embedded Systems and Internet of Things	3	-	-	20	30	50	-	-	-	100	3	-	-	03
SEM-3	25ETHNR201L	Embedded Systems and Internet of Things Laboratory	-	2	-	-	-	-	25	-		25	-	1	-	01
SEM-4	25ETHNR202	Internet of Things Architectures, Protocols and Systems Programming	3	-	-	20	30	50	-	-	-	100	3	-	-	03
SEM-4	25ETHNR202L	Internet of Things Architectures, Protocols and Systems Programming Lab		2	-	-	-	-	25	-	-	25	-	1	-	01
SEM-5	25ETHNR301	Machine Learning for Internet of Things	3	-	-	20	30	50	-	-	-	100	3	-	-	03
SEM-5	25ETHNR301L	Machine Learning for Internet of Things Lab	-	2	-	-	-	-	25	-	-	25	-	1	-	01
SEM-6	25ETHNR302	Internet of Things Security	3	-	-	20	30	50	-	-	-	100	3	-	-	03
SEM-6	25ETHNR302L	Internet of Things Security Lab	-	2	-	-	-	-	-	25	-	25	-	1	-	01
SEM-7	25ETHNR401	Seminar	2	-	-	20	30	50	-	-	-	100	2	-	-	02
Total			**14**	**8**		**100**	**150**	**250**	**75**	**25**	**0**	**600**	**14**	**4**	**0**	**18**

Double Minors offered by Each Department

Offering Department	Double Minor Offered	Sem-3	Sem-4	Sem-5	Sem-6	Sem-7
AI &ML Engineering	**Blockchain Technology**	Fundamentals of Blockchain Technology	Smart Contracts and Decentralized Applications	Blockchain Security and Cryptography	Decentralized AI and Web3 Technologies	Blockchain Applications and Emerging Trends
Chemical Engineering	**Environmental Engineering**	Air Pollution Control	Wastewater Treatment	Solid Waste Management	Climate Change and Sustainability	Mini Project
	Energy Engineering	Introduction of Energy	Bio-energy	Electrochemical Energy	Hydrogen Fuel	Mini Project
Civil Engineering	**Infrastructure Engineering**	Introduction to Infrastructure Engineering	Fundamentals of Infrastructure Engineering	Smart Transportation & Urban Infrastructure	Sustainable & Resilient Infrastructure Systems	Emerging Technologies in Infrastructure Engineering
Computer Engineering	**Cybersecurity Engineering**	Introduction to Cybersecurity	Cryptography and Network Security	Ethical Hacking	Digital Forensics	Cryptography and Data Protection
Electrical Engineering	**Renewable Energy systems**	Renewable Energy Sources for Sustainable Development	Solar Photovoltaic Systems	Wind Energy Conversion Systems	Power Electronics and Control for RES	Renewable Energy: Policies, Planning & Audit
E&TC Engineering	**Communication Engineering**	Analog Communication	Digital Communication	Cellular Networks	Mobile Computing	Optical & Microwave Communication
VLSI D&T Engineering	**Semiconductor IC Design**	Digital Electronics	System Design using Verilog	Digital CMOS Design	Analog CMOS Design	AI for VLSI
Mechanical Engineering	**Mechanical Systems Engineering**	Fundamentals of Manufacturing	Fundamentals of Engineering metallurgy	Fundamentals of Thermal Engineering	Fundamentals of Machine Design	Sustainable and Solar Engineering
Mechanical Sandwich Engineering	**Mechanical Systems Engineering**	Fundamentals of Manufacturing	Fundamentals of Engineering metallurgy	Fundamentals of Thermal Engineering	Fundamentals of Machine Design	Sustainable and Solar Engineering
R&A Engineering	**Robotics and Automation**	Fundamentals of Robotics and Automation	Programming for Robotics	Sensors and Actuators in Robotic Systems	Introduction to Robot Kinematics	Robot Simulation and Application

Double Minor offered by E&TC: Communication Engineering

Semester	Course Code	Course Name	Hrs/Week			Examination Scheme and Marks							Credits			
			L	P	T	CCA	ISE	ESE	PR	OR	TW*	Total	L	P	T	Total
SEM-3	25ETMNR201	Analog Communication	3	-	-	20	30	50	-	-	-	100	3	-	-	03
SEM-3	25ETMNR201L	Analog Communication Lab	-	2	-	-	-	-	25	-		25	-	1	-	01
SEM-4	25ETMNR202	Digital Communication	3	-	-	20	30	50	-	-	-	100	3	-	-	03
SEM-4	25ETMNR202L	Digital Communication Lab		2	-	-	-	-	25	-	-	25	-	1	-	01
SEM-5	25ETMNR301	Cellular Network	3	-	-	20	30	50	-	-	-	100	3	-	-	03
SEM-5	25ETMNR301L	Cellular Network Lab	-	2	-	-	-	-	25	-	-	25	-	1	-	01
SEM-6	25ETMNR302	Mobile Computing	3	-	-	20	30	50	-	-	-	100	3	-	-	03
SEM-6	25ETMNR302L	Mobile Computing Lab	-	2	-	-	-	-	-	25	-	25	-	1	-	01
SEM-7	25ETMNR401	Optical & Microwave Communication	2	-	-	20	30	50	-	-	-	100	2	-	-	02
	Total		**14**	**8**	**0**	**100**	**150**	**250**	**75**	**25**	**0**	**600**	**14**	**4**	**0**	**18**

S.Y. B. Tech. Electronics & Telecommunication Engineering (2025 Pattern)

Curriculum Structure: Semester III

Course Category	Course Code	Course Name	Hrs/Week			Examination Scheme and Marks							Credits			
			L	P	T	CCA	ISE	ESE	PR	OR	TW*	Total	L	P	T	Total
Program Core Course	25ETPCC201	Electronics Circuits	3	-	-	20	30	50	-	-	-	100	3	-	-	03
	25ETPCC202	Engineering Mathematics-III	3	-	-	20	30	50	-	-	-	100	3	-	-	03
	25ETPCC203	Digital Electronics	3	-	-	20	30	50	-	-	-	100	3	-	-	03
Multidisciplinary Minor	25COMDM201B	Multidisciplinary Minor-I	2	-	-	20	30	50	-	-	-	100	2	-	-	02
Open Elective Course	25OEC201	Open Elective Course-I	2	-	-	20	30	50	-	-	-	100	2	-	-	02
Program Core Course Lab	25ETPCC201L	Electronics Circuits Lab	-	2	-	-	-	-	25	-		25	-	1	-	01
Program Core Course Lab	25ETPCC202L	Linear Integrated Circuits Lab		2	-	-	-	-	25	-	-	25	-	1	-	01
Program Core Course Lab	25ETPCC203L	Digital Electronics Lab	-	2	-	-	-	-	25	-	-	25	-	1	-	01
Vocational and Skill Enhancement Course	25ETVSE201	Vocational and Skill Enhancement Course-I	-	2	-	-	-	-	-	25	-	25	-	1	-	01
Entrepreneurship/Economics/ Management Courses	25HSM201	Entrepreneurship/Economics/ Management Course-I	-	-	2	-	-	-	-	-	50	50	-	-	2	02
Value Education Course	25VEC201	Universal Human Values	-	-	2	-	-	-	-	-	50	50	-	-	2	02
Community Engagement Project	25ETELC201	Community Engagement Project	-	2	-	-	-	-	-	-	25	25	-	-	1	01
	Total		**13**	**10**	**04**	**100**	**150**	**250**	**75**	**25**	**125**	**725**	**13**	**04**	**05**	**22**

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Multidisciplinary Minor-I:

Sr. No.	Course Code	Course Name
1.	25COMDM201B	Data Structures

Open Elective-I

Sr. No.	Course Code	Course Name
1.	25OEC201A	Principles of Management and Organizational Behaviour
2.	25OEC201B	Circular Economy Sustainable Development
3.	25OEC201C	Start-up Management and Venture Creation
4.	25OEC201D	Health and Nutrition for Professionals
5.	25OEC201E	French Language Module-I
6.	25OEC201F	German Language Module-I
7.	25OEC201G	Japanese Language Module-I

Vocational and Skill Enhancement Course-I:

Sr. No.	Course Code	Course Name
1.	25ETVSE201	Employability Skill Development-I

Entrepreneurship/Economics/Management Courses (HSSM)-I:

Sr. No.	Course Code	Course Name
1.	25HSM201A	Engineering Economics
2.	25HSM201B	Entrepreneurship Development and IPR
3.	25HSM201C	Project Management and Business Planning
4.	25HSM201D	Financial Management for Engineers

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Curriculum Structure: Semester IV

Course Category	Course Code	Course Name	Hrs/Week			Examination Scheme and Marks							Credits			
			L	P	T	CCA	ISE	ESE	PR	OR	TW*	Total	L	P	T	Total
Program Core Course	25ETPCC204	Signals & Systems	3	-	-	20	30	50	-	-	-	100	3	-	-	03
	25ETPCC205	Principles of Communication Systems	3	-	-	20	30	50	-	-	-	100	3	-	-	03
	25ETPCC206	Control Systems	3	-	-	20	30	50	-	-	-	100	3	-	-	03
Multidisciplinary Minor	25COMDM202B	Multidisciplinary Minor-II	2	-	-	20	30	50	-	-	-	100	2	-	-	02
Open Elective Course	25OEC202	Open Elective Course-II	2	-	-	20	30	50	-	-	-	100	2	-	-	02
Program Core Course Lab	25ETPCC204L	Signals & Systems Lab	-	-	1	-	-	-	-	25	-	25	-	1	-	01
Program Core Course Lab	25ETPCC205L	Principles of Communication Systems Lab	-	2	-	-	-	-	25	-	-	25	-	1	-	01
Program Core Course Lab	25ETPCC206L	Control Systems Lab	-	2	-	-	-	-	-	25	-	25	-	1	-	01
Vocational and Skill Enhancement Course	25ETVSE202	Vocational and Skill Enhancement Course-II	-	2	-	-	-	-	25	-	-	25	-	1	-	01
Ability Enhancement Course	25AEC201	Modern Indian Language (MIL)	2	-	-	-	-	-	-	25	25	50	-	1	1	02
Entrepreneurship/Economics/ Management Courses	25HSM202	Entrepreneurship/Economics/ Management Course-II	-	-	2	-	-	-	-	-	50	50	-	-	2	02
Value Education Course	25VEC202	Indian constitution and governance	-	-	1	-	-	-	-	-	25	25	-	-	1	01
	Total		**15**	**06**	**04**	**100**	**150**	**250**	**50**	**75**	**100**	**725**	**13**	**05**	**04**	**22**

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Multidisciplinary Minor-II:

Sr. No.	Course Code	Course Name
1.	25COMDM202B	Object Oriented Programming

Open Elective-II:

Sr. No.	Course Code	Course Name
1.	25OEC202A	Leadership and Team Dynamics
2.	25OEC202B	Green Practices and ESG Frameworks
3.	25OEC202C	Innovation and Business Strategy
4.	25OEC202D	Stress Management and Mental Well-Being
5.	25OEC202E	French Language Module-II
6.	25OEC202F	German Language Module-II
7.	25OEC202G	Japanese Language Module-II

Vocational and Skill Enhancement Course-II:

Sr. No.	Course Code	Course Name
1.	25ETVSE202	Employability Skill Development-II

Entrepreneurship/Economics/Management Courses (HSSM)-II:

Sr. No.	Course Code	Course Name
1.	25HSM202A	Business Fundamentals for Entrepreneurs
2.	25HSM202B	Entrepreneurship and Start-ups
3.	25HSM202C	Fundamentals of Accounting and Finance
4.	25HSM202D	Business Intelligence and Analytics

Modern Indian Language (MIL):

Sr. No.	Course Code	Course Name
1.	25AEC201A	Marathi
2.	25AEC201B	Sanskrit

Course: Electronics Circuits				Code:25ETPCC201
Teaching Scheme (Hrs./Week)		**Credit**	**Evaluation Scheme**	
Lecture	3	3	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:**
  Basic Electronics Engineering, Basic Electrical Engineering

- **Course Objectives:**
  1. Understand the operation and characteristics of MOSFET and analyze biasing circuits.
  2. Learn how to determine and maintain the stable operating point of a transistor/MOSFET amplifier.
  3. Apply small signal models to analyze single stage MOSFET amplifiers.
  4. Study the operation and applications of adjustable voltage regulator ICs.
  5. Analyze op-amp characteristics and design basic linear application circuits using operational amplifiers.

- **Course Outcomes:** At the end of the course, students will be able to:

CO1: Examine MOSFET operation and characteristics.
CO2: Perform the DC analysis of MOSFET.
CO3: Perform the AC analysis of MOSFET.
CO4: Analyze and assess the performance of regulators.
CO5: Design basic analog circuits using operational amplifiers.

- **Course Contents:**

Unit I	MOSFET Fundamentals	8 Hours

Introduction to MOSFET, Types of MOSFET: Enhancement and Depletion type MOSFET, EMOSFET: Construction, Threshold voltage, operation regions, V-I characteristics: Transfer characteristics and output characteristics. MOSFET as a switch, CMOS inverter, resistor & diode, non-ideal effects in MOSFET viz. Finite output resistance, channel length modulation, body effect, subthreshold conduction, breakdown effects and temperature effects.

Unit II	MOSFET DC Analysis	8 Hours

DC Load Line, operating point (Q point), Types of biasing: Voltage divider bias and drain feedback bias, MOSFET Configurations: Common source circuit, Common Drain circuit and common Gate circuit.

Unit III	MOSFET AC Analysis	7 Hours

Common Source, Common Gate, Common Drain Amplifiers. AC analysis of a common-source amplifier with and without a bypass capacitor, Numerical analysis based on AC analysis of a common-source amplifier. Current sink & source, Current mirror Circuit. MOSFET Small Signal Frequency Response of Single Stage Amplifier, High & Low Frequency Effect.

Unit IV	Voltage Regulators	9 Hours

Three terminal voltage regulators: Block diagram of power supply, transistor series voltage regulator Types: Fixed and Variable, Block diagram of linear voltage regulator, IC 317 and IC337, Numerical based on design of Regulator. Features and specifications, typical circuits, current boosting, Low Dropout Regulator (LDO).

Unit V	Operational Amplifiers and Linear Applications	8 Hours

Block diagram, Op amp parameters, Current mirror, Op-amp characteristics (AC & DC). Inverting amplifier (Voltage series), non-inverting amplifier (voltage shunt), Effect on Ri, Ro, gain & bandwidth., Voltage follower, Summing amplifier, Differential amplifier, Practical integrator, first Order Low pass, Practical differentiator, High Pass Filter, Precision half-wave Rectifier.

● Continuous Comprehensive Assessment (Any Two (CCA1 Compulsory))		20 Marks
CCA1	**List of Course Activity**	**10Marks**

Application Based Course Activities (any one)

1. **Automatic Street Light Controller using MOSFET**
   Design a MOSFET-based automatic street light system using sensors to control switching operation for energy saving applications.

2. **Mobile Charger Power Supply Design**
   Develop a regulated DC power supply using IC317/IC337 and analyze voltage regulation used in mobile charging circuits

3. **Audio Amplifier using MOSFET and Op-Amp**
   Build a low-noise audio amplifier circuit for speaker applications using Common Source MOSFET amplifier and Op-amp stages.

4. **Temperature Monitoring and Control System**
   Implement an Op-amp based temperature sensing and control circuit using comparator and voltage regulator concepts for industrial automation.

CCA2	**Case Study/Survey**	**10 Marks**

List of Case Study:

1. MOSFET Usage in Low-Power Portable Electronics
2. High Frequency Effects in RF Amplifiers

List of Surveys:

- Amplifier Bandwidth Enhancement Techniques
- Stability Issues in High-Gain Feedback Amplifiers

CCA3	**Seminar:** Any topic from unit 1 to 5	**10 Marks**

- **Text Books:**
  1. Electronic Devices and Circuit Theory– Robert L. Boyles tad & Louis Nashelsky
  2. Ravish R Singh, "Network Analysis & Synthesis", McGraw-Hill Education.

- **Reference Books:**
  1. Integrated Electronics-Jacob Millman & Christos C. Halkias
  2. Fundamentals of Microelectronics– Behzad Razavi
  3. Electronics Devices-Thomas. L. Floyd.
  4. Microelectronics– Jacob Millman & Arvin Grabel

- **MOOC/NPTEL:**
  1. UDEMY Course on MOSFET Transistor - Complete Course for Beginners | MOSFETS All about MOSFET Transistor, Testing Transistor, MOSFET Transistor working principle, , NPN & PNP Channel MOSFET: MOSFET Transistor - Complete Course for Beginners | MOSFETS

Course: Engineering Mathematics-III				Code: 25ETPCC202
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	3	3	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** Basic knowledge of calculus, differential equations, matrices, and Fourier series studied in Engineering Mathematics I and II.

- **Course Objectives:**
  1. To equip students with essential mathematical tools such as probability, transforms, vector calculus, and complex analysis for solving engineering problems.
  2. The course aims to develop analytical thinking and the ability to model and analyze systems in electronics and telecommunication engineering.

- **Course Outcomes:** At the end of the course, students will be able to:

CO1: Apply fundamental concepts of probability and random variables to analyze uncertain systems.
CO2: Use Laplace transforms to solve differential equations and analyze electrical circuits.
CO3: Apply vector calculus concepts such as gradient, divergence, and curl in engineering applications.
CO4: Evaluate line, surface, and volume integrals and apply major theorems (Green's, Gauss's, Stokes') in physical problems.
CO5: Analyze functions of complex variables using analytic functions, Cauchy-Riemann equations, and complex integration techniques.

- **Course Contents:**

Unit I	Probability Theory and Random Variables	8 Hours

Basic concepts of probability, Conditional probability, Bayes' theorem, Random variables: discrete and continuous, Probability density function (PDF) and cumulative distribution function (CDF), Mathematical expectation and variance, Important distributions: Binomial, Poisson, Normal

Unit II	Laplace Transform	7 Hours

Laplace transform: Definition and properties, Laplace transform of standard functions, Inverse Laplace transform, Convolution theorem, Solution of linear differential equations, Applications to electrical circuits

Unit III	Vector Calculus	7 Hours

Vector differentiation, Vector differential operator, Gradient, Divergence and Curl, Directional derivatives, Vector identities, Applications in Engineering

Unit IV	Vector Analysis	8 Hours

Line, surface and volume integrals, Conservative, irrotational and solenoidal fields, Scalar potential, Green's, Gauss's and Stoke's theorems, Solution of difference equations, Applications to problems in electromagnetic fields

Unit V	Complex Variables and Analytic Functions	8 Hours

Functions of complex variable, Analytic functions, Cauchy–Riemann equations, Harmonic functions, Complex integration, Cauchy's integral theorem and Cauchy's integral formula

• **Continuous Comprehensive Assessment: (Any Two)**		**20 Marks**
CCA 1	**Report Writing / Mini-Project**	**10 Marks**

List of Topics:

1. **Probability Analysis in Digital Communication Systems**
   Study of noise effects and error probability in communication channels.
2. **Application of Laplace Transform in RLC Circuit Analysis**
   Modelling and solving transient response of electrical circuits.
3. **Vector Calculus in Electromagnetic Field Analysis**
   Use of gradient, divergence and curl in E&TC applications.
4. **Statistical Modelling of Random Signals and Noise**
   Analysis using Normal and Poisson distributions.
5. **Complex Variable Techniques in Signal Processing**
   Applications of analytic functions and complex integration in engineering problems.

CCA 2	**Seminar / Blog Writing**	**10 Marks**

List of Topics:

1. Role of Probability Theory in Modern Communication Engineering
2. Importance of Laplace Transform in Control Systems and Electronics
3. Real-Life Applications of Gauss and Stoke's Theorems
4. How Complex Numbers Simplified Electrical Engineering
5. Applications of Vector Fields in Wireless and Antenna Systems

CCA 3	**Case Study / Survey**	**10 Marks**

List of Topics:

1. Case Study on Noise Distribution in Mobile Communication Systems
2. Survey of Mathematical Techniques Used in Signal Processing
3. Case Study of Laplace Transform Applications in Power Electronics
4. Survey on Electromagnetic Field Analysis Methods Using Vector Calculus
5. Case Study on Complex Analysis Applications in Communication Networks

- **Textbooks:**
  1. **B. S. Grewal** – Higher Engineering Mathematics
  2. **Erwin Kreyszig** – Advanced Engineering Mathematics
- **Reference Books:**
  1. **B. V. Ramana** – Higher Engineering Mathematics
  2. **Murray Spiegel** – Schaum's Outline of Advanced Mathematics
  3. **H. K. Dass & Er. Rajnish Verma** – Higher Engineering Mathematics
- **NPTEL course on Advanced Engineering Mathematics by Prof. P. N. Agarwal|IIT Roorkee:** https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_ma68

Course: Digital Electronics			Code: 25ETPCC203	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	03	03	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** Basic Gates, Number Systems and their Conversations

- **Course Objectives:**

1. To understand K-map and its use to the design the various applications of Combinational Digital Circuits.
2. To analyze Sequential Logic using flip flops and their applications viz. Counters, processes and implement logical operations.
3. To understand the concepts of Sequential Circuits and apply them in State Machines.
4. To understand the Digital Logic Families and System Design using Programmable Logic Devices.
5. To understand the concepts of VHDL and its fundamental applications.

- **Course Outcomes:** At the end of the course, students will be able to:

CO1: Design Combinational Circuits.
CO2: Design Sequential Circuits.
CO3: Analyze FSM and ASM.
CO4: Design Digital System using PLDs.
CO5: Describe Fundamentals of VHDL.

- **Course Contents:**

Unit I	Combinational Logic Design	9 Hours

Definition of Combinational logic, Standard representations for logic functions, K-map representation of logic functions (SOP and POS forms), minimization of logical functions for min- terms and max-terms (upto 4 variables), don't care conditions.
Design Examples: Full adder, Full Subtractor, Code Converters -4 bit Binary to Gray, 2- bit Comparator, Multiplexers, multiplexer trees, Demultiplexers, Demultiplexer trees and 3: 8 Decoders.

Self-Study: Half Adder, Half Subtractor, BCD to Gray, BCD to Excess-3.

Unit II	Sequential Logic Design	09 Hours

1-Bit Memory Cell/latch, Clocked SR flip flop, J-K flip flop, M-S J-K flip flop, D and T flip flops. Use of Preset and Clear terminals in flip flops, Excitation Table for flip flops, Conversion of flip flops, Registers, Shift Registers, Counters: Ripple, Up/Down Counters, Synchronous Counters & its Design Examples (4 Bit)

Unit III	Finite State Machines	08 Hours

Moore and Mealy Machines, State diagram, State table, State reduction, State assignment, Design of Finite State Machine, Sequence Generators, Sequence Detector using flip flops. Introduction to Algorithmic State Machines-construction of ASM Chart and realization for Sequential Circuits.

Unit IV	Digital Logic Family and Programmable Logic Devices	07 Hours

Digital Logic Family: Performance parameters of Digital ICs- fan in, fan out, noise margin, propagation delay, power dissipation.
Operation of TTL NAND gate, CMOS inverter, NAND, NOR gates. Comparison of CMOS and TTL.
Programmable Logic Devices: Detail architecture of PROM, PAL, PLA and Designing Combinational Circuits using PLDs. General Architecture and Specifications of FPGA and CPLD.

Unit V	Introduction to VHDL	07 Hours
Introduction to Library, Entity and Architecture Modeling styles, Data Objects, Concurrent and Sequential Statements, Design examples using VHDL for Basic Gates, Full Adder, 4:1 Multiplexer and D & T flip-flops using Behavioral Modeling style. **Self-Study:** Design examples using VHDL for Full Subtractor, 1:4 De-multiplexer		

• **Continuous Comprehensive Assessment: (Any one assignment** from **CCA 1 or 2**, and **any one assignment** from **CCA 3 to 5)**		**20 Marks**
CCA 1	**Mini-Project**	**10 Marks**
Design and implementation of a **Digital Visitor Counter System** using counters, displays and sensors for classroom/laboratory occupancy monitoring.		
CCA 2	**Project Based Learning (PBL)**	**10 Marks**
Development of a **Smart Traffic Light Control System** using sequential circuits, counters and timing logic for traffic management applications		
CCA 3	**Case Study**	**10 Marks**
Case study and hardware analysis of **Digital Electronics in Consumer Appliances** such as washing machines, microwave ovens, calculators and digital clocks.		
CCA 4	**Hardware Design Activity**	**10 Marks**
Design and implementation of a **Digital Voting Machine (DVM)** using combinational and sequential logic circuits with verification of operational conditions.		
CCA 5	**Simulation & HDL Based Activity**	**10 Marks**
VHDL-based modeling and simulation of **Digital Arithmetic and Control Circuits** such as ALU, counters, multiplexers and shift registers using FPGA design tools.		

- **Text Books:**

1. R.P. Jain, "Modern Digital Electronics", Tata McGraw Hill Publication
2. Thomas Floyd, "Digital Fundamentals", Pearson Publication, India

- **Reference Books:**

1. John. F. Wakerly, "Digital Design-Principles and Practices", Pearson Publication
2. M.M. Mano, "Digital Design," Prentice Hall India.
3. Stephen Brown, "Fundamentals of digital logic design with VHDL" Tata McGraw Hill Publication

- **MOOC / NPTEL Courses:** NPTEL course on **Digital Circuits b**y Prof. Santanu Chattopadhyay|IIT Kharagpur**:** **https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_ee75**

Course: Data Structures			**Code: 25COMDM201B**	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	02	02	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** Fundamentals of Programming Languages, C Programming

- **Course Objectives:**

1. To understand the significance of data structures and implement searching and sorting methods using the C language.
2. To learn the concept and understand the importance of time and space complexity.
3. To understand data representation, implementation and applications of linear and nonlinear data structure.

- **Course Outcomes:** At the end of the course, students will be able to:

CO1: Apply and implement the principle sorting and searching algorithms on the given data using the C language.
CO2: Develop applications of stack and queue using arrays.
CO3: Implement and demonstrate the applicability of a Linked List.
CO4: Demonstrate the construction, representation, and traversal of a Binary Search Tree.
CO5: Develop programs to build, represent, and traverse Binary Search Trees for efficient data organization.

- **Course Contents:**

Unit I	**Searching and Sorting**	**6 Hours**
Algorithm Analysis: Time and Space Complexity, Asymptotic Notations: Big O, Omega, Theta, Best, Worst, and Average Case Analysis, Searching Algorithms: Linear Search, Binary Search, Sorting Algorithms: Bubble, Selection Sorting Algorithms		
Unit II	**Stack and Queue**	**6 Hours**
Stack: Concept, Basic Stack operations, Array representation of stack, Stack as ADT, Stack Applications: Reversing data, Arithmetic expression conversion (Infix to Postfix) and Expression evaluation. Queue: Concept, Queue operations, Array representation of queue, Queue as ADT, Circular queue		
Unit III	**Linked List**	**6 Hours**
Pointer: Basic concepts, Pointer declaration and initialization, Dynamic Memory Allocation (malloc, calloc, realloc, free), comparison of sequential and linked organization, Linked List: Singly, Doubly, and Circular Linked List; Stack and Queue implementation using Linked list.		
Unit IV	**Non-linear Data Structure: Tree**	**5 Hours**
Introduction to tree: Basic Tree Concepts. Binary Tree: Concept & Terminologies, Representation of Binary Tree in memory, Traversing a binary tree. Binary Search Tree (BST): Basic Concepts, BST operations,		
Unit V	**Non-linear Data Structure: Graphs**	**5 Hours**
Graph: Basic Concepts & terminology, Representation of graph: Adjacency matrix, Adjacency list. Operations on graph: Traversing a graph.		

List of Activities: Any two

1. **Algorithm Complexity Analysis:** Students measure and compare time/space complexity of different data structure operations.
2. **Case Study Redesign:** Present a poorly designed system and ask students to redesign it with efficient data structures.
3. **Peer Teaching:** Students explain a data structure concept to peers with examples and code.
4. **Team Based Projects:** Build a complete application (e.g., library management, hospital system, or traffic simulation) integrating multiple data structures.

