SEMESTER I

Course Code: 24HSM101	**Course Title: Professional English I**	
Course Category: HSMC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks: 100**

COURSE OBJECTIVES
• To learn the speaking skills for various social and academic contexts.
• To Enhance critical reading skills for analytical thinking and purposeful questioning.
• To understand the prediction and inference strategies of interaction.
• To Provide clear and concise written content.
• To demonstrate accurate applications of grammar rules.

UNIT I	**INTRODUCTION TO EFFECTIVE SPEAKING**	**9**
Listening: short text, formal & informal conversation, telephone conversation, Classroom lectures -**Speaking** : Introducing oneself, one's family / friend, Talk about preferences, Agree and Disagree, Giving opinions -**Reading**: Telephone message, Introduction of different kinds of reading materials (Technical and Non– technical) -**Writing**: principles of writing, Word formation, Word expansion (root words / etymology), Hints development, Reading comprehension exercises -**Grammar** : Parts of speech, Questions, WH type, Yes/ No and Tag Questions.		
UNIT II	**DIFFERENT STRATEGIES OF READING**	**9**
Listening : Listening to travel podcast, travel documentary, Listening and responding to video lectures/Talks- **Speaking** : Strategies for good conversation, Improving fluency and self– expression, Articulation, Accent and intonation- **Reading:** Different reading strategies, Skimming, Scanning, Newspaper report- **Writing: Descriptions**, Instructions, Recommendations, Definitions, Single sentence definition -**Grammar:** Types of sentences, Prepositions, Modal verbs.		
UNIT III	**GROUP INTERACTION**	**9**
Listening: Radio and TV advertisements, speeches of great personalities -**Speaking**: Group interaction, Speaking in formal situations (teachers, officials, foreigners), role-play -**Reading**: An article, excerpts from literature - **Writing**: Paragraph writing, Letter writing, Formal, informal -**Grammar**: Synonym and antonym, Tenses, Adjectives, Cause and Effect expressions.		

UNIT IV	INTRODUCTION TO EFFECTIVE WRITING	9
Listening: Listening to announcements, discussions/debates, Speaking, Responding to questions, Different forms of interviews, welcome address, vote of thanks - **Reading** : Longer technical texts, social media posts and brochures, comparing facts and figures- **Writing**: Email, etiquette, summarizing and paragraphing, Single word substitutes, Free writing on any given topic (My favorite place/ Hobbies/ School life, etc.)- **Grammar**: sentence pattern, idioms, Adverbs and Phrasal verbs.		
UNIT V	**EFFECTIVE WRITING**	**9**
Listening :Listening to dialogues, conversations and completing exercises based on them, Listening to longer texts and filling up the table- **Speaking** : sharing information of a personal kind, greeting, peer discussion- **Reading**: Reading and understanding specific meaning in a text , note making, reviews related to given topic - **Writing** :Types of essays, story writing, dialogue writing, use of abbreviations and acronyms –**Grammar**: transformation of sentences (simple, compound and complex), Collocations, fixed and semi fixed expressions.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Develop the strong knowledge in speaking.
CO2: Enhance the different strategies of reading skills.
CO3: Emphasizes critical thinking during group interactions.
CO4: Apply skills to write the information effectively.
CO5: Identify advanced writing abilities for writing practices.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						2	1	3	3	2	3		1		1
CO2						3	1	3	3	3	3		2		2
CO3						3	1	3	3	3	3		2		2
CO4						3	1	3	3	3	3		2		2
CO5						3	1	3	3	3	3		2		2

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Locker Kitty O and Stephen KyoKaczmarek., "Business Communication: Building Critical Skills", 6th Edition, McGraw – Hill, 2023.
T2.	Richards, Jack C., "Interchange Student's Book", 4th Edition, Cambridge University Press, 2015.
T3.	Orient Blackswan, "English for Engineers and Technologists", Volume 1, 2022.

REFERENCE BOOK(S)	
R1.	Rudolph F. Verderber and Kathleen S. Verderber., "Communicate! A Handbook for Interpersonal Communication Cengage Learning", 2017.
R2.	Wallwork Adrian., "English for Academic Correspondence and Socializing", Springer, 2011.
R3.	Raman, Meenakshi and Sangeetha Sharma., "Technical Communication: Principles and Practice", Oxford University Press, 2014.

Course Code: 24BSC101	Course Title: Matrices and Calculus	
Course Category: BSC	Credits: 4	
L:T:P (Hours/Week) 3:1:0	Total Contact Hours: 60	Max Marks: 100

COURSE OBJECTIVES
• To enhance the matrix algebra and properties.
• To acquire the knowledge of differential calculus.
• To Analyze and solving partial differentiation.
• To gain knowledge in integral calculus and apply it to practical challenges.
• To enhance problem-solving by utilizing triple integral calculus.

UNIT I	MATRICES	9+3
Eigen values and Eigenvectors of a real matrix, Properties of Eigen values and Eigenvectors – Cayley Hamilton theorem (excluding proof) – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation .		
UNIT II	**DIFFERENTIAL CALCULUS**	**9+3**
Representation of functions, Limit of a function, Continuity, Derivatives - Differentiation rules -Applications Maxima and Minima of functions of one variable, Absolute maximum and Absolute minimum – Concave upward, Concave downward.		
UNIT III	**MULTI VARIABLE CALCULUS**	**9+3**
Partial differentiation, Homogeneous functions and Euler's theorem – Total derivative, Change of variables – Jacobian's – Taylor's series for functions of two variables – Applications- Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.		
UNIT IV	**DOUBLE INTEGRAL**	**9+3**
Double integrals, Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves, Change of variables in double integrals.		
UNIT V	**TRIPLE INTEGRAL AND ITS APPLICATIONS**	**9+3**
Evaluation of Triple integrals, Simple Problems – Volume as triple integrals, Volume of solids, Change of variables in triple integrals.		
		Total: 60 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Gain and solve problems of matrix.
CO2: Create the notions of derivatives, limits, and continuity to display them.
CO3: Optimize functions by applying differentiation to partial derivatives.
CO4: Solve double integrals and coordinate transformations.
CO5: Understand the concept and geometric interpretation of triple integrals.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1								1	1	1	1
CO2	2	2	2	1								1	1	2	1
CO3	3	3	2	2								1	1	2	1
CO4	3	3	2	2								1	1	2	1
CO5	3	3	2	2								1	1	2	1

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Kreyszig Erwin, "Advanced Engineering Mathematics", 10th Edition, John Wiley And Sons (Asia) Limited, New Delhi, 2019.
T2.	James Stewart, "Calculus: Early Transcendental", 9th Edition, Cengage Learning, New Delhi, 2017.
T3.	David C Lay, "Linear Algebra and its Applications", 5th Edition, Pearson Publications, India, 2016.

REFERENCE BOOK(S)

R1.	Jain, R. K. and Iyengar, S.R.K., "Advanced Engineering Mathematics", 5th Edition, Narsa Publications, New Delhi, 2017.
R2.	Srimantha Pal and Bhunia, S.C, "Engineering Mathematics", Oxford University Press, 2015.
R3.	Patrick M and Fitz Patrick, "Advanced Calculus", 2nd Edition, American Mathematical Society, 2006.

Course Code: 24BSC102	Course Title: Engineering Physics	
Course Category: BSC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks: 100

COURSE OBJECTIVES
• To utilize the properties of matter and structure in engineering applications.
• To understand the fundamentals of laser and fiber optics and applications.
• To scrutinize the characteristics of matter and the methods of energy exchange.
• To examine and elucidate semiconductor materials and their