- **Textbooks:**
  1. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures, Galgotia Books Source, 2nd Edition
  2. Richard. F. Gilberg and Behrouz A. Forouzan, Data Structures: A Pseudocode Approach with C, Cengage Learning, 2nd Edition.
- **Reference Books:**
  1. Reema Thareja, Data Structures using C, Oxford University Press, 2nd Edition
  2. Yedidyah Langsam, Moshe J Augenstein and Aaron M Tenenbaum Data structures using C and C++ PHI Publications, 2nd Edition.
- **MOOC / NPTEL Courses:**
  1. Data Structure using C Programming by Dr. Dipti Verma and Mr. Aditya Tiwari: https://onlinecourses.swayam2.ac.in/nou23_cs13/preview

Course: Principles of Management and Organizational Behaviour			Code: 25OEC201A	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	2	2	CCA	20
			ISE	30
			ESE	50

Prerequisites:

- Basic knowledge of Engineering Mathematics
- Fundamentals of Economics and Accounting
- Analytical and quantitative reasoning skills

Course Objectives: The objectives of the course are -

1.To introduce the fundamental concepts, functions, and theories of management.
2. To develop an understanding of organizational behavior and individual dynamics at the workplace.
3. Evaluate leadership styles, communication processes, and team dynamics.
4. Apply decision-making, planning, organizing, and controlling techniques in practical scenarios.
5. Assess organizational culture, change management processes, and conflict resolution strategies.

Course Outcomes: At the end of the course, students will be able to:

CO1: Explain core management functions and classical as well as modern management theories.
CO2: Analyze individual behavior, personality, perception, and motivation in organizational settings.
CO3: Apply capital budgeting methods for evaluating engineering investment decisions.
CO4: Evaluate cost of capital and capital structure decisions.
CO5: Apply working capital and financial planning concepts for engineering projects.

- **Course Contents:**

Unit I	Introduction to Management	6 Hours

Definition and nature of management; functions of management (planning, organizing, staffing, directing, controlling); levels of management; managerial roles and skills; evolution of management thought (classical, behavioural, modern approaches); principles of management

Unit II	Planning and Organizing	6 Hours

Planning process; types of plans; decision-making process and techniques; organizing principles; organizational structure (line, functional, matrix); delegation, authority, and responsibility; centralization and decentralization.

Unit III	Individual Behavior in Organizations	6 Hours

Foundations of organizational behavior; personality and attitudes; perception and attribution; learning theories; motivation theories (Maslow, Herzberg, McGregor, etc.); job satisfaction and employee engagement.

Unit IV	Group Behavior and Leadership	6 Hours

Group dynamics; team development; communication process and barriers; leadership theories and styles; power and politics; conflict management; negotiation techniques; organizational culture.

Unit V	Organizational Change and Development	6 Hours

Organizational change and resistance to change; change management models; organizational development; stress management; ethics and corporate social responsibility; contemporary issues in management; digital transformation and innovation in organizations

List of Course Activities for Continuous Comprehensive Assessment (Any Two):

1. **Case Study Analysis**
   Students analyze a real organizational problem related to planning, leadership, motivation, or change management and present solutions.
2. **Group Discussion & Presentation**
   Teams discuss management topics such as leadership styles, organizational culture, or conflict management and deliver presentations.
3. **Role Play / Management Simulation**
   Students perform role plays on manager–employee communication, negotiation, decision-making, or team management scenarios.
4. **Mini Project on Organizational Study**
   Students visit or study an organization/startup and prepare a report on management practices, hierarchy, communication, and work culture.
5. **Hands-on Activity using Planning & Decision Tools**
   Students prepare organizational charts, decision trees, SWOT analysis, project planning schedules, or management process flowcharts using practical examples.

- **Textbooks:**
  1. Robbins, S. P. & Coulter, M., Management, Pearson Education.
  2. L. M. Prasad, Principles and Practice of Management, Sultan Chand & Sons.
- **Reference Books:**
  1. Robbins, S. P. & Judge, T. A., Organizational Behavior, Pearson Education.
  2. Koontz, H. & Weihrich, H., Essentials of Management, McGraw Hill.
  3. K. Aswathappa, Organizational Behavior, Himalaya Publishing House.
  4. Harold Koontz & Cyril O'Donnell, Principles of Management, McGraw Hill.
  5. P. Subba Rao, Management and Organizational Behavior, Himalaya Publishing House.
- **NPTEL/MOOCS:**
  1. NPTEL course on Principles of Management by Prof. Susmita Mukhopadhyay, Prof. S. Srinivasan, IIT Kharagpur: https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg88
  2. NPTEL course on Organizational Behaviour by Prof. M. P. Ganesh, IIT Hyderbad: https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_mg51

Course: Circular Economy for Sustainable Development				Code: 25OEC201B
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	2	2	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** Entrepreneurship, market survey, innovation

- **Course Objectives:** The objectives of the course are
  1. Understand the fundamentals principles of circular economy, sustainability, environmental systems, and resource cycles.
  2. Apply sustainable development goals (SDGs), life-cycle thinking, and circular economy models in real-world contexts.
  3. Develop the ability to assess materials, energy, and waste flows in businesses and communities to optimize resource use and reduce environmental impact.
  4. Examine environmental governance, global sustainability policies, and circular strategies for industry and society.
  5. Foster creative and practical solutions for sustainable consumption, production, and cleaner technologies.

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

  CO1: Explain the fundamental principles of circular economy and sustainable development, and differentiate between linear and circular economic systems.
  CO2: Analyse global environmental challenges and evaluate the role of Sustainable Development Goals (SDGs) in addressing sustainability issues.
  CO3: Apply life cycle thinking, material flow analysis, and resource efficiency tools to assess environmental impacts of products and processes.
  CO4: Design and evaluate circular business models incorporating strategies such as reuse, recycling, remanufacturing, and extended producer responsibility.
  CO5: Assess sustainability policies, governance mechanisms, and technological interventions to propose practical solutions for sustainable development.

- **Course Contents:**

Unit I	**Fundamentals of Circular Economy and Sustainable Development**	**6 Hours**

Concept of sustainable development; evolution of sustainability; environmental, social and economic dimensions (Triple Bottom Line); limitations of the linear economy (take–make–dispose model); principles of circular economy; relationship between circular economy and sustainability; planetary boundaries; ecological footprint; overview of global sustainability challenges; introduction to Sustainable Development Goals (SDGs) and their relevance to industry and society.

Unit II	**Resource Efficiency and Life Cycle Approaches**	**6 Hours**

Resource scarcity and resource efficiency; material flow analysis (MFA); life cycle thinking; Life Cycle Assessment (LCA) methodology and stages (goal and scope definition, inventory analysis, impact assessment, interpretation); carbon footprint and water footprint; eco-efficiency and resource productivity indicators; waste hierarchy (reduce, reuse, recycle, recover); strategies for decoupling economic growth from resource consumption

Unit III	**Circular Business Models and Industrial Applications**	**6 Hours**

Circular business model innovation; product life extension strategies; reuse, repair, refurbishment and remanufacturing; recycling technologies; product-as-a-service (PaaS); sharing economy; eco-design and design for environment (DFE); reverse logistics and closed-loop supply chains; Extended Producer Responsibility (EPR); industrial symbiosis; sustainable manufacturing practices.

Unit IV	**Policy, Governance and Sustainable Development Frameworks**	**6 Hours**

Environmental governance and regulatory frameworks; national and international sustainability policies; climate change mitigation and adaptation strategies; green finance and sustainable investment; Environmental, Social and Governance (ESG) reporting; corporate social responsibility (CSR); sustainable procurement practices; role of government, private sector and civil society in promoting circular economy; global environmental agreements and initiatives

Unit V	**Tools, Technologies and Case Studies in Circular Economy**	**6 Hours**

Emerging technologies enabling circular economy (IoT, Artificial Intelligence, blockchain for traceability); digitalization and smart resource management; sustainable supply chain management; urban circular systems and smart sustainable cities; waste-to-energy and waste-to-resource technologies; sectoral applications (manufacturing, agriculture, construction, energy); case studies of successful circular economy initiatives; challenges and future prospects of sustainable development.

- **List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Waste Audit & Recycling Survey**
   Students conduct a survey of waste generation in campus/home and suggest recycling or reuse strategies based on circular economy principles.
2. **Life Cycle Assessment (LCA) Mini Study**
   Analyze the life cycle of a product (plastic bottle, mobile phone, paper bag, etc.) and identify environmental impacts and sustainability improvements.
3. **Case Study Presentation on Circular Economy Models**
   Teams study companies practicing circular economy, green manufacturing, or sustainable business models and present findings.
4. **Hands-on Eco-Design / Upcycling Activity**
   Students create useful products from waste or redesign an existing product using eco-design and sustainability concepts.
5. **Sustainability Policy & SDG Mapping Project**
   Students map business/industrial activities with Sustainable Development Goals (SDGs) and prepare reports on sustainable practices.

- **Textbooks:**

1. Kirchherr, J., Reike, D., & Hekkert, M. – Conceptualizing the Circular Economy: An overview
2. Ellen MacArthur Foundation – Towards the Circular Economy (Vol. 1–3)
3. Pearce, D. & Turner, R. K. – Economics of Natural Resources and the Environment
4. Bruntland Commission Report – Our Common Future (UN document foundational to sustainability thought)

- **Reference Books:**

1. Bocken, N. M. P., et al. – Product Design and Business Model Strategies for a Circular Economy
2. Geissdoerfer, M., et al. – The Circular Economy: A Critical Literature Review
3. McDonough, W. & Braungart, M. – Cradle to Cradle: Remaking the Way We Make Things
4. UNEP / UN Documents – Global Environmental Outlook Reports
5. Geyer, R., et al. – Industrial Ecology and Circularity

- **MOOC / NPTEL Courses:**

1. Coursera : Sustainability and Circular Economy, Michael J. Readey, University of Colorado Boulder https://www.coursera.org/learn/sustainability-and-the-circular-economy
2. NPTEL2, Environment and Development, Prof. By Prof. Ngamjahao Kipgen, IIT Guwahati https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_hs83
3. NPTEL3, Education for Sustainable Development, By Prof. Atasi Mohanty, IIT Kharagpur https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_hs61
4. NPTEL4, Environmental Planning and Management, By Prof. Sonal K. Thengane, IIT Roorkee https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ge08
5. NPTEL5, Corporate social responsibility By Prof. Aradhna Malik, IIT Kharagpur https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg54

Course: Start-up Management &Venture Creation				Code: 25OEC201C
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	2	2	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** Entrepreneurship, market survey, innovation

- **Course Objectives:** The objectives of the course are
  1. Understand the fundamentals of startup management and venture creation.
  2. Develop the ability to identify, evaluate, and validate startup ideas.
  3. Gain knowledge of business models, funding mechanisms, and startup operations.
  4. Understand legal, ethical, and IPR aspects related to startups.
  5. Build entrepreneurial skills, teamwork, leadership, and lifelong learning orientation.

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

  CO1. Explain concepts, types, and lifecycle stages of start-ups and new ventures.

  CO2. Identify and analyze start up opportunities using market and customer discovery tools.

  CO3. Develop suitable business models and assess technical and financial feasibility of ventures.

  CO4. Apply knowledge of funding, legal, IPR, and government policies for startup creation.

  CO5. Prepare and present a startup business plan demonstrating teamwork, communication, ethics, and lifelong learning.

- **Course Contents:**

Unit I	**Introduction to Startups & Venture Creation**	**6 Hours**

Startup: Definition, characteristics, and types, Startup vs MSME vs traditional business, Startup lifecycle and growth stages, Role of startups in innovation and economic development Case studies of successful startups (Indian & global).

Unit II	**Idea Generation, Opportunity & Market Validation**	**6 Hours**

Entrepreneurial mindset and ideation techniques, Problem identification and solution fit, Design Thinking and Lean Startup approach, Customer discovery and validation, Market analysis and value proposition development.

Unit III	**Business Models & Feasibility Analysis**	**6 Hours**

Business Model Canvas and Lean Canvas, Technical, market, and financial feasibility, Cost structures, revenue models, and break-even analysis, Risk analysis and mitigation strategies, Sustainability and ethical considerations in startups

Unit IV	**Startup Ecosystem, Funding & Legal Aspects**	**6 Hours**

Startup ecosystem in India and globally, Government initiatives: Startup India, MSME, SIDBI, DPIIT, Sources of funding: bootstrapping, angel investors, venture capital, crowdfunding, Legal aspects: company registration, compliance, Intellectual Property Rights (IPR): patents, trademarks, copyrights

Unit V	**Startup Operations, Scaling & Business Plan**	**6 Hours**

Team formation, leadership, and culture, Operations and scaling strategies, Marketing, branding, and customer acquisition Business plan preparation and pitch deck, Future trends, failure analysis, and lifelong learning for entrepreneurs

- **List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Startup Idea Pitching Activity**
   Students develop and present innovative startup ideas addressing real-world problems using value proposition concepts.
2. **Business Model Canvas Workshop**
   Hands-on preparation of Business Model Canvas (BMC) for a startup including customer segments, revenue streams, and value proposition.
3. **Market Survey & Customer Validation**
   Students conduct field/online surveys to identify customer needs, validate startup ideas, and analyze market opportunities.
4. **Prototype / Product Demonstration**
   Teams create a basic prototype, mock-up, or digital model of a product/service and demonstrate its functionality and usefulness.
5. **Startup Business Plan Preparation**
   Students prepare a practical business plan including funding requirements, marketing strategy, operational plan, and financial feasibility analysis.

- **Textbooks:**

1. S. S. Khanka – Entrepreneurial Development, S. Chand & Company.
2. Vasant Desai – Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House.

- **Reference Books:**

1. Steve Blank & Bob Dorf – The Startup Owner's Manual, Wiley.
2. Alexander Osterwalder & Yves Pigneur – Business Model Generation, Wiley.
3. Barringer & Ireland – Entrepreneurship: Successfully Launching New Ventures, Pearson.
4. Peter F. Drucker – Innovation and Entrepreneurship, Harper Business.
5. Steve Blank & Bob Dorf – The Startup Owner's Manual, Wiley.

- **MOOC / NPTEL Courses:**

1. NPTEL1, Entrepreneurship, By Prof. C Bhaktavatsala Rao, IIT Madras https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg70
2. NPTEL2, Entrepreneurship Essentials By Prof. Manoj Kumar Mondal, IIT Kharagpur https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_ge08
3. NPTEL3, Innovation, Business Models and Entrepreneurship, By Prof. Vinay Sharma, Prof. Rajat Agrawal, IIT Roorkee: https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_mg95
4. NPTEL4, Entrepreneurship Essentials, By Prof. Manoj Kumar Mondal, IIT Kharagpur: https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_ge03
5. Coursera : Technology & Entrepreneurship Specialization, Brent Sebold, Arizona State University https://www.coursera.org/specializations/technology-and-entrepreneurship

Course: Health and Nutrition for Professionals			Code: 25OEC201D	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	2	2	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** No prerequisite required.
- **Course Objectives:**
  1. To understand the importance of nutrition and healthy lifestyle for professionals.
  2. To create awareness about balanced diet and nutritional requirements.
  3. To understand lifestyle diseases and their prevention.
  4. To develop healthy habits for stress management and productivity.
- **Course Outcomes:** At the end of the course, students will be able to:

  CO1: Explain the basic concepts of health and nutrition.

  CO2: Understand nutritional requirements and balanced diet.

  CO3: Identify lifestyle diseases and preventive measures.

  CO4: Apply principles of healthy living and stress management.

  CO5: Analyze the role of nutrition in improving professional productivity
- **Course Contents:**

Unit I	Introduction to Health and Nutrition	6 Hours

Concept of health and wellness, Dimensions of health (physical, mental, social), Importance of nutrition for professionals, Nutrients and their functions, Macronutrients and micronutrients

Unit II	Balanced Diet and Nutritional Requirements	6 Hours

Concept of balanced diet, Dietary guidelines, recommended dietary allowance (RDA), Nutritional needs during childhood, adolescence, adulthood and old age, Special Nutritional needs for working professionals
Vegetarian vs non-vegetarian diets, Food pyramid and healthy eating habits

Unit III	Lifestyle Diseases	6 Hours

Causes of lifestyle diseases, Obesity, diabetes, hypertension, heart disease, Role of diet in prevention of diseases, Importance of physical activity, Nutritional management of common diseases, Prevention through healthy diets and lifestyle

Unit IV	Health Management for Professionals	6 Hours

Work-life balance, Stress and its management, Role of exercise and yoga, Sleep and mental health, Ergonomics and workplace health

Unit V	Food Safety and Healthy Lifestyle	6 Hours

Food hygiene and sanitation, Food adulteration, Safe food handling practices, Sustainable and healthy eating habits, Nutrition for long-term health and productivity, Importance of hydration, Healthy snacking options at work

- **List of Course Activities for Continuous Comprehensive Assessment (Any Two):**
  1. **Balanced Diet Planning Activity**
     Students prepare a daily/weekly balanced diet chart for different age groups or working professionals based on nutritional requirements.

2. **Nutritional Analysis Survey**
   Conduct a survey on eating habits, junk food consumption, hydration, or lifestyle diseases and analyze the collected data.
3. **Healthy Recipe Preparation / Demonstration**
   Students prepare and present nutritious, low-cost, and healthy food recipes promoting balanced nutrition and food safety.
4. **Fitness, Yoga & Stress Management Activity**
   Practical sessions on yoga, exercise routines, meditation, posture correction, and stress management techniques for healthy living.
5. **Food Safety & Awareness Campaign**
   Students create posters, presentations, or awareness drives on food hygiene, adulteration detection, healthy snacking, and lifestyle disease prevention.

- **Textbooks:**
  1. Srilakshmi, B., Human Nutrition, New Age International (P) Ltd., Publishers, New Delhi.
  2. Joshi, Shubhangini A., Nutrition and Dietetics: With Indian Case Studies, 5th Edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2021.

- **Reference Books:**
  1. Swaminathan, M., Food and Nutrition, Bangalore Printing & Publishing Co. Ltd., Bangalore.
  2. Swami Nathan, M., Essentials of Food and Nutrition, Vol. I & II, Ganesh & Co., Madras (Chennai), 1974.
  3. Dietary Guidelines for Indians. A manual by National Institute of Nutrition, ICMR
  4. Safety and Health for Engineers, Roger L. Brauer, John Wiley & Sons.

- **MOOC / NPTEL Courses /Online Resources:**
  1. Adolescent Health and Well-Being: A Holistic Approach by By Prof. Sumana Samanta, Prof. Parmeshwar Satpathy, IIT Kharagpur: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ge102
  2. Diet Management in Health and Disease by By Dr. Vipparti Vijaya Lakshmi, The English and Foreign Languages University: https://onlinecourses.swayam2.ac.in/e-learning/preview/cec25_hc01
  3. Food and Nutrition by By Dr. Asna Urooj, University of Mysore: https://onlinecourses.swayam2.ac.in/e-learning/preview/cec19_ag02

Course: French Language Module-I			Code: 25OEC201E	
Teaching Scheme (Hrs/Week)		Credit	Evaluation Scheme	
Lecture	2	02	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** No prerequisite required.

- **Course Objectives:**
  1. To strengthen basic communication skills in French.
  2. To develop listening, reading, and writing skills in French.
  3. To enhance confidence in practical conversations.
  4. To apply French vocabulary and expressions in travel and public communication contexts.
  5. To prepare students for DELF A1 level competency.

- **Course Outcomes:** At the end of the course, students will be able to

  CO1. Use basic French expressions confidently in familiar situations.

  CO2. Interpret simple dialogues and instructions in French.

  CO3. Read and write short paragraphs on familiar topics.

  CO4. Participate in guided conversations using appropriate French expressions.

  CO5. Apply French language skills in practical and everyday situations.

- **Course Contents:**

Unit I	Introduction au français (Introduction to French)	6 Hours
French alphabet and pronunciation , Greetings and introductions , Numbers (1-100), days and months Classroom expressions		
Unit II	**Parler de ses loisirs et de sa famille (Talking about his hobbies and his family)**	**6 Hours**
Talking about a hobby, (Vocab: Activities, expressions + Aimer) , Family and friends , (Grammar: Subject pronouns, ER ending verbs, Family relations)		
Unit III	**La France (France)**	**6 Hours**
Reading about French city, Asking simple questions about France, Writing a post card (Vocab: Information on France and it's cities, interrogative words.)		
Unit IV	**Au café! (At the cafe!)**	**6 Hours**
Ordering in French, Fruits and vegetables , Quantities , Expressions of politeness		
Unit V	**Faire une invitation (Make an invitation)**	**6 Hours**
Letter writing , Organising a party , Accepting / refusing an invitation , Role play activities		

- **List of Course Activities for Continuous Comprehensive Assessment (Any Two):**
  1. Self-introduction in French: Students introduce themselves using simple French sentences.
  2. Greetings and Classroom Conversation: Students practice basic greetings and classroom expressions in French.
  3. **Listening Comprehension Exercise:** Students listen to short French audio clips and answer simple questions.
  4. **Picture Description in French:** Students describe a given picture using basic French vocabulary.
  5. French Culture Presentation: Students give a short presentation on French culture, food, or festivals.

- **Text Books:**

  1. Alter Ego A1 – Hachette (Goyal Publishers)

  2.Latitude 1 – Didier (Goyal Publishers)

- **Reference Books:**
  1. Myrna Bell Rochester, "Easy French Step-By-Step: Master High-Frequency Grammar for French Proficiency—Fast", McGraw Hill, ISBN-13 : 978-0071453875
  2. Eugene Jackson, Antonio Rubio, Julien J. Lafontant, Pamela Haze, "French Made Simple", Crown Publication, ISBN-13 : 978-0767918596
  3. Claire Miquel, "Communication Progressive du Français A1", Cle International, Atlantic Publishers and Distributors (P) Ltd., 7/22, Ansari Road, Darya Ganj, New Delhi – 110002
  4. Ranjit, Mahita & Singh, Monica, Apprenons le frangais', Part 1, Saraswati House Pvt. Ltd.,New Delhi. Second Revised Edition, 2007
  5. Ranjit, Mahita & Singh, Monica, Cahier d'exercices', (Apprenons le francais) 1., Saraswati House Pvt. Ltd., New Delhi. Second Revised Edition, 2007

- **MOOC / NPTEL Courses /Online Resources Online Resources:**
  1. https://www.elearningfrench.com/
  2. https://www.laits.utexas.edu/fi/index.html
  3. https://blog.rosettastone.com/french-accent-marks/
  4. https://www.frenchcircles.ca/online-free-french-resources/
  5. Proficiency course in French By Prof. Nirupama Rastogi (Retd): https://onlinecourses.swayam2.ac.in/e-learning/preview/cec19_lg04
  6. Foundations of French by Ramya Jagannathan: https://onlinecourses.swayam2.ac.in/e-learning/preview/imb26_mg73
  7. The Complete French Course : Learn French – Beginners : https://www.udemy.com/course/french-for-beginners-a1/?couponCode=PMNVD2025
  8. Complete French Course: Learn French for Beginners : https://www.udemy.com/course/complete-french-course/?couponCode=PMNVD2025

Course: German Language Module-I			Code: 25OEC201F	
Teaching Scheme (Hrs/Week)		Credit	Evaluation Scheme	
Tutorial	2	02	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** No prerequisite required.

- **Course Objectives:**
  1. To strengthen basic communication skills in German.
  2. To develop listening, reading, and writing skills in German.
  3. To enhance confidence in practical conversations.
  4. To apply German vocabulary and expressions in travel and public communication contexts.
  5. To prepare students for Goethe A1 level competency.

- **Course Outcomes:** At the end of the course, students will be able to

  CO1. Use basic German expressions confidently in familiar situations.

  CO2. Interpret simple dialogues and instructions in German.

  CO3. Read and write short passages on familiar topics.

  CO4. Participate in practical conversations using appropriate German expressions.

  CO5. Apply German language skills in everyday situations.

- **Course Contents:**

Unit I	Willkommen! (Welcome!)	6 Hours

Topics and Vocabulary: Greetings, Introductions, Numbers, Countries & languages

Grammar: Alphabet, Pronunciation, Personal pronouns

Skills

- Speaking: self-introduction
- Listening: simple conversations
- Reading: name cards, dialogues
- Writing: short introduction paragraph

Unit II	Familie, Freunde und ich (Family, Friends and I)	6 Hours

Topics and Vocabulary: Family members, Hobby and work

Grammar: Nominative case, Articles- der, die, das, Regular verb conjugation

Skills

- Speaking: describe family, ask about profession, introduce others
- Reading: small paragraphs about nuclear and joint families

Activity

Family tree presentation

Unit III	Orte und Dinge (Places and things)	6 Hours

Grammar: Sentence structure , Definite articles- der, die, das, Indefinite articles- ein, eine, ein,

Negative markers- kein, keine, kein, nicht

Skills

- Speaking**:** describing surroundings and objects
- Reading**:** simple descriptive passages and labels
- Writing**:** short descriptions using simple sentences

Activities

- Vocabulary Hunt
- Mystery Object Game

Picture Description

Unit IV	**Studentenleben & Alltag (Student life & everyday life)**	**6 Hours**

Topics and Vocabulary: Daily routine , University life , Subjects , Time expressions

Grammar: Time, Nominative case- personal pronouns, Nominative case- possessive Pronouns

Skills: Speaking and Writing: daily routine discussion

Listening: schedules at university and at the work place

Unit V	**Revision & Mini Project**	**6 Hours**

Integrated Skills : Students prepare: self-introduction , poster , dialogue , simple presentation

Suggested Project

My dream study trip to Germany/ Cultural connectivity between Germany and India/ Any other topic related to German language and culture.

Assessment

- Speaking viva
- Listening test
- Vocabulary quiz
- Listening exercises
- Pronunciation practice
- Role play activities

- **List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Self-introduction in German:** Students introduce themselves using simple German sentences.
2. **Greetings and Basic Conversation:** Students practice greetings and everyday expressions in German.
3. **Listening Comprehension Exercise:** Students listen to short German audio clips and answer questions.
4. **Picture Description in German:** Students describe simple pictures using basic German vocabulary.
5. **German Culture Presentation:** Students present topics related to German culture, food, or festivals.

- **Text Books:**
  1. Stefanie Dengler, “Netzwerk A1 (Textbook + Workbook + Glossar)”, Hachette , ISBN: 9788183077033, (Goyal Publishers)
  2. Monika Reimann Daniela Niebisch , Sylvette Penning-Hiemstra , Angela Pude , Franz Specht , Monika Bovermann, “ Schritte international Neu 1: Deutsch als Fremdsprache / Kursbuch + Arbeitsbuch mit Audios online”, Hueber Publications, GOYAL Publishers & Distributors Pvt. Ltd, ISBN-13 : 978-3193610829

- **Reference Books:**
  1. Deepak Kushwaha, “German Made Easy Part 1 + German Made Easy Part 2 with Answer”, Goyal Publishers
  2. Arnold Leitner, “German Made Simple”, Crown Publications, Penguin Random House India Pvt Ltd
  3. Kurs Und Ubungsbuch, “Studio-D A1 - Combo of 3 (German)”, Goyal Publishers & Distributers
  4. Funk and Kuhn, “Studio D A1Deutsch Buch “, Cornelsen Verlag (Goyal Publishers India)

- **MOOC / NPTEL Courses /Online Resources Online Resources:**
  1. Learn German Language: Complete German Course – Beginners (Udemy): https://www.udemy.com/course/complete-german-course-learn-german-for-beginners/
  2. German A1 - German For Complete Beginners! : https://www.udemy.com/course/german-for-complete-beginners/?couponCode=PMNVD2025
  3. DW Learn German: https://learngerman.dw.com/en/learn-german/s-9528
  4. Practise German for free (Goethe-Institut Resources) : https://www.goethe.de/en/spr/ueb.html
  5. Duolingo German : https://www.duolingo.com/course/de/en/Learn-German

Course: Japanese Language Module-I			Code: 25OEC201G	
Teaching Scheme (Hrs/Week)		Credit	Evaluation Scheme	
Tutorial	2	02	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** No prerequisite required.

- **Course Objectives:** The objectives of the course are-
  1. To strengthen basic communication skills in Japanese.
  2. To develop reading and writing skills in Japanese.
  3. To enhance confidence in practical conversations.
  4. To apply Japanese vocabulary and expressions in travel and public communication contexts.
  5. To prepare students for JLPT N5 level competency.

- **Course Outcomes:** At the end of the course, students will be able to

  CO1. Use beginner-level Japanese expressions for effective communication.

  CO2. Interpret short dialogues and passages in Japanese.

  CO3. Read and write basic Japanese sentences.

  CO4. Participate in practical conversations using appropriate Japanese expressions.

  CO5. Apply Japanese language skills in everyday situations.

- **Course Contents:**

Unit I	Nihongo nyūmon (Introduction to Japanese)	6 Hours
Hiragana and Katakana , Greetings and introductions , Numbers and dates , Pronunciation practice		
Unit II	**Kihon-tekina bunpō to goi (Basic Grammar and Vocabulary)**	**6 Hours**
Sentence patterns, Particles , Basic verbs , Pronouns and nouns		
Unit III	**Nichijō no komyunikēshon (Everyday Communication)**	**6 Hours**
Self-introduction , Family and hobbies , Daily activities , Asking simple questions , Kanji –Lesson 1 (Textbook 1)		
Unit IV	**Dokkairyoku to sakubun nōryoku (Reading and Writing Skills)**	**6 Hours**
Reading simple scripts, Vocabulary exercises , Writing practice , Sentence construction , Kanji – Lesson 2 (Textbook 1)		
Unit V	**Risuningu to supīkingu no renshū (Listening and Speaking Practice)**	**6 Hours**
Listening exercises , Pronunciation practice , Role play activities , Guided communication Kanji –Lesson 3 (Textbook 1)		

- **List of Course Activities for Continuous Comprehensive Assessment (Any Two):**
  1. **Self-introduction in Japanese:** Students introduce themselves using simple Japanese expressions.

2. **Greetings and Classroom Conversation:** Students practice basic greetings and classroom communication in Japanese.
3. **Listening Comprehension Exercise:** Students listen to short Japanese audio clips and answer simple questions.
4. **Picture Description in Japanese:** Students describe pictures using simple Japanese vocabulary.
5. **Japanese Culture Presentation:** Students present topics related to Japanese culture, food, or festivals.

- **Text Books:**
  1. 3A Corporation, "Minna No Nihongo 1-1,1-2,2-1,2.2 Main Textbook elementary", ISBN-13: 9789388141147, Goyal Publishers & Distributors Pvt. Ltd, India
  2. Eri Banno, Yoko Ikeda, Yutaka Ohno, Chikako Shinagawa, Kyoko Tokashiki, "Genki 1 Textbook: An Integrated Course in Elementary Japanese", ISBN-13 : 978-4789014403

- **Reference Books:**
  1. The Japan Foundation, "Marugoto: Japanese Language and Culture Starter A1 Coursebook for Communicative Language Activities", Goyal Publishers
  2. The Japan Foundation, "Marugoto Starter (A1) Rikai - Course Book For Communicative Language Competences", Goyal Publishers, ISBN-13: 9788183078047
  3. The Japan Foundation, "Marugoto Starter (A1) Katsudoo", Goyal Publishers
  4. "Japanese for Busy People,3rd edition", Association for Japanese Language Teaching, Kodansha Tokyo Japan Kodansha International, November, 2011.,
  5. Tae Kim, "A Guide to Japanese Grammar: A Japanese Approach to Learning Japanese Grammar", Createspace Independent Pub, ISBN-13 : 978-1495238963, Bookswagon, 2/13 Ansari Road, Daryaganj, New Delhi 110002
  6. Nyumon Nihongo- ALC Press, U.K
  7. Nihongo Soomatome N5, ASK Publishing, Tokyo

- **MOOC / NPTEL Courses /Online Resources Online Resources:**
  1. Online Japanese Beginner Course (Udemy): https://www.udemy.com/course/online-japanese-beginner-course
  2. JF-Japanese e-learning : https://minato-jf.jp/
  3. Introduction to Japanese Langauge : Prof Vatsala Misra (NPTEL) : https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_hs83
  4. Learn Japanese Language: Free Online Courses: https://www.busuu.com/en/course/learn-japanese-online

Course: Electronics Circuits Lab			Code: 25ETPCC201L	
Teaching Scheme (Hrs/Week)		Credit	Evaluation Scheme	
Practical	2	1	Practical	Marks: 25

- **Prerequisites:** Basic Electronics Engineering, Basic Electrical Engineering

- **Course Objectives:**

1. To study the characteristics of MOSFET devices by plotting drain and transfer characteristics and determining threshold voltage.
2. To design and analyze single-stage amplifier circuits such as common source (CS) and common emitter (CE) amplifiers and evaluate their performance parameters.
3. To design and implement adjustable voltage regulator circuits using LM317 voltage regulator and LM337 voltage regulator ICs and analyze their results.
4. To study Opamp characteristics and measure AC parameters.

Course Outcomes: At the end of the course, students will be able to:

CO1: Measure and interpret MOSFET characteristics, including drain characteristics, transfer Characteristics and threshold voltage.

CO2: Verify DC operating point for MOSFET

CO3: Design amplifier circuits, determining voltage gain, input impedance, output impedance, and frequency response.

CO4: Implement adjustable voltage regulators and compare theoretical and practical performance.

CO5: Measure AC Parameters of Opamp.

List of Experiments

Perform any 10 experiment (1-8 experiment compulsory)

1) **MOSFET Characteristics (Enhancement Type)**
   a) Plot Drain Characteristics (ID–VDS) and Transfer Characteristics (ID–VGS)
   b) Determine Threshold Voltage (Vth)
2) **Design, build single stage CS configuration & verify DC operating point and comment on result.**
3) **Small Signal Analysis of CE Amplifier**
   Measure Voltage Gain, Input Impedance, Output Impedance and Compare theoretical and practical results
4) **MOSFET Common Source (CS) Amplifier**
   a) Design and measure voltage gain
   b) Study frequency response
5) **Frequency Response of Single Stage Amplifier**

Plot Gain v/s Frequency curve, Determine Lower Cutoff (fL), Upper Cutoff (fH), and Bandwidth

6) **Design & implement adjustable voltage regulator using IC LM317/LM337 and comment on result.**

7) **Design build and test summing amplifier**

8) **Measure AC parameters of Opamp: a) CMRR b) Gain Bandwidth product. Compare the result with a**

datasheet of corresponding Op-Amp.

Virtual Laboratories:

9) **Frequency response of CS amplifier**

https: //aec-iitkgp.vlabs.ac.in/exp/cs-amplifier/

10) **Half Wave Rectifier**

https://be-iitkgp.vlabs.ac.in/exp/half-wave-rectification/

11) **Full Wave Rectifier**

https://be-iitkgp.vlabs.ac.in/exp/full-wave-rectification/

12) **BJT CE Amplifier**

https://be-iitkgp.vlabs.ac.in/exp/ce-amplifier/

Course: Linear Integrated Circuits Lab			Code:25ETPCC202L
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**
Practical	2	1	PR 25

- **Prerequisites:**

Basic Electronics Engineering, Electronic Circuits

- **Course Objectives:**

1. To understand the internal structure and working principles of operational amplifiers and their basic building blocks.

2. To analyze and design linear and non-linear applications of operational amplifiers.

3. To study and compare different types of ADC and DAC using OP-AMP circuits.

- **Course Outcomes:** At the end of the course, students will be able to:

CO1: Measure key Op-Amp parameters and compare the measured values with the manufacturer's datasheet specifications.
CO2: Design, build, and test fundamental Op-Amp application circuits such as integrator, precision rectifier (half & full wave), and Schmitt trigger, and evaluate their performance characteristics. Design and implement precision half-wave and full-wave rectifier circuits using Op-Amps.
CO3: Design, construct, and test basic data conversion systems including 2-bit R-2R ladder DAC and 2-bit flash ADC, and analyze their conversion accuracy .
CO4: Design and experimentally analyze timing and synchronization circuits such as Phase Locked Loop (PLL) and interpret their dynamic characteristics including lock range and capture range.
CO5: Design and test Op-Amp based square and triangular wave generators and verify waveform parameters such as frequency and Amplitude.

- **Course Contents:**

List of Experiments:

1. Measure AC parameters of Opamp: a) Open loop gain b) Slew rate. Compare the result with a datasheet of corresponding Op-Amp.
2. Measure DC parameters of Opamp and compare with the specifications. Input bias current, input offset current and CMRR Compare the result with a datasheet of corresponding Op-Amp.
3. Design, build and test integrator for given frequency a.
4. Design, build and test precision half wave rectifier.
5. Design, build and test op amp as comparator
6. Design, build and test Schmitt trigger and plot transfer characteristics.
7. Design, build and test PLL.
8. Design and implement 2 bit R-2R ladder DAC.
9. Design and build Wein bridge Oscillator.
10. Virtual Lab: https://aec-iitkgp.vlabs.ac.in/exp/schmitt-trigger/
11. Virtual Lab: https://ae-iitr.vlabs.ac.in/exp/wein-bridge-oscillator/
12. Virtual Lab: https://ae-iitr.vlabs.ac.in/exp/function-generator/

Course: Digital Electronics Lab				Code:25ETPCC203L
Teaching Scheme (Hrs/Week)		Credit	Evaluation Scheme	
Practical	02	01	Practical	Marks: 25

Prerequisites: Basic Electronics Engineering Lab

- **Course Objectives:**

1. To Provide Hands-on experience in Designing and Implementing Combinational Logic Circuits such as Multiplexers, Decoders, Adders, Subtractors and Code Converters using standard Digital ICs.
2. To Develop the ability to Design and Analyze Sequential Logic Circuits including Counters, Shift Registers, and Pulse Generators and to interpret their timing behavior.
3. To Introduce basic Digital System Simulation using VHDL, enabling students to verify Combinational Logic Circuits through HDL-based modeling.

- **Course Outcomes:** At the end of the course, students will be able to:

CO1: Design and Implement Combinational Logic Circuits using Multiplexers, Decoders and Arithmetic ICs, and verify their functionality using truth tables.

CO2: Design and Implement Sequential Logic Circuits such as Counters, Shift Registers, and Pulse Generators and interpret their operation using timing diagrams.

CO3: Develop and Simulate basic VHDL models of Digital Circuits such as Multiplexers and Adders for functional verification.

List of Experiments:

Group A: (Any 4)

1. a) Design and Implement 8:1 MUX using IC-74153 & Verify its Truth Table.
   b) Design & implement the given 4-variable function using IC-74153. Verify its Truth Table.
2. Design and implement full adder and full subtractor function using IC-74138.
3. Design and implement 3-bit Binary to Gray code converter and BCD to Excess-3 code converter using IC-74138.
4. Design and Implement 1-digit BCD adder using IC-7483.
5. Design and Implement 4-bit Binary adder and subtractor with mode control using IC-7483.

Group B: (Any 3)

6. Design and Implement MOD-N and MOD-NN using IC-7490 and draw Timing diagram.
7. Design and Implement Up/down Counter with mode control using IC-74191 / IC-74193.Draw Timing Diagram.
8. Design and Implement 4-bit right shift and left shift register using D-flip flop IC-7474.
9. Design and Implement Pulse train generator using IC-74194 / IC-7495 (Use right/left Shift).
10. Design and Implement 4-bit Ring Counter / Twisted ring Counter using shift registers IC-74194 / IC-7495.

Group C: (Any 1)

11. Simulate VHDL code for 4:1 multiplexer & 1:4 Demultiplexer.
12. Simulate VHDL code for Hall Adder and Half Subtractor.

Virtual Laboratories:

1. Digital Applications Lab: https://da-iitb.vlabs.ac.in/List%20of%20experiments.html
2. Hybrid Electronics Lab: https://he-coep.vlabs.ac.in/List%20of%20experiments.html

Course: Employability Skill Development-I				Code: 25ETVSE201
Teaching Scheme (Hrs./Week)		**Credit**	**Evaluation Scheme**	
Practical	2	1	Oral	Marks: 25

- **Prerequisites:** C Programming, Data Structures

- **Course Objectives:**
  1. To understand and implement basic data structures using programming.
  2. To develop programs for operations on arrays, stacks, queues, and linked lists.
  3. To implement searching and sorting algorithms and analyze their performance.
  4. To construct and perform operations on trees and graphs.

Course Outcomes: At the end of the course, students will be able to:
CO1: Implement basic data structures such as arrays, stacks, queues, and linked lists using programming.
CO2: Apply searching and sorting techniques to organize and retrieve data efficiently.
CO3: Construct operations on tree data structures such as Binary Search Trees.
CO4: Analyze and implement different data structure algorithms for solving computational problems.
CO5: Demonstrate the use of data structures through practical programming and virtual lab experiments.

List of Experiments (Any 10)

List of Experiments

1. Write a program to implement linear search and binary search algorithms to locate a target element in a dataset.
2. Write and execute programs to implement sorting algorithms such as Bubble Sort, Selection Sort, and Insertion Sort.
3. Student Database Management You are developing a student result management system. The database should support updating records, adding new entries, searching for specific students, and sorting based on performance. Using an array of structures, implement a student database with attributes: roll no, name, program, course, subject marks, total, and average. Support operations: dis- play, search, and sort. (Students can additionally perform modify, append.)
4. Stack or Queue using Array (Static Implementation) Simulate a parcel handling system at a post office where packages are stacked (LIFO) or queued (FIFO). Use an array to implement a stack (push, pop, display) or a queue (add, delete, dis- play). Choose the appropriate model based on the scenario.
5. Singly Linked List Operations You are building a text editor where lines of text are stored dynamically. You need to allow insertion and deletion of lines at any position, and display text both normally and in reverse. Use a singly linked list to implement: display, insert (front/end/middle),

delete (front/end/middle), display in reverse, and reverse the list.

6. Binary Search Tree Operations an online directory system uses a BST to keep names in a sorted manner and support fast searching. Create a binary search tree and implement recursive traversals (inorder, preorder, pos- torder) and search for a specific name in the directory.
7. Graph Traversal You are designing a navigation system for a campus with multiple buildings. The system should explore possible paths (routes) using BFS or DFS. Create a graph using an adjacency matrix and implement Breadth-First Search and Depth-First Search to explore the building connectivity.
8. Stack or Queue using Linked List (Dynamic Implementation) Design a service window system where customers arrive and are served in order (FIFO), or a browser history system where the last visited page is accessed first (LIFO). Use a linked list to implement a dynamic stack (push, pop, display) or queue (add, delete, display) based on the given use case.
9. Balanced Parentheses or Decimal to Binary Write a program to check for balanced parentheses in a given expression (including (), {}, []) using a stack implemented with arrays or linked lists. OR Write a program to convert a Decimal number to a binary number using a stack.
10. Height and Depth in BST Develop a program that constructs a Binary Search Tree and computes the height of the tree and the depth of a given node.
11. Count and Classify Nodes Write a program to count the number of: - Leaf nodes - Internal nodes - Nodes with only one child in a given binary tree.

Virtual Laboratories:

Computer Science and Engineering: https://ds1-iiith.vlabs.ac.in

Course: Engineering Economics (HSSM)			Code: 25HSM201A	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Tutorial	2	2	TW	50

- **Prerequisites:** Basic Mathematics, Basic Economics, General Engineering Knowledge

- **Course Objectives:** The objectives of the course are-
  1. To develop a comprehensive understanding of the principles of engineering economics among students.
  2. To equip students with analytical skills and knowledge required for evaluating engineering projects.
  3. To build a fundamental understanding of accounting principles, financial analysis, and various funding strategies.
  4. To enable students to understand market structures, pricing strategies, and the impact of government policies and economic factors.
  5. To examine the role of engineers in industrialization and economic development.

- **Course Outcomes:** At the end of the course, students will be able to:

CO1: Apply engineering economic concepts such as cost analysis, time value of money, break-even analysis, and investment evaluation.

CO2: Use cost estimation techniques, evaluate asset depreciation, perform capital budgeting, and carry out replacement analysis.

CO3: Interpret financial statements, analyse financial ratios, evaluate different sources of finance, manage working capital, and perform project appraisal.

CO4: Analyze various market structures and pricing strategies, and assess the impact of government policies, taxation, and inflation on engineering projects.

CO5: Analyze emerging trends such as circular economy concepts and Industry 4.0 from an economic perspective.

- **Course Contents:**

Unit I	Introduction to Engineering Economics	6 Hours

Basic Concepts: Definition and importance of engineering economics, principles and applications in decision making, cost estimation, investment analysis, profitability assessment, resource optimization, risk management, comparison with traditional economics, and overview of microeconomics and macroeconomics.
Cost Concepts: Fixed, variable, marginal, sunk, and opportunity costs.
Time Value of Money: Present worth, future worth, annuities, and compounding techniques.
Break-even Analysis: Cost–volume–profit (CVP) analysis and contribution margin.

Unit II	Cost Estimation and Capital Budgeting	6 Hours

Cost Estimation Techniques: Direct and Indirect Costs, Overheads
Depreciation Methods: Straight Line, Declining Balance, and Sum of Years' Digits
Capital Budgeting: Payback Period, Net Present Value (NPV), Internal Rate of Return (IRR), Profitability Index Replacement Analysis: Economic Life and Useful Life of Equipment

Unit III	Financial Management and Accounting	6 Hours

Basic Accounting Principles: Balance Sheet, Profit and Loss Statement, Cash Flow
Financial Ratios: Liquidity, Profitability, and Solvency Ratios
Sources of Finance: Equity, Debt, Venture Capital, Working Capital Management
Project Appraisal: Feasibility Studies, Risk Analysis in Investment Decisions

Unit IV	Market Structures and Economic Decision Making	6 Hours

Market Structures: Perfect competition, monopoly, oligopoly, and monopolistic competition.
Pricing Strategies: Cost-based pricing, market-based pricing, penetration pricing, and skimming pricing.
Government Policies and Taxation: GST, income tax, corporate tax, and industrial incentives.
Inflation: Concept of inflation and its impact on engineering projects

Unit V	Industrial Economics and Engineering Ethics	6 Hours

Industrialization and Economic Development: Role of engineers in economic growth.
Public and Private Sector Enterprises: Comparison of public sector and private sector enterprises.
Engineering Ethics and Professionalism: Corporate social responsibility (CSR) and sustainable development.
Emerging Trends: Green economics, circular economy, Industry 4.0, and their economic impacts.

- **Course activities for term work evaluation:**
  1. **Cost Estimation and Budgeting Exercise**
     Students prepare detailed cost estimates for a simple engineering product or project including material, labour, overhead, and profit calculations using practical data.
  2. **Case Study on Engineering Economic Decisions**
     Students analyse real-life engineering projects related to investment decisions, cost control, depreciation, or resource allocation and present economic solutions.
  3. **Capital Budgeting and Financial Analysis Activity**
     Students perform Payback Period, NPV, and IRR calculations for different investment alternatives using spreadsheets and interpret the results.
  4. **Market Survey and Pricing Strategy Analysis**
     Students conduct a survey on pricing methods, market competition, and consumer demand for engineering products and prepare an analytical report.
  5. **Mini Project on Industrial Economics and Sustainability**
     Students study an industry or startup and prepare a report on production systems, financial planning, CSR activities, green economics, or Industry 4.0 practices.

- **Textbooks:**
  1. Engineering Economics by R. Panneerselvam Publisher- PHI learning private limited
  2. Engineering Economy (16th Edition) by William G. Sullivan & Elin M. Wicks
  3. Fundamentals of Engineering Economics (2nd Edition) by Chan S. Park
  4. Principles of Engineering Economic Analysis by John A. White, Kenneth E. Case, and David B. Pratt

- **Reference Books:**
  1. Principles of Engineering Economy by Eugene L. Grant
  2. Engineering Economy: Analysis of Capital Expenditures by Gerald W. Smith
  3. Applied Economic Analysis for Technologists, Engineers, and Managers by Michael S. Bowman
  4. Engineering Economics for Capital Investment Analysis by Tung Au and Thomas P. Au
  5. Schaum's Outline of Engineering Economics by Jose A. Sepulveda and William E. Souder

- **MOOC / NPTEL Courses:**
  1. Engineering Economic Analysis – NPTEL (IIT Roorkee) by Prof. Pradeep K. Jha: https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_me98
  2. Project Management for Managers by By Prof. Mukesh Kumar Barua, IIT Roorkee: https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_mg71
  3. Financial Accounting By Prof. Puran Singh, IIT Mandi : https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_mg65
  4. Introduction to Market Structures By Prof. Amarjyoti Mahanta, IIT Guwahati: https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_hs84
  5. Ethics in Engineering Practice By Prof. Susmita Mukhopadhyay, IIT Kharagpur: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_mg42

Course: Entrepreneurship Development and IPR			Code: 25HSM201B	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Tutorial	2	2	TW	50

- **Prerequisites:** Market study, break even analysis, profit loss, accounting

- **Course Objectives:** The objectives of the Course are
  1. Understand the concepts, role, and importance of entrepreneurship and innovation in economic and social development.
  2. Identify and evaluate business opportunities, especially technology-based and sustainable ventures.
  3. Develop entrepreneurial mindset, creativity, and problem-solving ability.
  4. Understand startup ecosystem, government policies, IPR, funding, and incubation support.
  5. Prepare a basic business plan incorporating ethical, financial, and sustainability considerations.

- **Course Outcomes:** At the end of the course, students will be able to:
  CO1: Explain concepts of entrepreneurship, innovation, and their role in economic and societal development.
  CO2: Identify entrepreneurial opportunities using creativity, design thinking, and market analysis tools.
  CO3: Analyse feasibility of a business idea considering technical, financial, legal, and social aspects.
  CO4: Apply knowledge of startup ecosystem, IPR, funding, and government initiatives to venture creation.
  CO5: Develop and present a basic business plan demonstrating teamwork, communication, ethics, and lifelong learning attitude.

- **Course Contents:**

Unit I	**Introduction to Entrepreneurship**	**6 Hours**
Entrepreneurship: Definition, types, and characteristics, Entrepreneur vs Manager, Role of entrepreneurship in economic development, Innovation: Types and sources, Case studies of successful entrepreneurs (Indian & global)		
Unit II	**Creativity, Innovation & Opportunity Identification**	**6 Hours**
Entrepreneurial mindset and creativity, Design Thinking for innovation, Idea generation techniques, Opportunity identification and screening, Market research and customer validation, Technology-based entrepreneurship		
Unit III	**Feasibility Analysis & Business Models**	**6 Hours**
Technical, market, and financial feasibility, Business Model Canvas (BMC), Costing, pricing, and break-even analysis, Risk analysis and mitigation, Ethics and sustainability in entrepreneurship		
Unit IV	**Startup Ecosystem, IPR & Funding**	**6 Hours**
Startup India initiative and government schemes (MSME, SIDBI, DPIIT), Incubation centers, accelerators, and angel networks, Basics of Intellectual Property Rights (Patents, Copyrights, Trademarks), Sources of funding: Bootstrapping, venture capital, crowdfunding, Legal aspects of starting a venture		
Unit V	**Business Plan Development & Entrepreneurial Skills**	**6 Hours**
Business plan preparation and structure, Team building and leadership, Communication and pitching skills Social entrepreneurship and sustainable startups, Future trends and lifelong learning for entrepreneurs		

- **Course activities for term work evaluation:**

1. **Business Idea Identification and Opportunity Analysis**
   Students identify innovative business ideas, analyze market opportunities, customer needs, and prepare a brief opportunity assessment report.
2. **Case Study on Successful Entrepreneurs and Startups**
   Students study successful entrepreneurs or startups and analyze their business models, innovation strategies, challenges, and growth factors.
3. **Business Model Canvas (BMC) Activity**
   Students prepare a Business Model Canvas for a startup idea covering value proposition, customer segments, revenue streams, and key resources.
4. **Mini Project on Startup Ecosystem and IPR**
   Students explore startup support systems such as MSME, Startup India, incubation centers, patents, trademarks, and funding schemes and prepare a report.
5. **Business Plan Presentation and Pitching Activity**
   Students develop and present a basic business plan including marketing, financial planning, costing, break-even analysis, and sustainability considerations.

- **Textbooks:**

1. Vasant Desai – Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House.
2. S. S. Khanka – Entrepreneurial Development, S. Chand & Company.
3. Donald F. Kuratko – Entrepreneurship: Theory, Process and Practice, Cengage Learning.
4. Peter F. Drucker – Innovation and Entrepreneurship, Harper Business.

- **Reference Books:**

1. Osterwalder & Pigneur – Business Model Generation, Wiley.
2. Barringer & Ireland – Entrepreneurship: Successfully Launching New Ventures, Pearson.
3. Robert Hisrich et al. – Entrepreneurship, McGraw-Hill.

- **MOOC / NPTEL Courses/Online Resources:**

1. NPTEL1, Entrepreneurship, By Prof. C Bhaktavatsala Rao, IIT Madras : https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg70
2. NPTEL2, Entrepreneurship Essentials By Prof. Manoj Kumar Mondal, IIT Kharagpur https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_ge08
3. NPTEL3, Innovation, Business Models and Entrepreneurship, By Prof. Rajat Agrawal, Prof. Vinay Sharma, IIT Roorkee : https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg63
4. NPTEL4, Patent Drafting for Beginners, By Prof. Feroz Ali IIT Madras : https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_hs04
5. NPTEL5, Intellectual Property Rights and Competition Law, By Prof. KD Raju, Prof. Niharika Sahoo Bhattacharya, IIT Kharagpur: https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg96

Course: Project Management & Business Planning			Code: 25HSM201C
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**
Tutorial	2	2	TW 50

- **Prerequisites:** Basic understanding of management principles, Fundamental knowledge of engineering project work, Basic knowledge of economics and finance, Familiarity with planning and organizational concepts

- **Course Objectives**: The objectives of the course are
  1. To introduce the concepts and methodologies of project management in engineering and business sectors.
  2. To develop skills for project planning, scheduling, monitoring, and control.
  3. To understand financial and risk aspects associated with project management.
  4. To provide knowledge about entrepreneurship and business planning.
  5. To enable students to prepare and evaluate comprehensive business plans.

- **Course Outcomes:** After successful completion of course, students will be able to:

CO1: Explain the fundamentals, life cycle, and organizational aspects of project management.
CO2: Apply project planning and scheduling techniques such as WBS, CPM, and PERT.
CO3: Analyze project costs, budgeting methods, and risk management strategies.
CO4: Identify business opportunities and develop feasible business models.
CO5: Prepare and evaluate a complete business plan for new ventures or engineering projects.

- **Course Contents:**

Unit I	Introduction to Project Management	6 Hours

Definition and characteristics of a project, Concept and importance of project management, Types of projects (engineering, infrastructure, IT, industrial), Project life cycle: initiation, planning, execution, monitoring, and closure, Project stakeholders and their roles, Project management knowledge areas, Role and responsibilities of a project manager, Organizational structures for project management (functional, matrix, projectized), Overview of project management tools and techniques.

Unit II	Project Planning and Scheduling	6 Hours

Project planning process, Work Breakdown Structure (WBS) and task identification, Activity sequencing and dependency relationships, Project scheduling techniques, Gantt charts and milestone charts, Network diagrams and project network analysis, Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), Resource allocation and resource levelling, Project scheduling software tools overview

Unit III	Project Cost & Risk Management	6 Hours

Project cost estimation techniques, Budget preparation and financial planning, Project financing and funding sources, Cost control and cost performance monitoring, Earned Value Management (EVM) concept, Risk identification and classification, Risk assessment and analysis methods, Risk mitigation and contingency planning, Quality management in projects, Project monitoring, evaluation, and control techniques

Unit IV	Business Planning and Entrepreneurship	6 Hours

Introduction to entrepreneurship and innovation, Characteristics of successful entrepreneurs, Identification of business opportunities, Business idea generation and screening, Feasibility analysis (technical, economic, market feasibility), Market research and demand analysis, Product and service planning, Business model development, Legal requirements and regulatory framework for starting a business

Unit V	Business Plan Preparation and Evaluation	6 Hours

Structure and components of a business plan, Executive summary preparation, Marketing plan and competitive analysis, Operations and production planning, financial planning (cost, revenue, profit projections), Break-even

analysis and financial feasibility, Funding sources and venture capital, Business plan presentation and pitching, Evaluation of business proposals, Case studies of successful startups and business ventures

- **Course activities for term work evaluation:**

1. **Project Planning and Scheduling Activity**
   Students prepare a Work Breakdown Structure (WBS), Gantt chart, network diagram, and project schedule for a small engineering or business project using practical examples.
2. **Case Study on Project Management and Risk Analysis**
   Students analyze real-life engineering or business projects focusing on project planning, cost estimation, risk management, delays, and corrective actions.
3. **Hands-on Activity using Project Management Tools**
   Students use project planning tools/software to perform CPM, PERT, resource allocation, scheduling, and project tracking activities.
4. **Business Plan Development and Presentation**
   Students prepare and present a business plan including market analysis, feasibility study, budgeting, marketing strategy, and financial projections.
5. **Mini Project on Entrepreneurship and Business Feasibility**
   Students identify a startup/business idea and conduct feasibility analysis covering technical, economic, operational, and financial aspects.

- **Textbooks:**

1. Project Management: A Managerial Approach – Jack R. Meredith, Samuel J. Mantel Jr., Scott M. Shafer, John Wiley & Sons, 9th / 10th / 11th Edition,
2. Project Management in Practice –Jack R. Meredith, Samuel J. Mantel Jr., Scott M. Shafer, Margaret M. Sutton, John Wiley & Sons,6th / 7th Edition,Year: 2020

- **Reference Books:**

1. Project Management: A Systems Approach to Planning, Scheduling, and Controlling –: Harold Kerzner
   Publisher: John Wiley & Sons,12th Edition, 2017.
2. Operations Management – William J. Stevenson, Publisher: McGraw-Hill Education,Edition: 13th Edition.
3. Business Plan Preparation: Entrepreneurship Development –, S. S. Khanka Publisher: S. Chand Publishing.
4. Entrepreneurship Development and Small Business Enterprises –: Poornima M. Charantimath Publisher: Pearson Education.

- **MOOC / NPTEL Courses/Online Resources:**

1. Introduction to Project Management: Principles & Practices By Dr. Nimisha Singh, Quality Council of India: https://onlinecourses.swayam2.ac.in/e-learning/preview/imb25_mg80
2. Business Planning and Project Management by Dr. Ravi Ahuja, SPPU, Pune: https://onlinecourses.swayam2.ac.in/e-learning/preview/cec23_mg06
3. Project Management By Prof. Ramesh Anbanandam, IIT Roorkee: https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_mg01
4. Project Management: Planning, Execution, Evaluation and Control by By Prof. Sanjib Chowdhury, IIT Kharagpur: https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_mg78
5. Project Planning & Control, By Prof. Koshy Varghese, IIT Madras: https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ce91

Course: Financial Management for Engineers			Code: 25HSM201D
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**
Tutorial	2	2	TW 50

- **Prerequisites:** Basic knowledge of Engineering Mathematics, Fundamentals of Economics and Accounting, Analytical and quantitative reasoning skills

- **Course Objectives:** The objectives of the course are
  1. To introduce the principles and scope of financial management for engineering professionals
  2. To enable students to interpret and analyze financial statements.
  3. To develop ability to evaluate engineering investments using capital budgeting techniques.
  4. To understand cost of capital and financing decisions in organizations.
  5. To apply financial tools for techno-economic evaluation of engineering projects.

- **Course Outcomes:** At the end of the course, students will be able to:
  - CO1: Understand fundamental concepts of financial management and its role in engineering organizations.
  - CO2: Analyze financial statements and evaluate financial performance.
  - CO3: Apply capital budgeting methods for evaluating engineering investment decisions.
  - CO4: Evaluate cost of capital and capital structure decisions.
  - CO5: Apply working capital and financial planning concepts for engineering projects.

- **Course Contents:**

Unit I	**Introduction to Financial Management**	**6 Hours**

Role and scope of financial management in engineering organizations, Financial environment, financial markets and institutions, Time value of money: present value, future value, annuity concepts Financial statements: balance sheet, income statement and cash flow statement, Ratio analysis and financial performance indicators

Unit II	**Cost of Capital and Capital Structure**	**6 Hours**

Concept and importance of cost of capital, Cost of debt, equity and preference capital, Weighted average cost of capital (WACC), Capital structure theories: Net income approach, Net operating income approach, Modigliani–Miller theory, Leverage analysis: operating leverage, financial leverage and combined leverage

Unit III	**Capital Budgeting**	**6 Hours**

Nature and significance of capital budgeting, Cash flow estimation for engineering projects, Investment evaluation methods: Payback period, accounting rate of return, Discounted cash flow methods: Net present value (NPV), Internal rate of return (IRR), Profitability index, Risk and uncertainty in capital budgeting

Unit IV	**Working Capital Management**	**6 Hours**

Concept and importance of working capital, Operating cycle and cash conversion cycle, Management of cash, receivables and inventory, Short term financing sources, Working capital policies and risk–return trade-off

Unit V	**Financial Decision Making in Engineering Projects**	**6 Hours**

Techno-economic feasibility analysis, Project financing and financial planning, Budgeting and cost control techniques, Break-even analysis and sensitivity analysis, Introduction to financial modelling using spreadsheets

- **Course activities for term work evaluation:**

1. **Financial Statement Analysis Activity**
   Students analyze balance sheets, income statements, and cash flow statements of companies and interpret financial performance using ratio analysis.
2. **Case Study on Capital Budgeting Decisions**

Students evaluate engineering investment projects using Payback Period, NPV, IRR, and Profitability Index methods and recommend suitable decisions.

3. **Hands-on Activity using Financial Spreadsheet Tools**
   Students perform budgeting, break-even analysis, sensitivity analysis, and financial modelling using spreadsheet software.
4. **Mini Project on Working Capital Management**
   Students study working capital practices of an industry or business and prepare a report on inventory, receivables, cash management, and short-term financing.
5. **Presentation on Financial Decision Making in Engineering Projects**
   Students prepare and present techno-economic feasibility analysis, project financing methods, cost control strategies, and risk-return evaluation for engineering projects.

- **Textbooks:**
  1. Prasanna Chandra – Financial Management: Theory and Practice, McGraw Hill.
  2. I. M. Pandey – Financial Management, Vikas Publishing.
  3. Eugene F. Brigham and Michael C. Ehrhardt – Financial Management: Theory & Practice, Cengage Learning.

- **Reference Books:**
  1. Brealey, Myers and Allen – Principles of Corporate Finance, McGraw Hill.
  2. Van Horne & Wachowicz – Fundamentals of Financial Management, Pearson.
  3. Jonathan Berk and Peter DeMarzo – Corporate Finance, Pearson.
  4. Ross, Westerfield and Jordan – Fundamentals of Corporate Finance, McGraw Hill.

- **MOOC / NPTEL Courses/Online Resources:**
  1. Financial Management for Managers by Prof. Anil K. Sharma, IIT Roorkee : https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_mg31
  2. Corporate Finance by Prof. Abhijeet Chandra, IIT Kharagpur: https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg93
  3. Foundations of Accounting & Finance By Prof. Arun Kumar Gopalaswamy, IIT Madras: https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_ec01
  4. Working Capital Management By Prof.Anil K. Sharma, IIT Roorkee: https://onlinecourses.nptel.ac.in/e-learning/preview/noc19_mg40
  5. Engineering Economic Analysis By Prof. Pradeep Kumar Jha, IIT Roorkee: https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_me98

Course: Universal Human Values			Code: 25VEC201	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Tutorial	2	2	TW	50

- **Prerequisites:** The course requires openness to self-reflection and willingness to understand ethical and value-based perspectives in personal and professional life.

- **Course Objectives:**
  1. To help students understand the importance of human values in personal and professional life.
  2. To develop ethical awareness and responsible decision-making.
  3. To create harmony between individual, society, and nature.
  4. To encourage engineers to contribute towards sustainable and value-based development.

- **Course Outcomes:** At the end of the course, students will be able to

  CO1: Explain the concept of human values and self-exploration, and recognize their importance in personal life, professional life, and the role of engineers in society.

  CO2: Understand the importance of sustainable development, environmental responsibility, and ecological balance, and evaluate the impact of technology on society and nature.

  CO3: Apply values such as trust, respect, empathy, and responsibility to maintain harmony in family and society and practice ethical behavior in social interactions.

  CO4: Demonstrate professional ethics, value-based decision making, leadership, and teamwork in engineering practice for the welfare of society.

  CO5: Understand the relationship between self and body, differentiate their needs, and develop self-awareness and balanced lifestyle practices for personal well-being.

- **Course Contents:**

Unit I	Introduction to Human Values	6 Hours

Meaning and importance of human values, Basic needs of values, need for value based education in Engineering, Types of Human Values, Importance of human values to full fill happy and successful life, Values in personal life and professional life,, Factors affecting human values- Cultural, societal factors, personal factors , experiences, Concept of self-exploration, How to cultivate both values and skill in person's life that navigate him to face life's challenges and opportunities, Role of Engineer in society. Technology and values.

Unit II	Harmony in Nature	6 Hours

Understanding of harmony in Nature, Four orders of nature, Physical, Bio, Animal, Human order, interconnectedness and mutual fulfilment among four orders. Basic characteristic of nature, perseverance, bravery, Generosity, recyclability and self-regulation in nature, Holistic perception of harmony at all levels of existence, human being as a cause of imbalance in nature-pollution, depletion of resources, and role of technology in nature. Understanding existence of human being as a co-existence of mutually interacting units -in all pervasive space. Sustainable development, Environmental responsibility, Resource conservation, Ecological balance, Technology and its impact on society.

Unit III	Harmony in Family and Society	6 Hours

Family as the basic unit of society: role of family in developing values, mutual understanding, and responsibility. Values in relationships: trust, respect, affection, care, guidance, and gratitude in maintaining harmony in family and society. Ethical behaviour in society: honesty, responsibility, empathy, cooperation, and respect for diversity in social interactions.

Social harmony and responsible citizenship: duties and responsibilities of individuals towards society and community. Professional ethics and social responsibility: role of engineers and professionals in promoting ethical practices and sustainable development. Role of values in building a harmonious society: importance of value-based decision making in personal, social, and professional life.

Unit IV	Holistic Development and Professional Ethics	6 Hours

Holistic approach to life and education: integration of intellectual, emotional, ethical, and social development for balanced personal and professional growth. Human values and ethical principles: understanding honesty, integrity, empathy, responsibility, and respect in personal and social life. Professional ethics: ethical conduct in professional practice, integrity in work, accountability, and commitment to societal welfare. Ethical decision making: identifying ethical dilemmas and applying value-based reasoning in professional situations. Social and environmental responsibility of professionals: contribution of engineers and professionals towards sustainable development and societal well-being. Role of values in leadership and teamwork: importance of trust, cooperation, and ethical behaviour in professional environments.

Unit V	Harmony Between Self and Body	6 Hours

Understanding the Self and the Body: distinction between the conscious self (I) and the physical body. Self–body coexistence: relationship between the self as the experiencer and the body as the instrument of action. Needs of the self and the body: physical needs (food, rest, health) and psychological needs (happiness, values, purpose). Harmony in the individual: maintaining balance between mental well-being and physical health through responsible living. Role of self-awareness and self-regulation: understanding thoughts, emotions, and behaviour for a balanced life. Importance of healthy lifestyle: discipline, proper habits, and value-based living for overall well-being.

- **Activities for term work Evaluation:**
  1. Group Discussion on Human Values and Ethics
  2. Case Study Analysis on Ethical Issues in Society and Profession
  3. Reflective Journal Writing on Self-Development and Values
  4. Role Play / Skit on Social Responsibility and Moral Values
  5. Debate on Contemporary Ethical and Social Issues
  6. Community Service / Social Outreach Activity Report
  7. Seminar / Presentation on Professional Ethics and Leadership
  8. Essay Writing on Family Values, Harmony, and Responsibility
  9. Participation in Workshops, Expert Talks, and Value-Based Activities

- **Textbooks:**
  1. R. R. Gaur, R. Sangal, and G. P. Bagaria, A Foundation Course in Human Values and Professional Ethics, Excel Books, New Delhi.
  2. R. R. Gaur, R. Sangal, and G. P. Bagaria, Universal Human Values – Understanding Harmony AICTE / Excel Books.

- **Reference Books:**
  1. Mike W. Martin and Roland Schinzinger, Ethics in Engineering McGraw Hill.
  2. Charles B. Fleddermann, Engineering Ethics Pearson.

- **MOOC / NPTEL Courses:**

1. Exploring Human Values – Visions of Happiness and Perfect Society by Prof. A. K. Sharma, IIT Kanpur: https://nptel.ac.in/courses/109104068
2. Moral Thinking – An Introduction to Values and Ethics by Prof. Vineet Sahu, IIT Kanpur: https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_hs169
3. Human Values and Professional Ethics By Dr. Kounsar Jan, Deptt of education University of Kashmir: https://onlinecourses.swayam2.ac.in/e-learning/preview/imb26_mg125
4. Universal Human Values by Reliance Foundation Skilling Academy: https://www.skillindiadigital.gov.in/courses/detail/d7db86f0-d2d8-42aa-a8c0-502467563b5a

Course: Community Engagement Project				Code: 25ETELC201
Teaching Scheme (Hrs/Week)		Credit	Evaluation Scheme	
Practical	2Hrs/Week	1	Term Work	Marks: 25

- **Prerequisites:**

1. It is an experiential learning approach that combines community service, community development, education and learning.
2. Project involves students in community development and service activities and applies the experience to personal and academic development.
3. The targeted contribution of college students to the village/local development will benefit the community.

- **Course Objectives:** The course aims to:

1. Establish a mutually beneficial relationship between the college and the community.
2. Opportunities to engage with their local community, fostering empathy, teamwork, and problem-solving skills while contributing positively to their surroundings.
3. An understanding of the challenges faced by the local community and the role of engineering in addressing those challenges.
4. The ability to apply technical knowledge and skills to design solutions or interventions that create a positive impact on the community.
5. The skills to evaluate and critically analyze the outcomes of their engagement activities, deriving actionable insights for sustainable impact

- **Course Outcomes:** At the end of the course, students will be able to:

CO1 - Identify and Analyze local community needs and challenges by engaging with stake- holders and evaluating real-world problems.
CO2- Design and Implement practical, creative, and context-specific solutions using engineer- ing principles to address community issues.
CO3 - Reflect and Evaluate the effectiveness of their interventions and articulate lessons learned through reports and presentations.

- **Guidelines:**

1. A group of 3 to 4 students or a single student could be assigned for a particular habitation or village or municipal ward, as far as possible, in the near vicinity of their place of stay/college premise.
2. Each group is allotted to a faculty member of the department as a mentor.
3. The group of students will be associated with a government official / village authorities /NGOs etc. concerned, allotted by the district administration, during the duration of the project.
4. The Community Engagement Project should be different from the regular programmes of NSS/NC-C/Green Club/Hobby Clubs, Special Interests Groups etc.
5. An activity book has to be maintained by each of the students to record the activities undertak- en/involved and will be countersigned by the concerned mentor/HoD.
6. Project report shall be submitted by each student/group of students.
7. An internal evaluation shall also be conducted by a committee constituted by the HoD.
8. Evaluation to be done based on the active participation of the student and marks could be awarded by the mentor/HoD.
9. Students' groups can conduct an awareness programme on Health and Hygiene or in Organic Farming or in Fisheries or in advocating prohibition of liquor or about renewable energy, e- waste management or any other activity in an area of their studies and as per his/her aptitude.

- **List of topics:**

The below lists are not exhaustive and open for HoD's or mentors to add, delete or modify. It is expected that the focus should be on specific local issues in their nearby areas. The students are expected to carry out these projects with involvement, commitment, responsibility and accountability. The mentors of a student/group of students shall.

- Use and/or miss-use of cell phones
- Career orientation of youth
- Water facilities and drinking water availability
- Health and hygiene of the school going students, home makers and old personals
- Health intervention and awareness programmes
- Horticulture Herbal and Nutrition
- Traditional and Modern health care methods
- Food habits
- Air /Sound /Water pollution
- Plantation and Soil protection
- Renewable energy and Solar Systems
- Yoga awareness and practice
- Health care awareness programmes and their impact
- Organic farming, IoT implementations
- Food adulteration
- Incidence of Diabetes and other chronic diseases
- Blood groups and blood levels
- Chemicals in daily life
- Music and dance
- Women education and empowerment

Project Scope:

- Conduct workshops or awareness drives on topics like digital literacy, environmental sustain- ability, mental health, or career planning for local stakeholders.
- Develop a simple prototype or solution that addresses a real-world problem (e.g., a water-saving device, simple mobile apps, or tools for community use).
- Organize clean-up drives, tree plantations, recycling campaigns, or energy conservation initiatives.
- Promote health through awareness programs on hygiene, nutrition, and exercise.
- Teach basic computer or technical skills to students, staff, or the community

Text Books:

1. Waterman, A. Service-Learning: A Guide to Planning, Implementing, and Assessing Student Projects. Routledge, 1997.

2. Beckman, M., and Long, J. F. Community-Based Research: Teaching for Community Impact. Stylus Publishing, 2016.

MOOC / NPTEL/YouTube Links:

Ecology and Society https://onlinecourses.nptel.ac.in/noc20_hs77/preview

Web Links:

1. UNESCO: Education for Sustainable Development https://www.unesco.org
2. EPICS (Engineering Projects in Community Service) https://engineering.purdue.edu/EPICS
3. Ashoka: Innovators for the Public https://www.ashoka.org
4. Design for Change https://www.dfcworld.com

SEMESTER-IV

Course: Signals & Systems			Code: 25ETPCC204	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	3	3	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:**
  Basic Mathematics (Calculus, Linear Algebra, Trigonometry and Exponential Functions) and Basic Electronics Engineering (for systems analysis)

- **Course Objectives:** The course aims to:

1. Introduce the concept and classification of signals and systems in both continuous-time (CT) and discrete-time (DT) domains.
2. Develop understanding of time-domain analysis of signals and systems.
3. Analyze Linear Time-Invariant (LTI) systems using convolution and system properties.
4. Understand frequency-domain representation of signals using Fourier analysis.
5. Apply Laplace Transform and Z-Transform for system analysis in CT and DT domains.

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

CO1: Compute operations on signals by classifying basic signals and systems
CO2: Apply the knowledge of system classification and impulse response to find input output relation of LTI system using convolution
CO3:Execute the CT signals in frequency domain using Fourier Transform
CO4: Analyze the DT signals in frequency domain using Discrete Fourier Transform
CO5: Analyze the DT system using Z Transform

- **Course Contents:**

Unit I	**Introduction to Signals & Systems**	**8 Hours**
Introduction to signals, Elementary signals, Continuous-time and discrete-time signals, Basic signal operations , classification of signals, Introduction to systems, System properties		
Unit II	**Time Domain Analysis of LTI Systems**	**8 Hours**
Linear Time-Invariant (LTI) systems, Impulse response and system representation, Convolution integral & convolution sum, Properties of convolution, Interconnection of LTI systems, Difference and differential equation representation of systems		
Unit III	**Fourier Analysis of Signals**	**8 Hours**
Fourier Transform (FT), Fourier Transform of common signals, Properties of Fourier Transform, Frequency Response.		
Unit IV	**Discrete-Time Frequency Domain Analysis**	**9 Hours**
DTFS, DTFT, Discrete Fourier Transform (DFT), Properties of DFT, Frequency Response, FFT, Radix 2 DIT, DIF algorithm.		
Unit V	**Z Transform**	**9 Hours**
Z-Transform, Region of Convergence (ROC), Properties of Z-Transform, Inverse Z-Transform, System analysis using Z-Transform, Stability and causality in Z-domain		

• Continuous Comprehensive Assessment (Any Two)		20 Marks
CCA1	**List of Course Activity**	**10Marks**

1.**Signal Visualization using MATLAB/Python**
- Generate and visualize elementary CT and DT signals such as unit step, impulse, ramp, exponential and sinusoidal signals.
- Study operations like time shifting, scaling, folding, and amplitude scaling.

2.**Audio Signal Analysis using Fourier Transform**
- Record a speech/music signal and analyze its frequency spectrum using Fourier Transform.
- Compare frequency components of speech and musical signals.

3.**Convolution based System Simulation**
- Simulate convolution of input signals with impulse responses using MATLAB/Python.
- Observe the response of LTI systems for different inputs.

4.Mini Project on Digital Signal Processing Applications
- Develop a simple DSP application such as noise removal, echo generation, or audio filtering.

5.**Frequency Response Analysis of Filters**
- Study and compare low-pass, high-pass, band-pass, and band-stop filters using Fourier analysis.

6.Implementation of FFT Algorithm
- Implement Radix-2 DIT/DIF FFT algorithm and compare computational complexity with DFT.

7.Z-Transform based Stability Analysis
- Analyze stability and causality of discrete-time systems using pole-zero plots.

8.Real-Time Signal Acquisition using Sensors
- Acquire real-world signals from sensors (temperature/sound/light) using Arduino or similar platform and analyze them.

CCA2	**Case Study/Survey**	**10Marks**

List of Case Study Topics:

1.Applications of Signals and Systems in Communication Engineering
- Study signal transmission, modulation, and filtering in communication systems.

2.Speech Processing Systems
- Analyze how signals and transforms are used in speech recognition and voice assistants.

3.Biomedical Signal Processing
- Study ECG/EEG signal acquisition and analysis using Fourier methods.

4.Image and Video Compression Techniques
- Understand the role of DFT and FFT in JPEG/MPEG compression.

5.Noise Reduction Techniques in Audio Systems
- Study practical filtering methods used in audio and mobile communication systems.

6.Applications of DSP in Radar and Sonar Systems
- Explore signal detection and processing techniques used in defense applications.

7.System Stability Analysis using Z-Transform
- Study practical applications of pole-zero analysis in control and DSP systems.

List of Surveys:

1.Survey on Applications of Fourier Transform in Daily Life

- Applications in mobile phones, Wi-Fi, image processing, and medical diagnosis.

2.Survey on DSP Processors and Modern Embedded Systems

- Compare DSP processors used in smartphones, automotive systems, and IoT devices.

3.Survey on Audio and Video Streaming Technologies

- Study signal compression and transmission methods used in OTT platforms.

4.Survey on AI Applications using Signal Processing

- Explore use of signal processing in AI-based speech and image recognition systems.

5.Survey on Communication Technologies

- Study 4G/5G communication systems and role of signal processing techniques.

6.Survey on Biomedical Instruments

- Analyze use of signals and systems concepts in medical instruments like ECG, MRI, and EEG.

CCA3	Group Discussion / Seminar / Blog Writing	10 Marks

List of Group Discussion Topics:

1.Importance of Signal Processing in Modern Technology
2.Analog Signals vs Digital Signals
3.Role of Fourier Transform in Communication Systems
4.Applications of DSP in Artificial Intelligence
5.Impact of 5G Technology on Signal Processing
6.Signal Compression Techniques in Multimedia Systems

List of Seminar Topics:

1.Applications of Fourier Transform in Engineering
2.Digital Signal Processing in Healthcare Systems
3.FFT Algorithms and their Engineering Applications
4.Signal Processing in Wireless Communication
5.Biomedical Signal Analysis using DSP
6.Real-Time DSP Applications in Robotics and Automation
7.Role of Z-Transform in Discrete-Time System Analysis

List of Topics for Blog Writing:

1.How Signals and Systems are Used in Smartphones
2.Fourier Transform: The Backbone of Modern Communication
3.Applications of DSP in Music and Audio Processing
4.Signal Processing Techniques in Medical Diagnosis
5.Understanding FFT and its Real-Life Applications
6.Role of Signals and Systems in Artificial Intelligence
7.Digital Communication and Signal Processing in 5G Networks

- **Text Books:**

1. Simon Haykins and Barry Van Veen, Signals and Systems, Wiley India, 2nd Edition.
2. A. V. Oppenheim, A. S. Willsky, "Signals and Systems", Pearson, 2nd Edition.
3. B. P. Lathi, "Linear Systems and Signals" Oxford University Press, 2nd Edition

- **Reference Books:**

1. Nagoor Kanni Signals and Systems, Mc Graw Hill, 2nd Edition
2. John G. Proakis and Dimitris G. Manolakis, "Digital signal Processing: Principles, Algorithms, and Applications", 4th Edition. Sept. 2007.
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.

4. Charles Phillips, Signals, Systems and Transforms, Pearson Education, 3rd Edition.
5. P Ramesh Babu and R Anandanatarajan, Signals and Systems, Scitech, 4th Edition
6.P. Ramesh Babu, Digital Signal Processing, Scitech, 7th Edition

- **MOOC / NPTEL/YouTube Links:**
  1. NPTEL Course **"Principles of Signals & System":** https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ee37
  2. Lecture Series on, **"Signals & Systems":** http://www.nptelvideos.in/2012/12/signals-and-system.html

Course: Principles of Communication Systems			**Code:25ETPCC205**	
Teaching Scheme (Hrs./Week)		**Credit**	**Evaluation Scheme**	
Lecture	3	3	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:**
  Basic Electronics Engineering

- **Course Objectives:**

1. To equip/ familiarize students with basic fundamentals of communication systems.
2. To acquaint the students with the fundamental principles of modulation process and different amplitude and angle modulation systems.
3. To introduce the students with the concept of Sampling theorem and pulse modulation techniques
   PAM, PWM, PPM.
4. To impart pre-requisites of digital communication systems and explore digital representation techniques like PCM, DPCM, DM and ADM.

Course Outcomes: At the end of the course, students will be able to:
CO1: Describe the fundamentals of communication systems.
CO2: Apply amplitude modulation and demodulation techniques to analyze AM system performance.
CO3: Apply frequency modulation and demodulation techniques to analyze FM system performance.
CO4: Examine analog to digital conversion techniques and execute pulse modulation schemes for digital Communication systems.
CO5: Identify and Interpret real-world applications of communication systems.

- **Course Contents:**

Unit I	**Fundamentals of Communication System**	**9 Hours**

Introduction to Communication System, Block Diagram of Communication System, Types of Communication System: Analog, Digital, Wired and Wireless, Regenerative repeaters, Types of Noise: External and Internal, Noise Calculations , Noise Figure, Concept of baseband and bandpass signals, Signal Energy and Energy Spectral Density, Signal Power and Power Spectral Density .

Unit II	**Amplitude Modulation and Demodulation Techniques**	**9 Hours**

Need of Modulation, Amplitude Modulation (AM), Types of AM, Modulation Index, Spectrum of AM, Double Sideband Suppressed Carrier (DSB-SC) Modulation, Single Sideband Modula- tion (SSB), Vestigial Sideband Modulation (VSB), Power Efficiency, Envelope Detection, AM receiver.

Unit III	**Frequency modulation and demodulation Techniques**	**8 Hours**

Concept of FM, Modulation index, Spectrum, bandwidth, power and Relationship between Phase Modulation (PM) and Frequency modulation, features of Bessel coefficient, Narrow band and wideband FM, FM modulator and demodulator-FM generation by Armstrong 's method, FM detection using PLL.

Unit IV	Pulse Modulation Techniques	7 Hours
Need of analog to digital conversion, sampling theorem, Nyquist criteria, Types of sampling: Natural and Flat top. Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM) and Pulse Position Modulation (PPM)- Generation and Detection.		
Unit V	**Digital Representation of Analog Signals**	**7 Hours**
Quantization of Signals: Quantization error, Uniform & Non-Uniform types of Quantization, Mid-rise & Mid-tread Quantizer. Companding: A-law & μ-law. Pulse Code Modulation system: Generation & Reconstruction, Differential Pulse code modulation, Delta Modulation, Adaptive Delta Modulation.		

• **Continuous Comprehensive Assessment (Any Two (CCA1 Compulsory)**		**20 Marks**
CCA 1	**List of Course Activity (Any One)**	**10 Marks**
1. Mini project – To build AM Transmitter 2. Mini project – To build FM Transmitter		
CCA 2	**Case Study/Group Discussion/Seminar**	**10 Marks**
1) Television Evolution 2) Advancement in communication (wired to wireless)		
CCA 3	**Group Discussion/Seminar**	**10 Marks**
Any topic from unit 1 to 5		

Text Books:

1. Taub, Schilling and Saha, “Principles of Communication Systems”, McGraw-Hill, 4th Edition.
2. B P Lathi, Zhi Ding, “Modern Analog and Digital Communication System”, Oxford University Press.

- **Reference Books:**

1. Bernard Sklar and Prabitra Kumar Ray, “Digital Communications Fundamentals and Applications”, Pearson Education 2nd Edition.
1. George Kennedy, Benard Davis, S R M Prasanna, “Electronic Communication Systems”, McGraw Hill Education.
3. Wayne Tomasi, “Electronic Communications System”, Pearson Education, 5th Edition.
4. A.B Carlson, P B Crully and J C Rutledge, “Communication Systems”, Tata McGraw Hill Publication, 5th Edition.
5. Simon Haykin, “Communication Systems”,John Wiley & Sons, 4th Edition.

- **MOOCS/NPTEL:**

1. NPTEL course on Principles of Communication Systems - I, IIT Kanpur by Prof. Aditya Jagannatham: https://nptel.ac.in/courses/108104091
2. NPTEL course on **Principles of Communication Systems – II by** Prof. Aditya K. Jagannatham|IIT Kanpur: https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_ee73

Course: Control Systems			Code: 25ETPCC206	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	3	3	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:**

- **Course Objectives:**
  1. To understand the fundamental concepts, terminology, and mathematical modelling techniques used in control systems.
  2. To analyse the time-domain performance of first and second-order control systems and evaluate steady-state behaviour.
  3. To determine system stability using classical stability analysis techniques such as Routh-Hurwitz criterion and Root Locus.
  4. To interpret frequency response characteristics and represent control systems using state-space models.
  5. To explore modern industrial control techniques including PLC-based automation, sequence control, and emerging AI-based control strategies.

- **Course Outcomes:** At the end of the course, students will be able to:

CO1: Determine the transfer function of control systems using mathematical modeling, block diagram reduction, and signal flow graph techniques.

CO2: Analyze the transient and steady-state performance of first and second-order systems using time-domain specifications and error constants.

CO3: Apply Routh-Hurwitz criterion and Root Locus techniques to determine the stability of the control systems.

CO4: Evaluate the performance and stability of control systems using Bode plots and also by formulating state-space models for dynamic system analysis.

CO5: Apply PLC-based automation techniques by evaluating the role of conventional and advanced controllers in industrial control systems.

- **Course Contents:**

Unit I	Introduction to Control System	8 Hours

Basic Control System Terminologies and Classifications. Transfer function of Electric systems, Transfer function using Block diagram reduction techniques and Signal flow graph. Self-study: Standard test inputs for time domain analysis.

Unit II	Time domain Analysis	8 Hours

Transient analysis and time domain specifications of first and second order systems. Time domain specifications of second order under damped system from its step response. Steady state response - Steady state error and static error constants. Self-study: concept of stability absolute stability, relative stability, stability of system from pole locations.

Unit III	Stability analysis	8 Hours

Characteristic equation of a system. Routh Hurwitz stability criterion, Root locus: definition, magnitude and angle conditions, construction of root locus, concept of dominant poles, Application of root locus for stability analysis.

Unit IV	Frequency domain analysis	10 Hours

Frequency response and frequency domain specifications, correlation between time domain and frequency domain specifications, Bode plot: Determination of frequency domain specifications and stability analysis. Case study of Audio Equalizer.

State space representation: Transfer function from State space, physical variable form, phase variable forms.		
Unit V	**Controllers and Automation in Industrial Control Systems**	**8 Hours**
Introduction to Sequence Control, PLCs and Relay Ladder Logic, RLL Syntax, Structured Design Approach, RLL Programming for Traffic Light Control system, Model Predictive Control, AI-Based Controls.		

• **Continuous Comprehensive Assessment (Any two)**		**20 Marks**
CCA 1	**List of Course Activity**	**10 Marks**
Software Simulation: PLC ladder programming for any specific application 1. Automatic door opening system 2. Elevator system 3. Sequential Motor control system 4. Motor control system using timer /counter		
CCA 2	**Case Study/Survey**	**10 Marks**
List of Case Study: Case study on: 1. IoT-Based Industrial Automation System. 2. Audio Equalizer system 3. Adaptive cruise control system in car. 4. Automatic Room temperature controller. Survey: 1. Advanced modern controllers used in industry. 2. Signaling system in Metro/Trains		

- **Textbooks:**

1. N. J. Nagrath and M. Gopal, Control System Engineering, New Age International Publishers, 5th Edition.
2. K. Ogata, Modern Control Engineering, Prentice Hall India Learning Private Limited; 5th Edition.

- **Reference Books:**

1. Benjamin C. Kuo, Automatic control systems, Prentice Hall of India, 7th Edition.
2. M. Gopal, Control System Principles and Design, Tata McGraw Hill, 4th Edition.
3. Schaums Outline Series, Feedback and Control Systems Tata McGraw-Hill.
4. John J. DAzzo and Constantine H. Houpis, Linear Control System Analysis and Design, Tata McGraw-Hill, Inc.
5. Richard C. Dorf and Robert H. Bishop, Modern Control Systems, Addison Wesley

- **MOOC / NPTEL Courses:**

1. NPTEL Course on Control System by Prof. C.S.Shankar Ram IIT Madras: https://nptel.ac.in/courses/107106081
2. NPTEL Course on Control System Design by By Prof. G R Jayanth|IISc Bangalore: https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_ee65

Course: Object Oriented Programming			Code: 25COMDM202B	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	02	02	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** Fundamentals of Programming Languages, C Programming

Course Objectives:

1. Make the students familiar with basic concepts and techniques of object-oriented programming.
2. Develop an ability to write programs for problem solving.
3. Make the students familiar with Templates, Namespaces and Exception Handling concepts to write programs.

- **Course Outcomes:** At the end of the course, students will be able to:

CO1: Describe the principles of object-oriented programming.
CO2: Apply the concepts of data encapsulation, inheritance.
CO3: Understand Operator overloading and friend functions.
CO4: Apply the concepts of classes, methods inheritance and polymorphism to write programs.
CO5: Apply Templates, Namespaces and Exception Handling concepts to write programs.

- **Course Contents:**

Unit I	Foundation of Object-Oriented Programming	6 Hours

Introduction to procedural, modular, object-oriented and generic programming techniques, Limitations of procedural programming, need of object-oriented programming, fundamentals of object-oriented programming: objects, classes, data members, methods, messages, data encapsulation, data abstraction and information hiding, inheritance, polymorphism. Inline functions, Function overloading, call by value and call by reference, return by reference, functions with default arguments, this pointer, illustrative Simple Programs. Dynamic initialization of variables, memory management operators, Member dereferencing operators, operator precedence, typecast operators, Scope resolution operators.

Unit II	Classes & Objects	6 Hours

Defining class, Defining member functions, static data members, static member functions, private data members, public member functions, arrays of objects, objects as function arguments. Constructors and Destructors: types of constructors, handling of multiple constructors, destructors. (Complex Class & String Class)

Unit III	Operator Overloading	6 Hours

Fundamentals of Operator Overloading, Restrictions on Operators Overloading, Operator Functions as Class Members vs. as Friend Functions, Overloading Unary Operators, Overloading Binary Operators, Overloading of operators using friend functions.

Unit IV	Inheritance & Polymorphism	5 Hours

Introduction to inheritance, base and derived classes, friend classes, types of inheritance, hybrid inheritance, member access control, static class, multiple inheritance, ambiguity, virtual base class, Introduction to polymorphism, pointers to objects, virtual functions, pure virtual functions, abstract base class, Polymorphic class, virtual destructors, early and late binding, container classes, Contained classes, Singleton class

Unit V	Templates, Namespaces and Exception handling	5 Hours
Templates: Introduction, Function template and class template, function overloading vs. function templates Namespaces: Introduction, Rules of namespaces Exception handling: Introduction, basics of exception handling, exception handling mechanism, throwing and catching mechanism, specifying exceptions, Multiple Exceptions, Exceptions with arguments streams, stream classes, unformatted I/O, formatted I/O and I/O manipulators		

List of Activities:

Code Refactoring: Convert procedural language code into OOP style.

Basic Programs

1. Hello World: The classic first program to understand syntax and compilation.
2. Sum of Two Numbers: Input two integers and display their sum.
3. Simple Calculator: Perform addition, subtraction, multiplication, and division.
4. Even or Odd: Check whether a number is even or odd.
5. Factorial Program: Calculate factorial using loops or recursion.

Control Structures

1. Prime Number Check: Determine if a number is prime.
2. Fibonacci Series: Generate Fibonacci numbers using loops.
3. Reverse a Number: Reverse digits of an integer.
4. Palindrome Check: Verify if a number or string is a palindrome.
5. Armstrong Number: Check if a number is Armstrong (sum of cubes of digits equals the number).

Arrays & Strings

1. Array Sorting: Implement bubble sort or selection sort.
2. Matrix Addition: Add two matrices.
3. String Reversal: Reverse a string without using built-in functions.

- **Textbooks:**

1. E Balagurusamy, “Programming with C++”, Tata McGraw Hill, 3rd Edition.
2. Herbert Schildt, “The Complete Reference C++”, 4th Edition

- **Reference Books:**

1. Robert Lafore, “Object Oriented Programming in C++”, Sams Publishing, 4th Edition.
2. Matt Weisfeld, “The Object-Oriented Thought Process”, Pearson Education.

- **MOOC / NPTEL Courses:**

1. NPTEL Course on “Programming in C++” by Prof. Partha Pratim Das|IIT Kharagpur: https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_cs02

Course: Leadership and Team Dynamics			Code: 25OEC202A	
Teaching Scheme (Hrs/Week)		Credit	Evaluation Scheme	
Lecture	2	02	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** Basic communication and interpersonal skills

- **Course Objectives:** The objectives of the course are-

1. Introduce concepts of leadership, organizational behavior, and group dynamics.
2. Develop communication, interpersonal, and collaborative leadership skills.
3. Explain leadership styles, motivation theories, and team processes.
4. Enhance conflict resolution, negotiation, and decision-making abilities.
5. Prepare students for leadership roles in multicultural and multidisciplinary organizations

- **Course Outcomes:** At the end of the course, students will be able to

CO 1. Explain leadership theories, organizational behavior, and group dynamics concepts.
CO 2. Apply communication and interpersonal skills in team environments.
CO 3. Analyze leadership styles, group processes, and motivational approaches.
CO 4. Evaluate team effectiveness, conflict management, ethics, and leadership challenges.
CO 5. Develop leadership strategies for professional and global organizational environments.

- **Course Contents:**

Unit I	Foundations of Leadership and Organizational Behaviour	6 Hours
Introduction to leadership and team management, Leadership versus management , Leadership myths and leadership development , Organizational behavior fundamentals , Groups and types of groups , Stages of group development , Emotional intelligence and self-awareness		
Unit II	**Leadership Theories and Leadership Development**	**6 Hours**
Trait and behavioural leadership theories , Situational and contingency leadership models, Path-goal theory and Leader-Member Exchange (LMX) theory , Transformational and transactional leadership , Power, influence, and persuasion , Leadership ethics, values, and credibility		
Unit III	**Communication, Motivation, and Interpersonal Behaviour**	**6 Hours**
Communication process and barriers, Verbal and non-verbal communication , Social networks, rumors, and grapevine , Motivation theories and leadership , Transactional analysis and JOHARI Window , Coaching, mentoring, and feedback mechanisms		
Unit IV	**Team Dynamics and Conflict Management**	**6 Hours**
Group dynamics and team processes , Team formation and team effectiveness , Cooperation, competition, and cohesiveness , Delegation and empowerment , Conflict management and negotiation , Virtual and multicultural teams		
Unit V	**Organizational Ethics and High-Performance Leadership**	**6 Hours**
Organizational justice and ethical behavior , Corporate Social Responsibility (CSR) , Positive organizational scholarship , Building trust and credibility in teams , High-performance team development , Global leadership and leadership challenges in modern organizations		

- **List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Leadership Style Role Play**
   Students perform role plays demonstrating different leadership styles, communication approaches, and conflict management situations.
2. **Team Building & Group Dynamics Activity**
   Practical activities/games to study teamwork, cooperation, delegation, trust-building, and group decision-making.
3. **Case Study Analysis on Organizational Behaviour**
   Analyze real-life organizational situations related to motivation, leadership challenges, ethics, or team conflicts and present solutions.
4. **Communication & Negotiation Workshop**
   Hands-on practice sessions on verbal/non-verbal communication, negotiation skills, feedback mechanisms, and interpersonal behaviour.
5. **Self-Assessment & Leadership Development Report**
   Students prepare a report based on personality tests, emotional intelligence assessment, JOHARI window, or leadership skill evaluation with improvement plans.

- **Text Books:**

1. Hughes, R.L., Ginnett, R.C., & Curphy, G.J., Leadership: Enhancing the Lessons of Experience, 9th Edition, McGraw Hill Education, 2019.

- **Reference Books:**

1. Robbins, S.P., Judge, T.A. & Vohra, N., Organizational Behavior, 18th Edition, Pearson Education, 2019.
2. Parek, U. & Khanna, S., Understanding Organizational Behavior, 4th Edition, Oxford University Press, 2018.
3. Greenberg, J. & Baron, R., Behavior in Organizations, 10th Edition, Pearson-Prentice Hall, 2009.
4. Luthans, F., Organizational Behavior, 10th Edition, McGraw-Hill, 2004.
5. Cameron, K.S. & Spreitzer, G.M., The Oxford Handbook of Positive Organizational Scholarship, Oxford University Press, 2012.
6. Baron, R.A. & Byrne, D., Social Psychology, 10th Edition, Pearson Education, 2004.

- **MOOC / NPTEL Courses /Online Resources Online Resources:**

1. Organizational Behaviour: Individual Dynamics in Organization by Prof. Abraham Cyril Issac: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_mg20
2. Leadership and Team Effectiveness by Prof. Santosh Rangnekar: https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_mg39
3. Leadership & Management : https://swayam-plus.swayam2.ac.in/courses/course-details?id=F_WADHW_26
4. Harvard Business Review Leadership Resources : https://hbr.org/topic/subject/leadership-and-managing-people
5. https://www.edx.org/learn/leadership

Course: Green Practices & ESG Frameworks			Code: 25OEC202B	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	2	2	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** Basic knowledge of environmental science and sustainability, Understanding of industrial processes and resource utilization, Basic awareness of corporate management and ethics

- **Course Objectives:** The Objectives of the Course are

1. To introduce the principles of sustainability and green practices in engineering and industry.
2. To understand Environmental, Social, and Governance (ESG) frameworks used in modern organizations.
3. To analyse environmental impacts and promote sustainable resource management.
4. To study social responsibility and governance practices for sustainable development.
5. To apply ESG reporting standards and sustainability assessment tools in organizations.

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

CO1: Explain the concepts of sustainability, green practices, and ESG frameworks.

CO2: Analyse environmental impacts and adopt green technologies for sustainable development.

CO3: Evaluate social responsibility and stakeholder engagement practices in organizations.

CO4: Understand governance principles, ethical leadership, and regulatory frameworks.

CO5: Apply ESG reporting standards and sustainability assessment methods in industries.

- **Course Contents:**

Unit I	Fundamentals of Sustainability and Green Practices	6 Hours

Concept of sustainability and sustainable development, Environmental challenges: climate change, global warming, biodiversity loss, resource depletion, Principles of green practices and environmental responsibility, Green economy and circular economy concepts, Sustainable Development Goals (SDGs) and global sustainability initiatives, Sustainable consumption and production patterns, Role of engineering and technology in sustainable development, Importance of green practices in industrial and organizational activities.

Unit II	Environmental Sustainability and Green Technologies	6 Hours

Environmental sustainability and environmental protection strategies, Environmental Impact Assessment (EIA) and its importance, Carbon footprint analysis and greenhouse gas emissions, Carbon management strategies and carbon neutrality initiatives, Renewable energy technologies: solar, wind, hydro, biomass, Energy efficiency and energy conservation methods, Waste management techniques: reduce, reuse, recycle (3R concept), Water resource management and pollution control, Green manufacturing, eco-friendly materials, and cleaner production technologies

Unit III	Social Responsibility and Sustainable Development	6 Hours

Concept and importance of Corporate Social Responsibility (CSR), Employee welfare, workplace health, and safety standards, Labour rights and fair working conditions, Diversity, equity, and inclusion in organizations, Stakeholder engagement and community development initiatives, Social impact assessment and community sustainability programs, Ethical business conduct and responsible supply chain management, Role of organizations in social and economic development

Unit IV	Governance and Ethical Business Practices	6 Hours

Concept and principles of corporate governance, Governance structures and roles of board of directors, Transparency, accountability, and ethical leadership, Risk management and compliance mechanisms, Business ethics and anti-corruption policies, Legal and regulatory frameworks related to corporate governance, Sustainability governance and corporate responsibility policies, Governance practices for long-term organizational sustainability.

Unit V	ESG Reporting, Assessment, and Implementation	6 Hours

Introduction to ESG metrics and sustainability performance indicators, ESG reporting frameworks and standards, Global Reporting Initiative (GRI) guidelines, Integrated reporting and sustainability disclosure practices, ESG ratings, benchmarking, and performance evaluation, Green finance, sustainable investments, and climate finance, Implementation of ESG strategies in organizations, Challenges in ESG adoption and reporting, Case studies of ESG implementation in industries and multinational companies.

- **List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Campus Green Audit & Waste Segregation Study**
   Students conduct a sustainability audit of the campus/department by analysing waste generation, segregation practices, energy usage, and water consumption. Submit findings with improvement recommendations.
2. **Carbon Footprint Calculation Project**
   Students calculate the carbon footprint of a household, classroom, or small organization using standard carbon calculators and prepare a report suggesting carbon reduction strategies.
3. **ESG Reporting Case Analysis**
   Students select a company and study its ESG or sustainability report (based on GRI/SDG framework). Prepare a presentation evaluating environmental, social, and governance practices.
4. **Sustainable Product / Process Design Activity**
   Teams design an eco-friendly product, packaging solution, or green operational process applying principles of reduce–reuse–recycle and resource efficiency.
5. **Community Awareness & Social Responsibility Campaign**
   Organize and document an awareness activity such as tree plantation, plastic-free drive, energy conservation campaign, or social impact survey, followed by submission of outcomes and reflections.

- **Textbooks:**

1. Understanding Sustainability Principles and ESG Policies: Colin Read, Springer Nature, Year: 2023
2. The ESG and Sustainability Deskbook for Business, Kristyn Noeth, Springer, 2024

- **Reference Books:**

1. Values at Work: Sustainable Investing and ESG Reporting, Daniel C. Esty, Todd Cort, Palgrave Macmillan,Year: 2020
2. Business Responsibility and Sustainability in India, Bimal Arora, Pawan Budhwar, Divya Jyoti Publisher**:** Palgrave Macmillan,Year: 2019
3. Looking at and Beyond Corporate Governance in India,Authors**:** Seema Joshi, Ruchi Kansil Publisher**:** Springer / Palgrave MacmillanYear: 2023
4. Dharmanomics: An Indigenous and Sustainable Economic Model,Author: Sriram Balasubramanian Publisher: Bloomsbury India,Year: 2024

- **MOOC / NPTEL Courses /Online Resources Online Resources:**
  1. Sustainability through Green Manufacturing Systems An applied approach, By Prof. Deepu Philip and Prof. Amandeep Singh, IIT Kanpur: https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg85
  2. Sustainable Energy Technology By Prof. Sayak Banerjee, IIT Hyderabad: https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_me138
  3. Corporate social responsibility By Prof. Aradhna Malik, IIT Kharagpur : https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg54
  4. Implementing ESG and Sustainability in Business By Dr. Aditya Gupta, Indian Institute of Management, Bangalore: https://onlinecourses.swayam2.ac.in/e-learning/preview/imb25_mg77
  5. Business Ethics and Corporate Governance By Dr. Sweta Banerjee, Dr. Leena Dam, Sri Balaji University, Pune: https://onlinecourses.swayam2.ac.in/e-learning/preview/imb25_mg62

Course: Innovation and Business Strategy			Code: 25OEC202C	
Teaching Scheme (Hrs/Week)		Credit	Evaluation Scheme	
Tutorial	2	02	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** Basic understanding of technology, creativity, and problem-solving concepts.

- **Course Objectives:** The objectives of the course are-

1. Introduce concepts of innovation, creativity, and business strategy.
2. Develop strategic thinking and innovation management skills.
3. Explain business models, entrepreneurship, and technology innovation processes.
4. Familiarize students with sustainability, intellectual property rights, and innovation ecosystems.
5. Prepare students for innovation-driven business and entrepreneurial environments

- **Course Outcomes:** At the end of the course, students will be able to

CO 1. Explain concepts of innovation, creativity, and business strategy.
CO 2. Apply innovation management and strategic thinking tools for business problem-solving.
CO 3. Analyze business models, technology innovation, and entrepreneurial strategies.
CO 4. Evaluate sustainability, intellectual property, and innovation management practices.
CO 5. Develop innovative business solutions and strategic growth approaches.

- **Course Contents:**

Unit I	Foundations of Innovation and Creativity	6 Hours
Innovation and creativity: concepts and importance, Innovation in the current business environment , Types of innovation , Schools of innovation , Challenges of innovation , Divergent and convergent thinking		

Unit II	Innovation Management and Design Thinking	6 Hours
Innovation management process, Idea management systems, Design thinking and entrepreneurship Experimentation and prototyping , Co-creation and idea championship , Incubation and entrepreneurship ecosystems		

Unit III	Business Models and Strategic Innovation	6 Hours
Business models and value proposition , Entrepreneurship and social entrepreneurship , Blue Ocean Strategy , Strategic positioning and competitive advantage , Business model failure: reasons and remedies , Innovation-driven business growth		

Unit IV	Technology Innovation and Intellectual Property Rights	6 Hours
Technology innovation process , Technology forecasting and planning , Technological innovation management strategies , Management of innovation , Intellectual Property Rights (IPR) Patents, copyrights, and patents in India		

Unit V	Sustainable Innovation and Future Business Trends	6 Hours
Sustainability innovation and entrepreneurship, Innovation for sustainable development , SME involvement in sustainability , Material efficiency and sustainable business models , Managing investors for innovation , Future markets and innovation opportunities for India		

- **List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Innovation Idea Pitch Presentation**
   Students identify a real-world problem and present an innovative product, service, or business solution using creativity and design thinking tools.

2. **Business Model Canvas Workshop**
   Teams prepare a Business Model Canvas for a startup or sustainable business idea, explaining value proposition, customer segments, revenue streams, and competitive advantage.
3. **Prototype Development & Demonstration**
   Students create a basic prototype/mock-up of an innovative product or digital solution and demonstrate its functionality and market relevance.
4. **Case Study Analysis on Successful Innovations**
   Analyze companies known for innovation and strategy (e.g., startups or technology firms) and present factors behind their success, business strategy, and innovation practices.
5. **IPR & Patent Search Activity**
   Students perform a patent/trademark search related to a chosen innovation area and prepare a short report on intellectual property protection and commercialization opportunities.

- **Text Books:**

1. Krishnan, R.T. & Dabholkar, V., 8 Steps to Innovation: Going from Jugaad to Excellence, Harper Collins India.

- **Reference Books:**

1. Drucker, Peter F., Innovation and Entrepreneurship, Routledge.
2. Harvard Business Review Series, Innovation and Entrepreneurship, Harvard Business School Publishing.
3. Osterwalder, A. & Pigneur, Y., Business Model Generation, Wiley.
4. Kim, W. Chan & Mauborgne, Renée, Blue Ocean Strategy, Harvard Business Review Press.
5. Tidd, J. & Bessant, J., Managing Innovation, Wiley Publications.

- **MOOC / NPTEL Courses /Online Resources Online Resources:**

1. Innovation Business Models and Entrepreneurship by Prof. Vinay Sharma, Prof. Rajat Agrawal : https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_mg95
2. Entrepreneurship & IP strategy by Prof. Gouri Gargate : https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_hs213
3. Managing Innovation by Rishikesha T Krishnan and Vinay Dabholkar: https://onlinecourses.swayam2.ac.in/e-learning/preview/imb19_mg05
4. Business Strategy Specialization by University of Virginia: https://www.coursera.org/specializations/business-strategy
5. Design Thinking for Beginners: Develop Innovative Ideas (Udemy): https://www.udemy.com/course/design-thinking-for-beginners/?couponCode=PMNVD2025
6. Strategic Management Resources : https://www.hbsp.harvard.edu/catalog/collections/strategic-management-resources
7. https://www.edx.org/learn/innovation

Course: Stress Management and Mental Well Being				Code: 25OEC202D
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	2	2	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** Basic awareness about personal health, emotions, and daily life challenges.

- **Course Objectives:**
  1. To introduce the concept of stress, mental health, and wellbeing.
  2. To help students identify stressors in academic and professional life.
  3. To develop effective coping strategies and stress management skills.
  4. To promote emotional intelligence and resilience.
  5. To encourage healthy lifestyle habits for long-term wellbeing.

- **Course Outcomes:** At the end of the course, students will be able to:

  CO1: Explain the concepts of stress, mental health, and wellbeing

  CO2: Identify sources of stress and analyse their impact

  CO3: Apply stress management techniques

  CO4: Demonstrate emotional intelligence and coping strategies

  CO5: Design a personal wellbeing and stress management plan

- **Course Contents:**

Unit I	Fundamentals of Stress and Mental Health	6 Hours

Concept and definition of stress and mental wellbeing, Types of stress: Eustress and Distress, Stress response and General Adaptation Syndrome (GAS), Causes and symptoms of stress, Mind–body relationship, Impact of stress on academic performance and productivity. Difference between stress, anxiety, and depression.

Unit II	Sources of Stress and Emotional Awareness	6 Hours

Academic, professional, social, and personal stressors; Personality types and stress (Type A and Type B personality);
Emotional intelligence: Self-awareness, Self-regulation, Motivation, Empathy, Social skills; Identifying negative thinking patterns

Unit III	Stress Management Techniques	6 Hours

Relaxation techniques: Deep breathing, Progressive muscle relaxation; Meditation and mindfulness, Yoga and physical exercises for stress reduction, Time management and goal setting, Positive thinking and cognitive restructuring

Unit IV	Mental Wellbeing and Healthy Lifestyle	6 Hours

Importance of sleep, nutrition, and physical activity, managing emotions: anxiety, anger, frustration, Building resilience and self-confidence, Work–life balance, Digital wellbeing and social media stress

Unit V	Personal Development and Coping Strategies	6 Hours

Interpersonal communication and relationship management, Coping strategies for change and uncertainty, Conflict management and emotional regulation, Developing a personal wellbeing plan, Case studies on stress management in student and workplace environments.

- **List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Stress Diary & Self-Assessment Activity**
   Students maintain a weekly stress journal to identify stress triggers, emotional responses, and coping methods, followed by a reflective analysis report.
2. **Mindfulness and Relaxation Practice Session**
   Conduct guided activities such as meditation, deep breathing, yoga, or progressive muscle relaxation and submit observations on stress reduction outcomes.
3. **Case Study Analysis on Mental Wellbeing**
   Analyze real-life or workplace/student stress management cases and suggest coping strategies, emotional intelligence techniques, and wellbeing solutions.
4. **Work–Life Balance & Digital Wellness Survey**
   Students design and conduct a survey on stress, screen time, sleep, or work–life balance among peers, then present findings with recommendations.
5. **Personal Wellbeing and Stress Management Plan**
   Prepare an individual wellness plan including fitness, sleep, nutrition, time management, and emotional wellbeing strategies for long-term mental health improvement.

- **Textbooks:**

1. Leahy, Robert L. The Worry Cure. Three Rivers Press, 2006.
2. Carnegie, Dale. How to Stop Worrying and Start Living. Simon & Schuster, 1948.
3. Johnstone, Matthew. I Had a Black Dog. Robinson Publishing, 2005.

- **Reference Books:**

1. Goleman, Daniel. Emotional Intelligence: Why It Can Matter More Than IQ. Bantam Books, 1995.
2. Kabat-Zinn, Jon. Wherever You Go, There You Are: Mindfulness Meditation in Everyday Life. Hyperion, 1994.
3. Covey, Stephen R. The 7 Habits of Highly Effective People. Free Press, 1989.

- **MOOC / NPTEL Courses /Online Resources Online Resources:**

1. NPTEL course on Stress Management by Prof. Rajlakshmi Guha, IIT Kharagpur: https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_hs163
2. NPTEL course on Psychology of Stress, Health and Well-being by Prof. Dilwar Hussain, IIT Guwahati: https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_hs29

Course: French Language Module-II			Code: 25OEC202E	
Teaching Scheme (Hrs/Week)		Credit	Evaluation Scheme	
Tutorial	2	2	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** French Language Module-I

- **Course Objectives:** The objectives of the course are-
  1. To strengthen beginner-level communication skills in French.
  2. To improve listening, reading and writing abilities.
  3. To develop confidence in practical conversations.
  4. To introduce travel and public communication vocabulary.
  5. To prepare students for DELF A1 level competency.

- **Course Outcomes:** At the end of the course, students will be able to

  CO 1: Use basic French expressions confidently.
  CO 2: Understand simple dialogues and instructions.
  CO 3: Read and write short paragraphs.
  CO 4: Participate in guided conversations.
  CO 5: Apply French in practical situations.

- **Course Contents:**

Unit I	Voyages (Travel)	6 Hours
Talking about one's dream travel destination, The near future tense , Prepositions , Giving a reason (parce que / car)		
Unit II	**Au magasin… au restaurant (At the store… at the restaurant)**	**6 Hours**
Clothes and accessories , Shopping dialogues , French cuisine and some famous dishes , Restaurant communication		
Unit III	**La vie quotidienne (Daily life)**	**6 Hours**
Pronominal verbs , Talk about one's routine , Talk about one's favourite outings , Conversation to plan outings		
Unit IV	**Quand j'était petie …(When I was little…)**	**6 Hours**
Past tense (Le passé compose), Talk about some activities in the past, Past continuous (L'imparfait) Talk about one's childhood		
Unit V	**La francophonie (The French-speaking world)**	**6 Hours**
Francophone countries , Talking about seasons and climate , Expressing emotions, Conversations		

- **List of Course Activities for Continuous Comprehensive Assessment (Any Two):**
  1. **Shopping Role Play:** Students perform shopping conversations using French vocabulary and expressions.
  2. Restaurant Communication Activity: Students practice ordering food and interacting in French.
  3. Travel Conversation Simulation: Students perform dialogues related to travel and directions.

4. **Travel Conversation Simulation:** Students perform dialogues related to travel and directions.
5. **Paragraph Writing in French:** Students write short paragraphs on daily routines or hobbies.
6. **French Culture Presentation:** Students present information on French-speaking countries or traditions.

- **Text Books:**

1. Véronique M Kizirian, Emmanuelle Daill, Annie Berthet, Catherine Hugot, "Alter Ego+ (A1)", Hachette , ISBN: 9782011558107, (Goyal Publishers)
2. Nathalie Hirschsprung, Tony Tricot, "Cosmopolite 1-A1", Textbook +Workbook (2 Book Set) (Goyal Publishers), ISBN: 9788194434108

- **Reference Books:**

1. Annie Heminway, "Practice Makes Perfect: Complete French Grammar", McGraw-Hill Education, ISBN-13 : 978-1259642371
2. Claire Miquel, "Vocabulaire progressif du francais - Niveau debutant (A1)", Cle International, ISBN-13 : 978-2090380170, Bookswagon, 2/13 Ansari Road, Daryaganj, New Delhi 110002
3. Evelyne Siréjols, "Communication En Dialogues", CLE international, ISBN: 9782090380637 (Goyal Publishers)
4. Myrna Bell Rochester, "Easy French Step-By-Step: Master High-Frequency Grammar for French Proficiency—Fast", McGraw Hill, ISBN-13 : 978-0071453875
5. Claire Miquel, "Communication Progressive du Français A1", CLE International, Atlantic Publishers and Distributors (P) Ltd., 7/22, Ansari Road, Darya Ganj, New Delhi – 110002
6. Ranjit, Mahita & Singh, Monica, Apprenons le frangais', Part 2, Saraswati House Pvt. Ltd.,New Delhi. Second Revised Edition, 2007
7. Ranjit, Mahita & Singh, Monica, Cahier d'exercices', (Apprenons le francais) Part 2., Saraswati House Pvt. Ltd.,New Delhi. Second Revised Edition, 2007

- **MOOC / NPTEL Courses /Online Resources Online Resources:**

1. The Complete French Course : Learn French – Beginners : https://www.udemy.com/course/french-for-beginners-a1/?couponCode=PMNVD2025
2. Francés Introductorio: https://www.coursera.org/learn/frances-introductorio
3. Français Débutant A1 : https://www.coursera.org/learn/french-beginner
4. The Complete French Course : Learn French - Low Intermediate : https://www.udemy.com/course/the-complete-french-course-learn-french-low-intermediate/?couponCode=PMNVD2025
5. Complete French Course: Learn French for Beginners : https://www.udemy.com/course/complete-french-course/?couponCode=PMNVD2025

Course: German Language Module-II			Code: 25OEC202F	
Teaching Scheme (Hrs/Week)		Credit	Evaluation Scheme	
Tutorial	2	02	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** German Language Module-I
- **Course Objectives: The objectives of the course are-**
  1. To strengthen beginner-level communication skills in German.
  2. To improve reading, writing and listening abilities.
  3. To develop confidence in practical conversations.
  4. To introduce travel and public communication vocabulary.
  5. To prepare students for Goethe A1 level competency.
- **Course Outcomes:** At the end of the course, students will be able to

  CO 1: Use beginner-level German expressions confidently.
  CO 2: Understand simple dialogues and instructions.
  CO 3: Read and write short passages.
  CO 4: Participate in practical conversations.
  CO 5: Apply German in everyday situations.
- **Course Contents:**

Unit I	Wohnen und Leben (Housing and life)	6 Hours

Topics and Vocabulary: house (different types of houses and things inside a house), furniture , renting

Grammar: Accusative case, Definite, Indefinite articles in accusative case, Accusative case – Personal Pronouns, Accusative case – Possessive Pronouns

Skills: Speaking: describe room/home, Reading: advertisements , Writing: a message to friends to invite for celebration

Unit II	Stadt und Orientierung (City and Orientation)	6 Hours

Topics and Vocabulary: Places in city , Means of transport , Directions , Travel , Planning and hotel booking

Grammar: Types of sentences and formation- statement, interrogative sentence, imperative sentence, Past tense formation- haben, sein

Skills : Speaking: asking/giving directions, Listening: friends planning a trip, Writing: My last trip, Reading: trip blogs and experiences

Activity: Navigation task

Unit III	Essen und Trinken (Food and Drink)	6 Hours

Topics and Vocabulary: Food, Beverages, Restaurant expressions, Shopping and cooking

Grammar: Perfekt tense introduction - haben/sein, Adjectives

Skills: Reading and writing: food blogs, Speaking: ordering food, expressing likes/dislikes

Activity: café role-play

Unit IV	Gesundheit und Körper (Health and body)	6 Hours

Topics and Vocabulary: Body parts , Symptoms , Medicine ,

Grammar: Conjunctions, Modal auxiliary- function, usage, structure

Skills: Email writing/ message writing- unable to attend an event because of illness, Reading- health related small text,

Activity: doctor-patient conversations

Unit V	Intercultural Communication (Intercultural Communication)	6 Hours

Topics: German etiquette, punctuality, university culture, workplace culture

Skills: intercultural awareness , formal communication

- **List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Shopping Role Play:** Students perform shopping conversations using German vocabulary and expressions.
2. **Restaurant Communication Activity:** Students practice food ordering conversations in German.
3. **Travel Conversation Simulation:** Students perform dialogues related to travel situations and directions.
4. **Paragraph Writing in German:** Students write short paragraphs on familiar topics in German.
5. **German Culture Presentation:** Students present information about German-speaking countries and traditions.

- **Text Books:**

1. Stefanie Dengler, “Netzwerk A1 (Textbook + Workbook + Glossar)”, Hachette , ISBN: 9788183077033, (Goyal Publishers)
2. Kurs Und Ubungsbuch, “Studio-D A1 - Combo of 3 (German)”, Goyal Publishers & Distributers

- **Reference Books:**

1. Martin Durrell, “Hammer's German Grammar and Usage”, Fifth Edition: Volume 1, Hodder Education
2. Harriette Lanzer, Anne Lise Gordon, “German Vocabulary Builder”, OUP Oxford
3. Funk and Kuhn, “Studio D A1Deutsch Buch “, Cornelsen Verlag (Goyal Publishers India)

- **MOOC / NPTEL Courses /Online Resources Online Resources:**

1. DW Learn German: https://learngerman.dw.com/en/learn-german/s-9528
2. Practise German for free (Goethe-Institut Resources) : https://www.goethe.de/en/spr/ueb.html
3. Learn German Easily: https://learn-german-easily.com/
4. BBC Languages German: https://www.bbc.co.uk/languages/german/
5. Gothe Exam A1 practice material : https://www.goethe.de/ins/mm/en/spr/prf/gzsd1/ueb.html
6. Best Way to Learn German Language: Full Beginner (A1.1): https://www.udemy.com/course/best-way-to-learn-german-full-beginner-starter-kit/?couponCode=PMNVD2025
7. Best Way to Learn German Language: Beginner Level 2 (A1.2) : https://www.udemy.com/course/learn-german-for-the-advancing-beginner-a1-a2/?couponCode=PMNVD2025

Course: Japanese Language Module-II			Code: 25OEC202G	
Teaching Scheme (Hrs/Week)		Credit	Evaluation Scheme	
Tutorial	2	02	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** Japanese Language Module-I

- **Course Objectives:**
  1. To strengthen beginner-level Japanese communication skills.
  2. To improve reading and writing abilities in Japanese.
  3. To develop confidence in practical conversations.
  4. To introduce travel and public communication vocabulary.
  5. To prepare students for JLPT N5 level competency.

- **Course Outcomes:** At the end of the course, students will be able to

  CO1. Use beginner-level Japanese expressions for effective communication.

  CO2. Interpret short dialogues and passages in Japanese.

  CO3. Read and write basic Japanese sentences.

  CO4. Participate in practical conversations using appropriate Japanese expressions.

  CO5. Apply Japanese language skills in everyday situations.

- **Course Contents:**

Unit I	Kihon bunpō (tsudzuki) (Basic Grammar Continuation)	6 Hours
Verb forms, Adjectives, Particle usage, Question and negative forms		
Unit II	**Jissen-tekina komyunikēshon (Practical Communication)**	**6 Hours**
Shopping conversations, Travel communication, Restaurant communication , Asking directions Communication with Doctor, Kanji –Lesson 4 (Textbook 1 &2)		
Unit III	**Risuningu to supīkingu no sukiru (Listening and Speaking Skills)**	**6 Hours**
Pronunciation improvement, Listening comprehension, Dialogue practice , Group conversation Kanji –Lesson 5 (Textbook 1 &2)		
Unit IV	**Yomikaki (Reading and Writing)**	**6 Hours**
Reading short passages , Writing paragraphs , Vocabulary enhancement , Translation practice , Kanji – Lesson 6 (Textbook 1 &2)		
Unit V	**Bunka-teki oyobi shakai-teki komyunikēshon (Cultural and Social Communication)**	**6 Hours**
Japanese culture and etiquette, Social conversations, Telephone communication, Presentation activities Kanji –Lesson 7 (Textbook 1 &2)		

- **List of Course Activities for Continuous Comprehensive Assessment (Any Two):**
  1. Shopping Role Play: Students perform shopping conversations using Japanese vocabulary and expressions.

2. **Restaurant Communication Activity:** Students practice ordering food and basic interaction in Japanese.
3. **Travel Conversation Simulation:** Students perform dialogues related to travel and directions in Japanese.
4. **Paragraph Writing in Japanese:** Students write short paragraphs on daily routines or hobbies.
5. **Japanese Culture Presentation:** Students present information about Japanese traditions or festivals.

- **Text Books:**

1. 3A Corporation, "Minna No Nihongo 1-1,1-2,2-1,2.2 Main Textbook elementary", ISBN-13: 9789388141147, Goyal Publishers & Distributors Pvt. Ltd, India
2. Banno Eri, "Genki: An Integrated Course in Elementary Japanese II Textbook [third Edition]", ISBN-13 : 978-4789017329, Japan Times

- **Reference Books:**

1. The Japan Foundation, "Marugoto: Japanese Language and Culture Starter A1 Coursebook for Communicative Language Activities", Goyal Publishers
2. The Japan Foundation, "Marugoto Starter (A1) Rikai - Course Book For Communicative Language Competences", Goyal Publishers, ISBN-13: 9788183078047
3. The Japan Foundation, "Marugoto Starter (A1) Katsudoo", Goyal Publishers
4. "Japanese for Busy People,3rd edition", Association for Japanese Language Teaching, Kodansha Tokyo Japan Kodansha International, November, 2011.,
5. Tae Kim, "A Guide to Japanese Grammar: A Japanese Approach to Learning Japanese Grammar", Createspace Independent Pub, ISBN-13 : 978-1495238963, Bookswagon, 2/13 Ansari Road, Daryaganj, New Delhi 110002
6. Timothy G. Stout , Kaori Hakone, "Japanese Kanji for Beginners: (JLPT Levels N5 & N4) First Steps to Learn the Basic Japanese Characters", Tuttle Publishing UK, Verseas Press India Pvt Ltd.

- **MOOC / NPTEL Courses /Online Resources Online Resources:**

1. Online Japanese Beginner Course (Udemy): https://www.udemy.com/course/online-japanese-beginner-course
2. JF-Japanese e-learning : https://minato-jf.jp/
3. Introduction to Japanese Langauge : Prof Vatsala Misra (NPTEL) : https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_hs83
4. Learn Japanese Language: Free Online Courses: https://www.busuu.com/en/course/learn-japanese-online
5. Marugoto Online : https://www.marugoto-online.jp/info/
6. JLPT N5 Practice Material: https://www.jlpt.jp/e/samples/sampleindex.html

Course: Signals & Systems Lab			Code: 25ETPCC204L
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**
Tutorial	1	1	Oral / Marks: 25

- **Prerequisites:**
  Basic Mathematics (Calculus, Linear Algebra, Trigonometry and Exponential Functions) and Basic Electronics Engineering (for systems analysis)

- **Course Objectives:** The course aims to

1. Introduce the concept and classification of signals and systems in both continuous-time (CT) and discrete-time (DT) domains.
2. Develop understanding of time-domain analysis of signals and systems.
3. Analyze Linear Time-Invariant (LTI) systems using convolution and system properties.
4. Understand frequency-domain representation of signals using Fourier analysis.
5. Apply Laplace Transform and Z-Transform for system analysis in CT and DT domains.

Course Outcomes: At the end of the course, students will be able to:

CO1: Compute operations on signals by classifying basic signals and systems
CO2: Apply the knowledge of system classification and impulse response to find input output relation of LTI system using convolution
CO3: Execute the CT signals in frequency domain using Fourier Transform
CO4: Analyze the DT signals in frequency domain using Discrete Fourier Transform
CO5: Analyze the DT system using Z Transform

List of Tutorials

1. A) Sketch and write mathematical expression for the following signals in Continuous Time (CT) and Discrete Time (DT)
a) Sine b) Rectangular c) Triangular d) Exponential e) Unit Impulse
f) Unit Step g) Ramp h) Signum i) Sinc h) Gaussian
B) Classify and find the respective value for the above signals if applicable
a) Periodic / Non-Periodic
b) Energy / Power /Neither
c) Even and Odd signal
2. Take any two CT and DT signals and perform the following operations:
Amplitude scaling, Addition, multiplication, differentiation, integration (accumulator for DT)
Time scaling, Time folding, Time shifting
3. Express any two system mathematical expressions in input output relation form and determine whether each one of them is, Memory less, Causal, Linear, Stable, Time invariant, Invertible
4. Express any two system mathematical expressions in impulse response form and determine whether each one of them is, Memory less, Causal, Linear, Stable, Time invariant, Invertible.
5. Perform Convolution Integral of two Continuous time signals and Convolution Sum of any two Discrete Time signal. (Various Combinations can be taken for this.)
6. State and prove the various properties of CT Fourier Transform. Take rectangular and sinc signal as examples and demonstrate the applications of CTFT properties. Demonstrate the interplay between the time and frequency domain
7. State and prove the properties of Discrete Fourier Transform.
8. Radix 2 DIT & DIF butterfly structures to compute 2 point, 4 point, 8 point DFT
9. State and prove the properties of Z Transform. Take any example of a system in time domain and demonstrate the application of Z transform in system analysis.

Course: Principles of Communication Systems Lab			Code: 25ETPCC205L
Teaching Scheme (Hrs./Week)		**Credit**	**Evaluation Scheme**
Practical	2	1	Practical / Marks: 25

- **Prerequisites:**
  Basic Electronics Engineering

- **Course Objectives:**
  1. Understand and implement analog and digital modulation techniques and analyze their performance parameters.
  2. Study signal sampling, encoding, and detection methods used in modern communication systems.
  3. Develop programming skills for analyzing communication system parameters such as SNR, Sampling and PCM companding.
  4. Explore practical communication hardware, measurement techniques, and system architectures used in real-world applications**.**

Course Outcomes: At the end of the course, students will be able to:

CO1: Analyze AM (DSB-FC) and FM signals.

CO2: Verify the Sampling Theorem in the time domain and examine the effects of under-sampling and over-sampling on signal reconstruction.

CO3: **Analyze** the generation and detection processes of Delta Modulation (DM) and Adaptive Delta Modulation

CO4: **Measure** the resonant frequency of different antennas using a **Vector Network Analyzer (VNA)**

List of Experiments (Any 10)

List of Experiments

1. AM Generation (DSB-FC): Calculation of modulation index by graphical method, Power of AM Wave for different modulating signal and Observe Spectrum.
2. Frequency modulator & demodulator using Varicap/Varactor Diode and NE 566 VCO, IC 565 (PLL based detection), calculation of modulation index & BW of FM.
3. Verification of Sampling Theorem in time domain (Flat top & Natural sampling).
4. Generation and Detection of PWM using IC 555
5. Study of DM: Generation and detection
6. Study of ADM: Generation and detection
7. Write a program to calculate Signal to noise ratio for PCM system & DM system
8. Write a program to demonstrate PCM Companding.
9. Write a program to Verify Sampling Theorem
10. Project based Learning / Poster Presentation Choose one communication application and presents the system architecture.
11. Measure resonant frequency for different Antenna using VNA.

Course: Control Systems Lab				Code: 25ETPCC206L
Teaching Scheme (Hrs./Week)		Credit	Evaluation Scheme	
Practical	2	1	Oral	Marks: 25

- **Prerequisites:** Engineering Mathematics, Basic Electronics Engineering

- **Course Objectives:**

1. **To develop analytical ability** in students for modelling and simplifying control systems using block diagram reduction, signal flow graphs, and system analogies.
2. **To apply computational and simulation tools** for analyzing dynamic systems through time response, stability analysis, root locus, and frequency response techniques.
3. **To design and implement basic automation logic** using PLC ladder programming for industrial control applications.

- **Course Outcomes:** At the end of the course, students will be able to:

CO1: Apply block diagram reduction, signal flow graph techniques, and electrical–mechanical analogies to obtain transfer functions of dynamic systems.
CO2: Analyze system performance and stability using computational methods and software simulations such as step response, root locus, and Bode plot.
CO3: Develop and implement basic PLC ladder programs for industrial automation problems such as motor control and traffic signal systems.

List of Experiments

1. Numerical on Block diagram reduction technique, Signal Flow Graphs (at least 4 numerical)
2. Numerical on transfer function of Electric Circuits with their analogy Force-Voltage and Force Current.
3. Computation and software simulation of First order system for Step input.
4. Software Simulation for stability analysis for any given Characteristic Equation of the system.
5. Computation and software simulation of root locus for given system transfer function.
6. Computation and software simulation of Bode plot for given system transfer function and investigate Stability.
7. PLC ladder programming for Motor start/stop circuit using latching mechanism.
8. PLC ladder programming for traffic light signal.
9. Derivation of Properties and solve numerical on state transition matrix.

Virtual Laboratories: Perform any two VLAB experiments

Link : https://ce-dei.vlabs.ac.in/List%20of%20experiments.html

Course: Employability Skill Development-II			Code: 25ETVSE202
Teaching Scheme (Hrs./Week)		**Credit**	**Evaluation Scheme**
Practical	2	1	Practical / Marks: 25

- **Prerequisites:**
  C Programming, Data Structures

- **Course Objectives:**
  1. To understand and apply the basic concepts of Object-Oriented Programming.
  2. To develop programs using classes and objects.
  3. To implement OOP concepts such as inheritance, polymorphism, encapsulation, and abstraction.

- **Course Outcomes:** At the end of the course, students will be able to:

CO1: Implement basic object-oriented programs using classes and objects.
CO2: Apply OOP concepts such as inheritance, polymorphism, encapsulation, and abstraction.
CO3: Develop programs using function overloading and operator overloading.
CO4: Demonstrate the use of file handling and exception handling.
CO5: Design and implement object-oriented solutions for real-world problems.

List of Experiments:

Group1: [Any Four to be performed]

1. Write a program to sort the numbers in an array using separate functions for read, display, sort and swap. The objective of this assignment is to learn the concepts of input, output, functions, call by reference.

2. Write a program that illustrates the concept of Function over loading.

3. Write a program to perform following operations on complex numbers Add, Subtract, Multiply, Divide, Complex conjugate. Design the class for complex number representation and the operations to be performed. The objective of this assignment is to learn the concepts classes and objects.

4. Write a program to implement Stack. Design the class for stack and the operations to be performed on stack. Use Constructors and destructors. The objective of this assignment is to learn the concepts classes and objects, constructors and destructors.

5. Write a program to overload unary operators for complex class. Group B: [Any Seven to be performed]

Group2: [Any Seven to be performed]

6. Write a program to perform following operations on complex numbers Add, Subtract, Multiply, Divide. Use operator overloading for these operations. The objective of this assignment is to learn the concepts operator overloading.

7. Write a program to implement string class. Write constructors, destructor, Accepts function and Display function.

8. Write a program to implement string class. Write constructors, destructor, Accepts function and Display function. To overload = operator so as call copy constructor.

9. Write a program to implement containment concept using Employee, B Date, & String Classes.

10. Write a program to Read and Display the information of Employee Using Multiple Inheritance. Use Basic Info and Department Info as a base classes of Employee class.

11. Write a program that illustrates run time polymorphism by using virtual functions.

12. Write a program which use try and catch for exception handling.

13. Write a program which to implement class and function template.

14. Write a program which to demonstrate use of namespace in the program.

15. Write a program which copies the contents of one file to another.

Virtual Laboratories:

Object Oriented Programing Laboratory: OOPS Lab | Indian Institute of Information Technology Bhagalpur

Course: Modern Indian Language (Marathi)				Code: 25AEC201A
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	02	02	TW	25
			OR	25

- **Prerequisite:** No prerequisite required.

- **Course Objectives:**

अभ्यासक्रमाची उद्दिष्ट्ये :

१. प्रगत भाषिक कौशल्यांची क्षमता विकसित करणे.
२. प्रसारमाध्यमातील संज्ञापनातील स्वरूप आणि स्थान स्पष्ट करणे.
३. व्यक्तिमत्त्व विकास आणि भाषा यांच्यातील सहसंबंध स्पष्ट करणे
४. लोकशाहीतील जीवनव्यवहार आणि प्रसारमाध्यमे यांचे परस्पर संबंध स्पष्ट करणे.
५. प्रसारमाध्यमांची लेखनक्षमता विकसित करणे.

- **Course Outcomes:**

हा अभ्यासक्रम पूर्ण केल्यानंतर विद्यार्थी पुढील बाबी साध्य करू शकतील :

CO१. मराठी भाषेतील प्रगत भाषिक कौशल्यांचा प्रभावीपणे वापर करून संवाद साधू शकतील.
CO२. प्रसारमाध्यमांतील संज्ञापनाचे विविध प्रकार, स्वरूप व समाजातील त्यांचे स्थान स्पष्ट करू शकतील.
CO३. व्यक्तिमत्त्व विकासामध्ये भाषेचे महत्त्व ओळखून प्रभावी संवादकौशल्य विकसित करू शकतील.
CO४. लोकशाहीतील जीवनव्यवहार आणि प्रसारमाध्यमे यांतील परस्परसंबंधांचे विश्लेषण करू शकतील.
CO५. प्रसारमाध्यमांसाठी विविध प्रकारचे लेखन कौशल्य आत्मसात करून प्रभावी लेखन करू शकतील.

- **Course Contents:**

Unit I	**घटक १**	**६ तास**

- मराठी भाषेची आविष्कार रूपे
- भाषा आणि व्यक्तिमत्त्व विकास: सहसंबंध
- लोकशाहीतील जीवनव्यवहार आणि प्रसारमाध्यमे

Unit II	**घटक २**	**६ तास**

- वृत्तपत्रासाठी बातमीलेखन आणि मुद्रितशोधन
- आकाशवाणीसाठी भाषणाची संहितालेखन
- दूरचित्रवाणीसाठी माहितीपटासाठी संहितालेखन
- समीक्षणात्मक लेखन: पुस्तक समीक्षण, चित्रपट समीक्षण

Unit III	**घटक ३**	**६ तास**

- भाषा, जीवन व्यवहार आणि नवमाध्यमे, समाजमाध्यमे
- नवमाध्यमे आणि समाजमाध्यमांचे प्रकार: ब्लॉग, फेसबुक, ट्विटर
- नवमाध्यमे आणि समाजमाध्यमांविषयक साक्षरता, दक्षता, वापर, परिणाम

Unit IV	**घटक ४**	**६ तास**

- वेबसाईट आणि ब्लॉग, ट्विटरसाठी लेखन, ई-मेल
- व्यावहारिक लेखन कौशल्य : अर्जलेखन व पत्रलेखन

Unit V	**घटक ५**	**६ तास**

- अनुवाद कौशल्य (Translation): इंग्रजी किंवा इतर भाषांमधून मराठीत अनुवाद करणे.
- कथा/कादंबरी/संवाद लेखन: सर्जनशील साहित्याची निर्मिती, पटकथा आणि संवाद लेखन.

- **Textbooks:**

१. सायबर संस्कृती : डॉ. रमेश वरखडे
२. व्यावहारिक मराठी: डॉ. ल. रा. नसिराबादकर, फडके प्रकाशन, कोल्हापूर
३. उपयोजित मराठी : संपादक डॉ. केतकी मोडक, संतोष शेणई, सुजाता शेणई
४. आधुनिक माहिती तंत्रज्ञानाच्या विश्वात , दीपक शिक्रापूरकर, उज्ज्वल मराठे, उत्कर्ष प्रकाशन, पुणे
५. व्यावहारिक मराठी, पुणे विद्यापीठ प्रकाशन, पुणे
६. प्रसारमाध्यमांसाठी लेखन कौशल्य, यशवंतराव चव्हाण मुक्त विद्यापीठ, नाशिक

Course activities for Term Work Evaluation

Subject teacher should frame minimum 10 assignments-based covering on all five units

1. सारांश लेखन (Summary Writing)

विद्यार्थ्यांनी उतारा वाचून स्वतःच्या शब्दात एक संक्षिप्त सारांश लिहावा.

Students read a passage and write a **short summary** in their own words.

2 . भाषांतर (Translation Assignment)

Students translate text from **English to Marathi**.

विद्यार्थ्यांनी इंग्रजी भाषेतील मजकूर मराठीमध्ये भाषांतरित करावा.

Example

- Short technical paragraph translation
- Daily communication sentences

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3. पत्र लेखन (Letter Writing)

विद्यार्थ्यांनी वेगवेगळ्या प्रकारची औपचारिक व अनौपचारिक पत्रे लिहावी

Types

- औपचारिक पत्र (Formal Letter)
- अनौपचारिक पत्र (Informal Letter)
- अर्ज लेखन

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4. **गट्क्रिया (Group Activity)**

विद्यार्थ्यांनी खालीलपैकी एक गट क्रियाकलाप करावा.

Example

- रोड शो
- स्किट प्ले
- एकांकिका

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5. सादरीकरण (Presentation Assignment)

विद्यार्थ्यांनी तंत्रज्ञान, पर्यावरण, सामाजिक इ . कोणत्याही एका विषयावर सादरीकरण करावे.

Students present a topic in Marathi.

Examples

- तंत्रज्ञानातील नवीन शोध
- पर्यावरण विषयक सादरीकरण

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6. गटचर्चा (Group Discussion)

विद्यार्थ्यांनी गटांमध्ये एखाद्या विषयावर चर्चा करावी.

Students discuss a topic in groups.

Example Topics

- सोशल मीडियाचा प्रभाव
- ऑनलाइन शिक्षणाचे फायदे व तोटे

7. मराठी ब्लॉग लिहणे

विद्यार्थ्यांनी त्यांच्या अभ्यासाच्या क्षेत्रातील विकासावर २०० शब्दांपर्यंत ब्लॉग लिहून पोस्ट लिहून सोशल मीडियावर पोस्ट कराव्या.

Write blogs and posts on social media up to 200 words on recent development in their field of study.

8. पुस्तक परीक्षण (Book Review)

विद्यार्थ्यांना मराठी पुस्तक किंवा लेख वाचावे आणि त्यावर समीक्षा लिहावी.

Students read a Marathi book or article and write a **review**.

9. चित्रपट परीक्षण (Marathi film Review)

विद्यार्थ्यांनी उपलब्ध असलेला सामाजिक मराठी चित्रपट पाहावा आणि त्यावर समीक्षा लिहून, ती त्यांच्या आवडीच्या सोशल मीडियावर पोस्ट करावी.

Social Marathi movie available and write a review on post it on social media of their choice.

10. स्पर्धांमध्ये सहभाग (Participation in Competition)

पुरुषोत्तम, फिरोदिया, दाजीकाका गाडगीळ करंडक, आणि श्रीटेज करंडक या स्पर्धांमध्ये सहभाग नोंदवावा.Participation in Purushottam karandam, Firodia karandak, Dajikaka Gadgil Karandak and Shreetej Karandak.

Course: Modern Indian Language (Sanskrit)				Code: 25AEC201B
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	2	2	OR	25
			TW	25

Prerequisites: Basic ability to read Devanagari script is helpful but not mandatory.

- **Course Objectives:**
  1. To introduce engineering students to the basic structure of the Sanskrit language.
  2. To highlight the relevance of Sanskrit in modern fields such as Computational Linguistics and Artificial Intelligence.
  3. To encourage appreciation of Indian Knowledge Systems and their applications in modern engineering and research.

- **Course Outcomes:** At the end of the course, students will be able to:

CO1: Understand the basic structure, phonetics, and grammar of the sanskrit language.
CO2: Construct simple Sanskrit sentences using basic grammatical rules.
CO3: Interpret selected Sanskrit verses related to science, mathematics, and philosophy.
CO4: Recognize the contributions of ancient Indian scholars to science and engineering.
CO5: Appreciate the relevance of Sanskrit in modern fields such as computational linguistics, knowledge

- **Course Contents:**

Unit I	**Introduction to Sanskrit Language**	**6 Hours**

Importance and historical development of Sanskrit, Characteristics of Sanskrit as a scientific language, Sanskrit alphabet (Varnamala): vowels and consonants, Pronunciation rules and phonetics, Basic introduction to Sanskrit grammar

- पठित अवबोधनम् | गद्यान्श् अपेक्षित कार्य : प्रश्नोत्तरामी तथा निर्देशानुसार कृतयः
- पठित अवबोधनम् | पद्यान्श

Unit II	**Basic Sanskrit Grammar**	**6 Hours**

Introduction to nouns (Subanta), Gender and number (Vachana), Case system (Vibhakti), Introduction to verbs (Dhatu), Present tense forms, Formation of simple sentences सन्धिकार्यम् समास प्रत्ययाः त्यकार अव्ययाः समय लेखनम् - अनुप्रयुक्त-व्याकरणम्

Unit III	**Reading and Interpretation of Sanskrit Texts**	**6 Hours**

Reading simple Sanskrit shlokas, Vocabulary building for scientific and technical terms, Translation of selected Sanskrit passages, Interpretation of verses related to logic, mathematics, and nature, Practice exercises in sentence construction and translation

Unit IV	**Reading and Interpretation of Sanskrit Texts**	**6 Hours**

Translation of selected Sanskrit passages, Interpretation of verses related to logic, mathematics, and nature Practice exercises in sentence construction and translation, लेखनकौशलम् वृत्तान्तलेखनम्, चित्रपटवर्णनम्, निबन्धलेखनम्

Unit V	**Sanskrit and Modern Science & Technology**	**6 Hours**

Sanskrit and computational linguistics
Logic and knowledge representation in Sanskrit texts
References to engineering concepts in ancient texts
Sanskrit terminology used in mathematics, astronomy, and architecture. Mathematical problems

from **Lilavati** by **Bhaskara II**
Structure of Sanskrit grammar and its relevance to computer science
Applications of Sanskrit in modern research
Overview of Sanskrit influence on Artificial Intelligence and language processing

- **Textbooks:**
  1. सरस्वती - मणिका संस्कृत व्याकरणम
  2. नवम तथा दशम कक्षा 'मणिका' पुस्तकम
  3. संस्कृत आल्हादः - दादशी कक्षा तथा निभन्धसोपनः

Reference Books:
1. Panini Ashtadhyayi – Panini
Selected Sanskrit texts related to science and mathematics.

Course activities for Term Work Evaluation
Subject teacher should frame minimum 10 assignments-based covering on all five units

1. Summary Writing: Students read a passage and write a short summary in their own words.
2 Translation Assignment: Students translate text from English to Sanskrit.
3 Short technical paragraph translation
4 Daily communication sentences
5 Letter Writing
6 Group Discussion
7 Book Review
8 Film review
9 Blog writing
10 Participation in a Competition

Course: Business Fundamentals for Entrepreneurs			Code: 25HSM202A
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**
Tutorial	2	2	TW 50

- **Prerequisites:** Basic understanding of economics and management principles, Analytical thinking and problem-solving skills, Awareness of technological innovations and industry trends

- **Course Objectives:** The objectives of the course are-
  1. To introduce engineering students to fundamental concepts of entrepreneurship and business management.
  2. To develop the ability to identify and evaluate entrepreneurial opportunities in technology-driven markets.
  3. To provide knowledge of basic marketing, financial, and operational aspects required to start and manage a business.
  4. To enable students to understand business models, startup ecosystems, and funding mechanisms.
  5. To develop the capability to prepare a structured business plan for a technology-based venture.

- **Course Outcomes:** At the end of the course, students will be able to:

  CO1: Explain the role of entrepreneurship in economic and technological development.

  CO2: Identify and analyze business opportunities using systematic tools and techniques.

  CO3: Apply marketing and financial fundamentals for planning entrepreneurial ventures.

  CO4: Design sustainable business models and evaluate startup feasibility.

  CO5: Develop and present a comprehensive business plan for a technology-based enterprise.

- **Course Contents:**

Unit I	**Introduction to Entrepreneurship**	**6 Hours**

Concept and evolution of entrepreneurship, Entrepreneur vs manager, Types of entrepreneurs: techno-entrepreneurs, social entrepreneurs, women entrepreneurs, intrapreneurs.
Characteristics of successful entrepreneurs. Role of entrepreneurship in economic development. Entrepreneurial ecosystem in India – Startup India, Make in India, atmanirbhar Bharat initiatives.

Unit II	**Opportunity Identification and Business Environment**	**6 Hours**

Creativity and innovation in entrepreneurship, Idea generation techniques – brainstorming, design thinking, TRIZ basics, Opportunity recognition and feasibility analysis, Environmental scanning – PESTLE analysis.
Industry and market analysis, Legal forms of business organizations: sole proprietorship, partnership, LLP, private limited company.

Unit III	**Marketing Fundamentals for Entrepreneurs**	**6 Hours**

Introduction to marketing management, Market research and customer discovery, Market segmentation, targeting and positioning (STP), Product development and product life cycle, Pricing strategies for startups.
Digital marketing tools and social media marketing for new ventures

Unit IV	**Financial Fundamentals for Startups**	**6 Hours**

Introduction to accounting and financial statements, Cost concepts and break-even analysis, Financial planning and budgeting, Sources of startup funding – angel investors, venture capital, bank loans, incubators, crowdfunding, Government schemes supporting startups in India, Basics of financial risk management.

Unit V	**Business Planning and Startup Management**	**6 Hours**

Business models and Business Model Canvas, Preparation of a business plan – structure and components.
Operations management for start-ups, Intellectual Property Rights (IPR) and regulatory compliance.
Startup growth strategies and scaling, Sustainability and ethical practices in entrepreneurship.

- **Course activities for term work evaluation:**
  1. **Business Opportunity Identification Activity**
     Students identify innovative startup ideas, analyze market needs, customer problems, and prepare an opportunity assessment report.
  2. **Case Study on Successful Startups and Entrepreneurs**
     Students study successful startups or entrepreneurs and analyze their business models, innovation strategies, marketing approaches, and growth factors.
  3. **Hands-on Activity using Business Planning Tools**
     Students prepare SWOT analysis, Business Model Canvas (BMC), customer segmentation, and basic market analysis using practical examples.
  4. **Mini Project on Startup Ecosystem and Funding**
     Students explore startup support systems such as Startup India, incubators, venture capital, crowdfunding, and government schemes and prepare a report.
  5. **Business Plan Development and Pitch Presentation**
     Students develop and present a business plan including product idea, marketing strategy, financial planning, pricing, budgeting, and startup feasibility analysis.

- **Textbooks:**
  1. Hisrich, R. D., Peters, M. P., & Shepherd, D. A., Entrepreneurship, McGraw Hill Education.
  2. Barringer, B. R., & Ireland, R. D., Entrepreneurship: Successfully Launching New Ventures, Pearson Education.
  3. Kuratko, D. F., Entrepreneurship: Theory, Process and Practice, Cengage Learning.

- **Reference Books:**
  1. Drucker, P., Innovation and Entrepreneurship, Harper Business.
  2. Ries, E., The Lean Startup, Crown Publishing.
  3. Desai, V., Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House.
  4. Blank, S., & Dorf, B., The Startup Owner's Manual, K & S Ranch Press.
  5. Timmons, J. A., & Spinelli, S., New Venture Creation, McGraw Hill.

- **MOOC / NPTEL Courses/Online Resources:**
  1. NPTEL Course on Entrepreneurship, By Prof. C Bhaktavatsala Rao, IIT Madras : https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg70
  2. NPTEL course on Business Fundamentals for Entrepreneurs by Prof. Devdip Purkayastha, IIT Bombay: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_mg11
  3. NPTEL Course on Entrepreneruship and Start-ups, By Dr. P. Jakulin Divya Mary, National Institute of Technical Teachers' Training and Research, Chennai: https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr25_ed60
  4. NPTEL Course on Business Development: From Start to Scale Prof. C Bhaktavatsala Rao, IIT Madras : https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_mg61

Course: Entrepreneurship and Start-ups			Code: 25HSM202B	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Tutorial	2	2	TW	50

- **Prerequisites:** Market study, break even analysis, profit loss, accounting

- **Course Objectives:** The objectives of the course are:
  1. Understand the concepts, role, and importance of entrepreneurship and innovation in economic and social development.
  2. Identify and evaluate business opportunities, especially technology-based and sustainable ventures.
  3. Develop entrepreneurial mindset, creativity, and problem-solving ability.
  4. Understand startup ecosystem, government policies, IPR, funding, and incubation support.
  5. Prepare a basic business plan incorporating ethical, financial, and sustainability considerations.

- **Course Outcomes:** At the end of the course, students will be able to:

  CO1: Explain concepts of entrepreneurship, innovation, and their role in economic and societal development.
  CO2: Identify entrepreneurial opportunities using creativity, design thinking, and market analysis tools.
  CO3: Analyze feasibility of a business idea considering technical, financial, legal, and social aspects.
  CO4: Apply knowledge of start-up ecosystem, IPR, funding, and government initiatives to venture creation.
  CO5: Develop and present a basic business plan demonstrating teamwork, communication, ethics, and lifelong learning attitude.

- **Course Contents:**

Unit I	**Introduction to Entrepreneurship**	**6 Hours**

Entrepreneurship: Definition, types, and characteristics, Entrepreneur vs Manager, Role of entrepreneurship in economic development, Innovation: Types and sources, Case studies of successful entrepreneurs (Indian & global)

Unit II	**Creativity, Innovation & Opportunity Identification**	**6Hours**

Entrepreneurial mind-set and creativity, Design Thinking for innovation, Idea generation techniques, Opportunity identification and screening, Market research and customer validation, Technology-based entrepreneurship

Unit III	**Feasibility Analysis & Business Models**	**6 Hours**

Technical, market, and financial feasibility, Business Model Canvas (BMC), Costing, pricing, and break-even analysis, Risk analysis and mitigation, Ethics and sustainability in entrepreneurship

Unit IV	**Startup Ecosystem, IPR & Funding**	**6 Hours**

Startup India initiative and government schemes (MSME, SIDBI, DPIIT), Incubation centres, accelerators, and angel networks, Basics of Intellectual Property Rights (Patents, Copyrights, Trademarks), Sources of funding: Bootstrapping, venture capital, crowdfunding, Legal aspects of starting a venture

Unit V	**Business Plan Development & Entrepreneurial Skills**	**6 Hours**

Business plan preparation and structure, Team building and leadership, Communication and pitching skills, Social entrepreneurship and sustainable start-ups, Future trends and lifelong learning for entrepreneurs

- **Course activities for term work evaluation:**
  1. **Business Opportunity Identification Activity**
     Students identify innovative start-up ideas, analyse market needs, customer problems, and prepare an opportunity assessment report.

2. **Case Study on Successful Startups and Entrepreneurs**
   Students study successful startups or entrepreneurs and analyze their business models, innovation strategies, marketing approaches, and growth factors.
3. **Hands-on Activity using Business Planning Tools**
   Students prepare SWOT analysis, Business Model Canvas (BMC), customer segmentation, and basic market analysis using practical examples.
4. **Mini Project on Startup Ecosystem and Funding**
   Students explore startup support systems such as Startup India, incubators, venture capital, crowdfunding, and government schemes and prepare a report.
5. **Business Plan Development and Pitch Presentation**
   Students develop and present a business plan including product idea, marketing strategy, financial planning, pricing, budgeting, and startup feasibility analysis.

- **Textbooks:**
  1. Hisrich, R. D., Peters, M. P., & Shepherd, D. A., Entrepreneurship, McGraw Hill Education.
  2. Barringer, B. R., & Ireland, R. D., Entrepreneurship: Successfully Launching New Ventures, Pearson Education.
  3. Kuratko, D. F., Entrepreneurship: Theory, Process and Practice, Cengage Learning.

- **Reference Books:**
  1. Drucker, P., Innovation and Entrepreneurship, Harper Business.
  2. Ries, E., The Lean Startup, Crown Publishing.
  3. Desai, V., Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House.
  4. Blank, S., & Dorf, B., The Startup Owner's Manual, K & S Ranch Press.
  5. Timmons, J. A., & Spinelli, S., New Venture Creation, McGraw Hill.

- **MOOC / NPTEL Courses/Online Resources:**
  1. NPTEL course on Entrepreneurship and Start-ups by Dr. P. Jakulin Divya Mary, National Institute of Technical Teachers' Training: https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr25_ed60
  2. NPTEL Course on Entrepreneurship, By Prof. C Bhaktavatsala Rao, IIT Madras : https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg70
  3. NPTEL Course on Business Development: From Start to Scale Prof. C Bhaktavatsala Rao, IIT Madras: https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_mg61
  4. Government Schemes for Start-ups: https://www.startupindia.gov.in/content/sih/en/government-schemes.html

Course: Fundamentals of Finance and Accounting			Code: 25HSM202C	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Tutorial	2	2	TW	50 Marks

- **Prerequisites:** Basic knowledge of arithmetic and percentages, along with the ability to interpret simple numerical data and tables. No prior background in accounting or finance is required.

- **Course Objectives:** The objectives of the course are
  1. This course introduces basic concepts of financial accounting and corporate finance to engineering students.
  2. It helps students understand financial statements.
  3. Apply accounting principles, and use financial tools for decision-making.

- **Course Outcomes:** At the end of the course, students will be able to:
  CO1: Apply key accounting principles in business contexts.
  CO2: Interpret financial statements and reports.
  CO3: Understand working capital and its components.
  CO4: Evaluate capital budgeting decisions.
  CO5: Gain awareness of financial markets and financing options.

- **Course Contents:**

Unit I	**Introduction to Accounting**	**6 Hours**

Meaning and purpose of accounting, Users of accounting information, Accounting principles, concepts and conventions, Types of accounts and rules of debit and credit, Journal, Ledger and Trial Balance Preparation of Final Accounts (simple adjustments)

Unit II	**Financial Statements and Analysis**	**6 Hours**

Introduction to Financial Statements, Balance Sheet: Classification of assets and liabilities, Profit and Loss Statement, Cash Flow Statement – Format and Components, Financial Ratio Analysis – Concept and Uses Computation of Liquidity and Profitability Ratios

Unit III	**Cost Concepts and Working Capital**	**6 Hours**

Meaning and classification of costs, Fixed vs Variable costs, Break-even analysis – concept and formula, Importance of working capital, Working capital cycle, Techniques for managing working capital

Unit IV	**Introduction to Finance and Time Value of Money**	**6 Hours**

Meaning and scope of finance, Financial goals and functions, Time Value of Money – Concept, Present value and future value, Simple and compound interest, Annuities and perpetuities

Unit V	**Capital Budgeting and Financial Markets**	**6 Hours**

Introduction to capital budgeting, Payback period, Net Present Value (NPV), Internal Rate of Return (IRR) Overview of financial markets, Financing options – Equity and Debt

- **Course activities for term work evaluation:**
  1. **Accounting Principles and Journal Preparation Activity**
     Students prepare journal entries, ledgers, and trial balances for simple business transactions to understand the fundamentals of accounting practices.
  2. **Financial Statement Analysis Case Study**
     Students analyse balance sheets, profit and loss statements, and cash flow statements of companies to evaluate financial performance and decision-making.
  3. **Cost Analysis and Break-even Calculation Exercise**

Students perform cost classification, break-even analysis, and working capital calculations using numerical examples and practical business scenarios.

4. **Time Value of Money and Investment Analysis Activity**
   Students solve problems related to simple and compound interest, annuities, present value, future value, NPV, and IRR for financial decision-making.
5. **Mini Project on Capital Budgeting and Financial Markets**
   Students study capital budgeting techniques, financing options, equity and debt markets, and prepare a report on investment and financing decisions.

- **Textbooks:**
  1. S. A. Siddiqui & A. S. Siddiqui – Fundamentals of Financial Accounting – PHI Learning
  2. Paul D. Kimmel, Jerry J. Weygandt, Donald E. Kieso – Financial Accounting: Tools for Business Decision Making – Wiley
  3. Mike Piper – Accounting Made Simple – CreateSpace
- **Reference Books:**
  1. Prasanna Chandra – Financial Management: Theory & Practice – McGraw-Hill
  2. Stephen A. Ross, Randolph W. Westerfield & Jeffrey Jaffe – Corporate Finance – McGraw-Hill
  3. Ray H. Garrison, Eric W. Noreen & Peter C. Brewer – Managerial Accounting – McGraw-Hill
  4. Jerry J. Weygandt, Paul D. Kimmel, Donald E. Kieso – Accounting Principles – Wiley
- **NPTEL/MOOCS:**
  1. NPTEL course on Foundations of Accounting & Finance by Prof. Arun Kumar Gopalaswamy, IIT Madras: https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ec10
  2. NPTEL Course on Financial Markets, Institutions and Financial Services By Prof. Divya Verma, Guru Gobind Singh Indraprastha University, Delhi: https://onlinecourses.swayam2.ac.in/e-learning/preview/cec26_mg12
  3. NPTEL Course on Working Capital Management by Prof. Anil K. Sharma, IIT Roorkee: https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg61
  4. Time value of money- Concepts and Calculations http://digimat.in/nptel/courses/video/109107115/109107115.html

Course: Business Intelligence and Analytics			Code: 25HSM202D
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**
Lecture	2	2	TW 50

- **Prerequisites:** Basic knowledge of computer applications, spreadsheet tools, elementary statistics, and database management concepts.

- **Course Objectives:**
  1. To introduce the concepts of Business Intelligence (BI) and Business Analytics (BA) in modern organizations.
  2. To understand the role of Decision Support Systems and Data Warehousing in business decision-making.
  3. To learn techniques of data analysis, reporting, and visualization used in BI tools.
  4. To develop knowledge of data preparation, predictive analytics, and machine learning applications in business.

- **Course Outcomes:** At the end of the course, students will be able to:
  CO1: Understand the concepts of Decision Support Systems, Business Intelligence, and Business Analytics.
  CO2: Understand the architecture of Data Warehouses and OLAP systems used in business intelligence.
  CO3: Apply data preparation, reporting, and visualization techniques to analyze business data.
  CO4: Analyze the impact of predictive analytics, machine learning, and analytics applications
  CO5: Apply Machine Learning in BI

- **Course Contents:**

Unit I	Introduction to Data-Driven Business Intelligence and Analytics	6 Hours

Decision Support Systems (DSS): Definition of system, representation of decision-making process, evolution of information systems, Decision Support System, development of DSS, Simon's four stages of decision-making process, strategies and approaches of decision makers. Business Intelligence (BI): Definition of BI, components of BI, BI architecture, data–information–knowledge concepts, setting up data for BI, role of mathematical models, business intelligence architectures, ethics in business intelligence. Business Analytics (BA): Definition of business analytics, types of analytics – descriptive, diagnostic, predictive and prescriptive analytics, concept of insights, business analytics in practice, importance of data in business analytics, types of data, data quality, 5Vs of big data, data sources and collection methods, data privacy, security and ethical considerations.

Unit II	Analytical Decision-Making and Architecture of DW & BI	6 Hours

Analytical decision-making process, characteristics, framing business problems into analytical questions, skills of a business analyst. Data exploration and visualization (Excel, Tableau, Power BI), concept of statistical analysis and hypothesis testing. Data visualization, exploratory data analysis (EDA), data cleaning and inspection. BI and DW architecture, relation between BI and DW, role of DSS, EIS, MIS, digital dashboards, need for BI. OLAP concepts, OLAP vs OLTP, cubes, drill-down, roll-up, slice-and-dice, ROLAP vs MOLAP, schemas: star, snowflake, fact constellation.

Unit III	Predictive, Prescriptive Analytics and Reporting Authoring	6 Hours

Text analytics and web analytics, report authoring (relational & multidimensional models), types of reports (list, crosstab, statistics, charts, maps, financial), report features (grouping, sorting, filtering, calculations, conditional formatting, summary lines, drill-up, drill-down, drill-through), report scheduling and output formats (PDF, Excel, CSV, XML).

Unit IV	Business Analytics in Marketing and Finance	6 Hours

Marketing Analytics, Customer segmentation, targeting, and positioning, Campaign management and ROI measurement, Data-driven marketing strategies. Financial Analytics - Risk management and credit scoring,

financial forecasting and planning, Case studies: Financial performance improvement through analytics (Non-Statistical - Conceptual Treatment only).

Unit V	Business Analytics Applications and Machine Learning in BI	6 Hours

Impact of machine learning in BI: classification problems, evaluation of classification models, Bayesian methods, logistic regression. Clustering methods: partition and hierarchical methods, evaluation of clustering models. Association rule mining: structure of association rules and Apriori algorithm.

- **Course activities for term work evaluation:**
  1. **Business Intelligence Case Study Analysis**
     Students analyse real-world business cases to understand the role of Business Intelligence (BI), Decision Support Systems (DSS), and data-driven decision-making in organizations.
  2. **Data Visualization and Dashboard Development Activity**
     Students create charts, dashboards, and analytical reports using tools such as Excel, Tableau, or Power BI to present business insights effectively.
  3. **Hands-on Activity on Data Analysis and Reporting**
     Students perform data cleaning, exploratory analysis, report generation, and visualization using business datasets to identify trends and patterns.
  4. **Marketing and Financial Analytics Mini Project**
     Students analyse customer segmentation, campaign performance, sales trends, and financial data using analytical techniques and prepare a business analytics report.
  5. **Machine Learning Applications in Business Activity**
     Students explore classification, clustering, association rule mining, and predictive analytics techniques using sample datasets and present their findings and business implications.

- **Textbooks:**
  1. Camm, Cochran, Fry, Ohlmann, Anderson, Sweeney, Williams - Essentials of Business Analytics, Cengage Learning.

- **Reference Books:**
  1. Data Mining: Concepts and Techniques, Jiawei Han and Micheline Kamber
  2. James Evans, Business Analytics, Pearson.
  3. Albright Winston, Business Analytics - Data Analysis - Data Analysis and Decision Making, Cengage Learning, Reprint
  4. Sahil Raj, Business Analytics, Cengage Learning.
  5. Knaflic, C. N. (2015). Storytelling with data: A data visualization guide for business professionals. Wiley.
  6. Siegel, E. (2016). Predictive analytics: The power to predict who will click, buy, lie, or die. Wiley.

- **e-Books:**
  1. https://www.knime.com/sites/default/files/inline-images/KNIME_quickstart.pdf
  2. www.cs.ccsu.edu/~markov/weka-tutorial.pdf
  3. http://www.biomedicahelp.altervista.org/Magistrale/Clinics/BIC_PrimoAnno/IdentificazioneModelliDataMining/Bus iness%20Intelligence%20-%20Carlo%20Vercellis.pdf
  4. https://download.e-bookshelf.de/download/0000/5791/06/L-G-0000579106-0002359656.pdf

- **MOOC / NPTEL Courses:**
  1. Business Analytics for management decision By Prof. Rudra P Pradhan, IIT Kharagpur : https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_mg11
  2. Business analytics and data mining modeling using R By Prof. Gaurav Dixit, IIT Roorkee : https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_mg24
  3. Business Analysis for Engineers : http://www.digimat.in/nptel/courses/video/110106050/110106050.html
  4. Business Intelligence & Analytics By Prof. Saji K Mathew, IIT Madras: https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_cs65

Course: Indian Constitution and Governance				Code: 25VEC202
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Tutorial	1	1	TW	25

- **Prerequisites:** Basic awareness of Indian history, civic studies at school level, and general understanding of social and political systems.

- **Course Objectives: The objectives of the course are**
  1. To introduce students to the philosophy, features, and framework of the Indian Constitution.
  2. To understand the structure, powers, and functions of the Union and State governments.
  3. To explain Fundamental Rights, Duties, and Directive Principles and their role in democracy.
  4. To familiarize students with constitutional bodies and governance mechanisms in India.
  5. To develop awareness of contemporary issues related to constitutional values, governance, and citizenship.

Course Outcomes: At the end of the course, students will be able to:

CO1. Explain the historical background, features, and structure of the Indian Constitution.
CO2. Describe Fundamental Rights, Directive Principles, and Fundamental Duties and their significance
CO3. Apply constitutional provisions to analyze the functioning of Union and State governments.
CO4. Analyze the role of constitutional and statutory bodies in Indian governance
CO5. Evaluate contemporary governance issues with reference to constitutional values and ethics.

- **Course Contents:**

Unit I	**Introduction to Indian Constitution**	**3 Hours**
Meaning and importance of Constitution Historical background and making of the Indian Constitution Salient features of the Indian Constitution Preamble: objectives and significance Citizenship – provisions and amendments		
Unit II	**Fundamental Rights, Duties, and Directive Principles Fundamental Rights**	**3 Hours**
Types, scope and limitations Right to Equality, Freedom, Religion, Constitutional Remedies Directive Principles of State Policy – objectives and classification Fundamental Duties and their relevance Relationship between Fundamental Rights and DPSPs		
Unit III	**Union and State Government Structure Union Government**	**3 Hours**
President, Vice-President, Prime Minister, Council of Ministers Powers and functions of Parliament State Government: Governor, Chief Minister, State Legislature Center–State relations: legislative, administrative, and financial		
Unit IV	**Constitutional and Statutory Bodies Election Commission of India**	**3 Hours**
Composition, powers, and functions Union Public Service Commission (UPSC) and State Public Service Commissions (SPSC): roles and responsibilities Comptroller and Auditor General (CAG) of India: duties and significance in financial accountability Finance Commission: composition, functions, and role in centre–state financial relations Judiciary in India: structure, jurisdiction, and role of the Supreme Court and High Courts		
Unit V	**Governance, Democracy and Contemporary Issues Concept of democracy and good governance Local self-government**	**3 Hours**
Panchayati Raj and Urban Local Bodies Constitutional amendments and landmark judgments Ethical governance and citizen participation Current issues related to Indian Constitution and governance		

- **Textbooks:**
  1. M. V. Pylee, An Introduction to the Constitution of India, Vikas Publishing
  2. D. D. Basu, Introduction to the Constitution of India, LexisNexis

- **Reference Books:**
  1. Granville Austin, The Indian Constitution: Cornerstone of a Nation, Oxford University Press
  2. Subhash Kashyap, Our Constitution: An Introduction to India's Constitution and Constitutional Law, National Book Trust

- **MOOC / NPTEL Courses:**
  1. NPTEL1, Introduction to Indian Constitution, By Prof. Priyanca Mathur, Dr. Amrita Purkayastha, Dr. Sneha Yadav, JAIN (Deemed to be University), Bangalore : https://onlinecourses.swayam2.ac.in/e-learning/preview/imb26_mg151
  2. NPTEL2, Constitution Law and Public Administration in India, By Prof. Sairam Bhat, National Law School of India University: https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_lw05
  3. NPTEL3, Constitutional Studies, By Prof. Sudhir Krishnaswamy, National Law School of India University: https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_lw03
  4. NPTEL4, Public Policy and Governance, By Dr. A. Sridhar Raj, Institute of Public Enterprise: https://onlinecourses.swayam2.ac.in/e-learning/preview/cec24_hs38

- **Activities for Term work Evaluation:**
  1. Group Discussion on Fundamental Rights and Duties
  2. Debate on Constitutional and Contemporary Governance Issues
  3. Case Study Analysis on Indian Judiciary and Landmark Judgments
  4. Seminar / Presentation on Indian Constitution and Democratic Values
  5. Poster Making on Fundamental Rights, Duties, and Good Governance
  6. Essay Writing on Role of Citizens in Democracy and Nation Building
  7. Mock Parliament / Mock Election Activity
  8. Assignment on Constitutional Bodies and Their Functions
  9. Field Visit / Report on Local Self-Government Institutions
  10. Quiz / Awareness Activity on Indian Constitution and Governance Systems

Course: Embedded System and Internet of Things			Code: 25ETHNR201	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	03	03	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** Basic Knowledge of Microcontrollers

- **Course Objectives:**
  1. To learn and understand the basics of Embedded systems.
  2. To be acquainted with interfacing of sensors and actuators with microprocessor.
  3. To design embedded systems applications.
  4. To understand Internet of Things and its usefulness for society

- **Course Outcomes:** At the end of the course, students will be able to:

CO1: Identify and understand the unique characteristics and components of embedded systems

CO2: Compare various development boards Arduino, Raspberry pi, Beagle bone

CO3: Implement interfacing of various sensors, actuators to the development boards

CO4: Design, implement and test an embedded system application

CO5: Configure U-Boot, Understand IoT building blocks

- **Course Contents:**

Unit I	ES Overview	8 Hours

- Embedded Systems: Architecture & Characteristics of ES, Types of Embedded systems, Examples of
- Embedded Systems. Embedded System On Chip (SOC).
- Components of ES: Hardware and software
- Hardware components of ES: Power supply: types, characteristics, selection criteria, Processing
- Unit, Input devices, Output Devices

Unit II	Introduction to ES System Software	8 Hours

Introduction to Embedded operating Systems: Operating Systems Concepts, Real time operating systems, and, Task Scheduling, Different OS tasks, Introduction to Real-Time Operating Systems, characteristics, selection criteria, bootloader: U-boot.

Unit III	Sensors, Actuators and Interfacing	8 Hours

Sensors : Roles of Sensors & Actuators, Types of sensors , Active and passive, analog and digital, Contact and no-contact, Absolute and relative working of Sensors: Position, occupancy and motion, velocity and acceleration, force, pressure,flow, Acoustic, Humidity, light, radiation, temperature, chemical, biosensor, camera. Development boards: Types of boards - Arduino, Raspberry pi, Beagle bone, ESP8266, selection criteria. Interfacing of sensors with development boards.

Unit IV	Embedded System - Application Development	8 Hours

Integrated Development Platforms for Application Development in ES environment, SDLCRequirements, Architecture, Design, Components, Coding, Testing and Deployment.
Study of any two Open source IDE for ES application development with respect to any of the two indicated Case studies

Unit V	IoT	7 Hours

Introduction of IoT: Definition and characteristics of IoT, Technical Building blocks of IoT, Device, Communication Technologies, Data, Physical design of IoT, IoT enabling technologies, IoT Issues and Challenges- Planning, Costs and Quality, Security and Privacy, Risks
#Exemplar/ Case Studies
Smart Home: Characteristics of Smart Home - Smart Home Energy Management, Smart Appliances, Communication Technologies for Smart Homes, maintenance, security, challenges.
Smart Agricultural: characteristics and applications -Scarecrow, Smart Irrigation System, Crop Water Management, Integrated Pest Management, Sensor-based field and resource mapping, Remote equipment monitoring)

Course activities for CCA Evaluation: Any two

1. IoT Application Case Study Analysis
Students analyze a real-world IoT application such as Smart City, Smart Agriculture, Smart Healthcare, Industrial IoT, or Home Automation. They identify the system architecture, communication protocols, security challenges, and benefits, and propose improvements or alternative solutions.

2. Group Discussion & Presentation on IoT Technologies
Teams discuss emerging IoT technologies and trends such as MQTT vs CoAP, BLE vs Zigbee, IoT Security Challenges, Edge Computing, Cloud-based IoT, or 5G-enabled IoT. Each team presents its findings and participates in a technical discussion.

3. IoT Network Design and Simulation Activity
Students design and simulate an IoT communication network for a given application scenario. The activity includes selection of sensors, gateways, communication protocols, cloud connectivity, and data flow. Students present the design rationale and expected system performance.

4. Mini Project on IoT System Development
Students develop a small IoT-based solution using platforms such as Arduino, Raspberry Pi, BeagleBone, or online simulators. Example projects include Smart Lighting, Environmental Monitoring, Smart Irrigation, or Health Monitoring Systems. Students submit a project report and demonstrate the working prototype.

5. Hands-on Activity using IoT Design and Security Tools
Students prepare IoT architecture diagrams, protocol comparison charts, security threat models, network topologies, cloud integration workflows, or connectivity solution flowcharts for selected IoT applications. The activity emphasizes practical design, analysis, and documentation skills.

- **Textbooks:**
  1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, ISBN: 0:0996025510, 13: 978-0996025515.
  2. Lyla B. Das, “Embedded Systems: An Integrated Approach” Pearson , ISBN: 9332511675, 9789332511675

- **Reference Books:**
  1. Sriram V. Iyer, Pankaj Gupta, “Embedded Real-time Systems Programming”, Tata McGraw-Hill, ISBN: 13: 9780070482845
  2. David Hanes, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, Cisco Press, ISBN-13: 978-1-58714-456-1, ISBN-10: 1-58714-456-5, 2017
  3. Raj Kamal, “Embedded Systems: Architecture, programming and Design”, 2nd Edition, McGrawHill, ISBN: 13: 9780070151253
  4. Olivier Hersent, Omar Elloumi and David Boswarthick, “The Internet of Things: Applications to the Smart Grid and Building Automation”, Wiley, 2012, 9781119958345 3.
  5. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012, ISBN:978-1-119-99435-0

- **MOOCS/NPTEL:**
  1. NPTEL course on ACM India Summer School on IoT and Embedded Systems, IIT Madras: https://nptel.ac.in/courses/128108016

Course: Internet of Things Architectures, Protocols and Systems Programming			Code: 25ETHNR202	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	3	3	CCA	20
			ISE	30
			ESE	50

- **Prerequisites: Computer Networks, Embedded Systems**

- **Course Objectives:**

Objective of this course is to provide students with

1. The knowledge and understanding of Internet of Things
2. Provide a strong foundation of fundamentals of Internet of Things and need of IoT Security
3. Get acquainted with various communication protocols of Internet of Things
4. Detailed understanding of present scope of Internet of Things with case studies

- **Course Outcomes:** At the end of the course, students will be able to:

CO1. Model Internet of Things using various protocols of standard communication layers
CO2. Represent and analyze various communication models, carry out the comparative analysis in terms of specified parameters
CO3. Choose an appropriate communication model for given design criteria
CO4. Understand essentials of IoT Security
CO5. Provide most optimum model of connectivity solution to various things in different application areas.

- **Course Contents:**

Unit I	Introduction to Internet of and Things (IoT)	8 Hours

Introduction: Enabling Technologies of IoT, Logical Design of IoT, IoT communication Models, IoT Communication API‟s Cloud Services: IAAS, PAAS, SAAS, IoT Specific Cloud Services RFID: Introduction to RFID and its Applications in IoT.

Unit II	IoT Protocols	10 Hours

PHY/MAC Layer: Wireless HART, ZWave, Bluetooth Low Energy, Zigbee Smart Energy
Network Layer: IPv4, IPv6, 6LoWPAN, ICMP, RPL,COAP
Transport Layer: (TCP, UDP, DCCP, SCTP)-(TLS, DTLS)
Session Layer: HTTP, CoAP, XMPP, AMQP, MQTT

Unit III	IoT Security	8 Hours

Vulnerabilities Security Requirements and Threat Analysis, Misuse Cases, IoT Security Tomography, and Layered Attacker Model, Identity Management and Establishment, Access Control, and Secure Message Communication, Security Models, IoT Security Protocols.

Unit IV	System Software for IoT	8 Hours

Software for IoT Development Boards like Arduino, Raspberry Pi, Beagle Bone, Intel Galileo: IDE, Simulator, Emulator, Debugger, OS , Software Libraries for Internet connectivity Devices, Gateways, Internet, and Web/Cloud Services Software Development Prototyping Online Component API and Web APIs

Unit V	IoT Case Studies	8 Hours

Smart Cities, Agriculture, Health and Lifestyle, Industry, Home Automation, Telecom/5G.

Course activities for CCA Evaluation: Any two

1. IoT Architecture and Application Study
   Students study a real-world IoT application (Smart Home, Smart City, Healthcare, Agriculture, etc.) and prepare a report explaining enabling technologies, communication models, cloud integration, and system architecture.
2. IoT Protocol Analysis Assignment
   Students compare IoT communication protocols such as MQTT, CoAP, HTTP, ZigBee, BLE, and 6LoWPAN based on architecture, features, advantages, limitations, and applications.
3. IoT Security Case Study
   Students analyze a security breach or cyberattack involving IoT devices and identify vulnerabilities, threats, security requirements, and mitigation techniques.
4. IoT Development Platform Exploration
   Students explore Arduino, Raspberry Pi, BeagleBone, or similar IoT development boards and prepare a technical presentation on hardware specifications, software tools, and application domains.
5. Cloud-Based IoT Application Design
   Students design a cloud-connected IoT solution using IoT cloud platforms and APIs. The activity includes system architecture, data flow, communication protocol selection, and dashboard design.
6. Mini Project: IoT Prototype Development
   Students develop a simple IoT-based prototype such as Smart Lighting, Smart Irrigation, Environmental Monitoring, or Home Automation using sensors, microcontrollers, and cloud services.
7. Technical Seminar on Emerging IoT Trends
   Students deliver a seminar on emerging technologies such as Industrial IoT (IIoT), IoT in 5G Networks, Edge Computing, Digital Twins, Smart Healthcare, or AIoT.
8. Case Study Presentation on IoT Applications
   Students investigate and present case studies related to Smart Cities, Agriculture, Healthcare, Industry 4.0, Home Automation, or Telecom/5G-enabled IoT systems.
9. IoT Network and Protocol Simulation
   Students use simulation tools or protocol analyzers to study communication between IoT devices and analyze packet exchange, latency, throughput, and protocol behavior.
10. Literature Review Activity
    Students review recent research papers, IEEE articles, or industry reports on IoT technologies and submit a summary highlighting key innovations and future challenges.

- **Text books:**

1. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on Approach)”, University Press 1st Edition, 2014
2. Jeeva Jose, “Internet of Things”, ISBN-10 : 938617359X, Khanna Book Publishing, 2018
3. Raj Kamal, Internet of Things: Architecture and Design Principle” , ISBN-13: 978-93-5260-522-4, McGraw Hill Education (India) 2017

- **Reference Books:**

1. The Internet of Things: From RFID to the Next-Generation Pervasive Networked Lu Yan,Yan Zhang, Laurence T. Yang, Huansheng Ning
2. Designing the Internet of Things , Adrian McEwen (Author), Hakim Cassimally
3. Hakima Chouchi, “The Internet of Things Connecting Objects to the Web”, ISBN 078 -1-84821-140-7, Wiley Publications
Asoke K Talukder and Roopa R Yavagal, “Mobile Computing,” Tata McGraw Hill, 2010.
4. Computer Networks; By: Tanenbaum, Andrew S; Pearson Education Pte. Ltd., Delhi, 4th Edition
5. Data and Computer Communications; By: Stallings, William; Pearson Education Pte.Ltd., Delhi, 6th Edition

- **MOOC / NPTEL Courses:**
  1. NPTEL course on Introduction to internet of things IIT Kharagpur, Prof. Sudip Misra: https://nptel.ac.in/courses/106105166

Course: Embedded Systems and Internet of Things Laboratory			Code: 25ETHNR201L
Teaching Scheme (Hrs./Week)		**Credit**	**Evaluation Scheme**
Practical	2	1	Practical	Marks: 25

- **Prerequisites:**

- **Course Objectives:**
  1. To understand the fundamentals and functionality of various embedded board platforms.
  2. To design and implement interconnection and integration of sensors to embedded board platform.
  3. To design and implement application of IoT using various sensors

Course Outcomes: At the end of the course, students will be able to:
CO1. Understand the working of embedded boards.
CO2. Apply the knowledge to interface various sensors with IoT development board.
CO3. Design and implement IoT system for real time applications.

List of Experiments

Group A

1. Study of Raspberry Pi 4, Arduino board and Operating systems for the same. Understand the process of OS installation on the Raspberry Pi.
2. Study of different sensors:- temperature sensor, bio-sensor, IR sensor, chemical sensor(PH), gauge sensor, ultrasonic sensor etc.
3. Understand the connection and configuration of GPIO and its use in programming. Write an application of the use of push switch and LEDs.
4. Write an application to read temperature from the environment. If temperature crosses threshold value then it notifies with buzzer.

Group B

5. Interface IR sensor to Raspberry Pi/ Arduino. Write a program to detect obstacle using IR sensor and notify it using LED.
6. Understanding and connectivity of Raspberry-Pi /Beagle board with a Zigbee module. Write a network application for communication between two devices using Zigbee to on and off remote led.
7. Interface stepper motor and seven segment display with Raspberry Pi/Arduino and write a program to control the motion of motor and display number of rotation made by motor on 7 segment display.
8. Write an application using Raspberry Pi/Arduino for streetlight control system. System consists of smart street lights that have external light sensing that automatically turns on at desired intensity based on amount of lighting needed.
9. Write an application using Raspberry Pi/Arduino for traffic signal monitoring and control system.
10. Write an application using Raspberry Pi/Arduino for smart health monitoring system which records heart beat rate and temperature and also sends sms alerts if readings are beyond critical values.
11. Implement a weather monitoring system using humidity, temperature and raindrop sensor and Raspberry Pi/Arduino board.
12. Create a simple web interface for Raspberry-Pi/Beagle board to control the connected LEDs remotely through the interface.

Group C

13. Internet of things enabled real time water quality monitoring system

14. Implement smart home automation system. The system automates home appliances and control them over internet from anywhere.
15. Develop a Real time application like a smart home security.
Description: When anyone comes at door the camera module automatically captures his image and sends a notification to the owner of the house on his mobile phone using GSM modem.

Course: Internet of Things Architectures, Protocols and Systems Programming Lab				Code: 25ETHNR202L
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Practical	2	1	Practical	Marks: 25

- **Prerequisites:** Computer Networks, Embedded Systems

- **Course Objectives:**
  1. Explain the fundamental concepts and architecture of the Internet of Things (IoT)
  2. Describe the core principles of IoT along with the significance and requirements of IoT security.
  3. Analyze various communication protocols used in IoT systems.

- **Course Outcomes:** At the end of the course, students will be able to:

CO1. Apply IoT concepts by implementing sensor interfacing, communication protocols, and simulation tools.
CO2. Analyze different communication techniques and data transmission methods for efficient and reliable IoT systems.
CO3. Design IoT-based solutions for real-world applications using appropriate hardware, software, and networking technologies.

List of Experiments

1. Implement interfacing of temperature, humidity, and motion sensors with a microcontroller ESP32 and observe sensor outputs.
2. Implement MQTT protocol for device-to-device communication.
3. Send sensor data to cloud using HTTP/HTTPS.
4. Implement Bluetooth/BLE communication between two devices to transmit and receive data.
5. Implement and test a Wi-Fi based data transmission system using ESP8266/ESP32 for reliable communication.
6. Simulate IoT-based circuits using Tinkercad or Proteus to verify functionality before hardware implementation.
7. Install and configure Raspberry Pi OS on a Raspberry Pi and execute basic networking tasks.
8. Design and implement a smart parking system.

Virtual Laboratories:
https://iot-amrt.vlabs.ac.in/List%20of%20experiments.html

Course: Analog Communication				Code: 25ETMNR201
Teaching Scheme (Hrs./Week)		**Credit**	**Evaluation Scheme**	
Lecture	3	3	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** Basic Electronics Engineering

- **Course Objectives:**
  1. To equip/ familiarize students with basic fundamentals of communication systems.
  2. To acquaint the students with the fundamental principles of modulation process and different amplitude and angle modulation systems.
  3. To introduce the students with the concept of Sampling theorem and pulse modulation techniques PAM, PWM, PPM.
  4. To impart pre-requisites of digital communication systems and explore digital representation techniques like PCM, DPCM, DM and ADM.

- **Course Outcomes:** At the end of the course, students will be able to:

CO1: Describe the fundamentals of communication systems.
CO2: Apply amplitude modulation and demodulation techniques to analyze AM system performance.
CO3: Apply frequency modulation and demodulation techniques to analyze FM system performance.
CO4: Examine analog to digital conversion techniques and execute pulse modulation schemes for digital Communication systems.
CO5: Interpret real-world applications of communication systems.

- **Course Contents:**

Unit I	Fundamentals of Communication System	9 Hours

Introduction to Communication System, Block Diagram of Communication System, Types of Communication System: Analog, Digital, Wired and Wireless, Regenerative repeaters, Types of Noise: External and Internal, Noise Calculations, Noise Figure, Concept of baseband and bandpass signals.

Unit II	Amplitude Modulation and Demodulation Techniques	9 Hours

Need of Modulation, Amplitude Modulation (AM), Types of AM, Modulation Index, Spectrum of AM, Double Sideband Suppressed Carrier (DSB-SC) Modulation, Single Sideband Modulation (SSB), Power Efficiency, Envelope Detection, AM receiver.

Unit III	Frequency modulation and demodulation Techniques	8 Hours

Concept of FM, Modulation index, Spectrum, bandwidth, power and Relationship between Phase Modulation (PM) and Frequency modulation, features of Bessel coefficient, Narrow band and wideband FM, FM modulator and demodulator, FM detection using PLL .

Unit IV	Pulse Modulation Techniques	7 Hours

Need of analog to digital conversion, sampling theorem, Nyquist criteria, Types of sampling: Natural and Flat top. Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM) and Pulse Position Modulation (PPM)- Generation and Detection.

Unit V	Digital Representation of Analog Signals	7 Hours

Quantization of Signals: Quantization error, Uniform & Non-Uniform types of Quantization, Mid-rise & Mid-tread Quantizer. Pulse Code Modulation system: Generation & Reconstruction, Differential Pulse code modulation, Delta Modulation, Adaptive Delta Modulation.

• **Continuous Comprehensive Assessment (Any Two (CCA1 Compulsory)**	20 Marks

CCA 1	**List of Course Activity (Any One)**	**10 Marks**

Mini project –

1. To build an AM detector circuit using a diode envelope detector.
2. To build a 555 timer–based PWM generator and observe waveforms on a CRO, Mini project

CCA 2	**Case Study/Group Discussion/Seminar**	**10Marks**

List of Case Study:

1. FM Radio Broadcasting System
2. AM Radio Broadcasting System
3. Mobile Communication (4G/5G)
4. Satellite Communication
5. Walkie-Talkie Communication

CCA 2	**Group Discussion/Seminar**	**10Marks**

Group Discussion/Seminar: Topic from unit 1 to 5

- **Text Books:**

1. Taub, Schilling and Saha, “Principles of Communication Systems”, McGraw-Hill, 4th Edition.

2. B P Lathi, Zhi Ding, “Modern Analog and Digital Communication System”, Oxford University Press.

- **Reference Books:**

1. Bernard Sklar and Prabitra Kumar Ray, “Digital Communications Fundamentals and Applications”, Pearson Education 2nd Edition.

1. George Kennedy, Benard Davis, S R M Prasanna, “Electronic Communication Systems”, McGraw Hill Education.

3. Wayne Tomasi, “Electronic Communications System”, Pearson Education, 5th Edition.

4. A.B Carlson, P B Crully and J C Rutledge, “Communication Systems”, Tata McGraw Hill Publication, 5th Edition.

5. Simon Haykin, “Communication Systems”, John Wiley & Sons, 4th Edition.

- **MOOC / NPTEL Courses:**

1. NPTEL course on Analog Communication – IIT Kharagpur by Prof. Goutam Das: https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_ee74

Course: Digital Communication			Code: 25ETMNR202	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	3	3	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** Computer network, Fundamentals of Wireless Communication

- **Course Objectives:**

1. **To Introduce** the fundamentals and block diagram of digital communication systems
2. **To Analyze** digital modulation schemes
3. **To Describe** spread spectrum modulation techniques
4. **To Explain** information theory concepts and source coding theorems.
5. **To Understand** error-control coding techniques

- **Course Outcomes:** At the end of the course, students will be able to:

CO1: Understand the concepts of digital communication systems.

CO2: Describe various digital modulation schemes

CO3: Apply spread spectrum modulation techniques for communication

CO4:. **Explain** information theory concepts and source coding principles.

CO5: Analyze error-control coding techniques for error detection and correction in digital communication systems.

- **Course Contents:**

Unit I	Introduction to Digital Communication	6 Hours

Introduction to Digital Communication System: Block Diagram, Basic Digital Communication Nomenclature, Digital Multiplexing: Multiplexers and hierarchies, Data Multiplexers. Data formats and their spectra, synchronization: Bit Synchronization, Scramblers, Frame Synchronization. Inter-symbol interference, Eye Diagram, Equalization

Unit II	Digital Modulation Techniques	6 Hours

. Pass band transmission model, Signal space diagram, Generation and detection, Error Probability, derivation and Power spectra of coherent BPSK, BFSK and QPSK. Geometric representation, Generation and detection of - M-ary PSK, M-ary QAM and their error probability, Non-coherent BFSK, DPSK.

Unit III	Spread Spectrum Modulation	6 Hours

Pseudorandom (PN) Sequences**:** Generation and Characteristics, Synchronization in Spread Spectrum Systems Use of Spread Spectrum, Direct Sequence (DS) Spread Spectrum, Spread Spectrum and Code Division Multiple Access (CDMA), Ranging Using DS Spread Spectrum, Frequency Hopping (FH) Spread Spectrum,

Unit IV	Information Theoretic Approach to Communication System	6 Hours

Introduction to information theory, Entropy and its properties coding, Channel capacity, Channel coding theorem, Information Capacity theorem, Source coding theorem, Huffman coding, Shannon-Fano.

Unit V	Error-Control Coding	6 Hours

Linear Block Codes: Coding, Syndrome and error detection, Error detection and correction capability, Standard array and syndrome decoding. Cyclic Codes: Coding & Decoding, Convolutional Codes: Coding & Decoding.

Course activities for CCA evaluation: Any two

1. Demonstrate Time Division Multiplexing (TDM) using any simulation tool.
2. Simulation of BPSK & QPSK waveforms

3. Study and simulate BPSK Bit error Rate in presence of noise.
4. Poster Presentation on signal constellation diagrams for various modulation techniques.
5. Seminar on spread spectrum communication & CDMA technology in mobile networks.
6. Study on Calculation of entropy for different message sources.
7. Presentation on Claude Shannon and Information Theory.
8. A case study on modern coding techniques such as Turbo Codes and LDPC Codes.
9. Seminar on Applications of Digital Communication in Modern Wireless Systems
10. Report on 5G Communication.

- **Text Books:**

1. Taub, Schilling and Saha, “Principles of Communication Systems”, McGraw-Hill, 4th Edition,
2. B.P. Lathi, Zhi Ding , “Modern Analog and Digital Communication System”, Oxford University Press, 4th Edition.

- **Reference Books:**

1. Bernard Sklar, Prabitra Kumar Ray, “Digital Communications Fundamentals and Applications”, Pearson Education, 2nd Edition
2. Wayne Tomasi, “Electronic Communications System”, Pearson Education, 5th Edition
3. A.B Carlson, P B Crully, J C Rutledge, “Communication Systems”, Tata McGraw Hill Publication, 5th Edition
4. Simon Haykin, “Communication Systems”, John Wiley & Sons, 4th Edition
5. Simon Haykin, “Digital Communication Systems”, John Wiley & Sons, 4th Edition.

- **MOOC / NPTEL Courses:**

1. NPTEL Course on Digital Communications by Prof. Abhishek Dixit|IIT Delhi: https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_ee10

Course: Analog Communication Laboratory			Code: 25ETMNR201L
Teaching Scheme (Hrs./Week)		**Credit**	**Evaluation Scheme**
Practical	2	1	Practical — Marks: 25

- **Prerequisites:** Basic Electronics Engineering

- **Course Objectives:**
  1. Understand and implement analog and digital modulation techniques and analyze their performance parameters.
  2. Study signal sampling, encoding, and detection methods used in modern communication systems.
  3. Develop programming skills for analyzing communication system parameters such as SNR, Sampling and PCM companding.
  4. Explore practical communication hardware, measurement techniques, and system architectures used in real-world applications**.**

- **Course Outcomes:** At the end of the course, students will be able to:

CO1: Analyze AM (DSB-FC) and FM signals.
CO2: Verify the Sampling Theorem in the time domain and examine the effects of under-sampling and over-sampling on signal reconstruction.
CO3: **Analyze** the generation and detection processes of Delta Modulation (DM) and Adaptive Delta Modulation
CO4: **Measure** the resonant frequency of different antennas using a **Vector Network Analyzer (VNA)**

List of Experiments (Any 10)

List of Experiments

1. AM Generation (DSB-FC): Calculation of modulation index by graphical method, Power of AM Wave for different modulating signal and Observe Spectrum.
2. Frequency modulator & demodulator using Varicap/Varactor Diode and NE 566 VCO, IC 565 (PLL based detection), calculation of modulation index & BW of FM.
3. Verification of Sampling Theorem in time domain (Flat top & Natural sampling).
4. Generation and Detection of PWM using IC 555
5. Study of DM: Generation and detection
6. Study of ADM: Generation and detection
7. Write a program to calculate Signal to noise ratio for PCM system & DM system
8. Write a program to demonstrate PCM Companding.
9. Write a program to Verify Sampling Theorem
10. Project based Learning / Poster Presentation Choose one communication application and presents the system architecture.
11. Measure resonant frequency for different Antenna using VNA.

Course: Digital Communication Laboratory			Code: 25ETMNR202L
Teaching Scheme (Hrs./Week)		**Credit**	**Evaluation Scheme**
Practical	2	1	Practical / Marks: 25

- **Prerequisites:** Analog Communication

Course Objectives:

1. To familiarize students with various digital modulation techniques used in digital communication systems.
2. To equip students the students with tools required for performance analysis of digital communication systems.
3. To introduce the students with the concept of information theory & coding techniques.

- **Course Outcomes:** At the end of the course, students will be able to:

CO1: Analyze the operation and performance of digital communication systems
CO2: Evaluate the performance of communication systems in the presence of noise
CO3: Implement the source coding and channel coding techniques

List of Experiments (Any 8)

1. Study of BPSK transmitter & receiver using suitable hardware setup/kit.
2. Study of QPSK transmitter & receiver using suitable hardware setup/kit.
3. Study of BFSK transmitter & receiver using suitable hardware setup/kit.
4. Study of Baseband receiver performance in presence of Noise using suitable hardware setup/kit.
5. Study of DSSS transmitter and receiver using suitable hardware setup/kit.
6. Simulation Study of performance of BPSK receiver in presence of noise.
7. Simulation study of various Entropies and mutual information in a communication system.
8. Simulation Study of CDMA technique.
9. Simulation study of Source Coding technique
10. Simulation LBC Coding and decoding using suitable software
11. Case study on OFDM transmitter & receiver.

Dr. S. B. Dhonde	Dr. D. Y. Dhande	Dr. D.S. Bormane
BOS Chairman, E&TC Engineering	Dean Academics	Principal

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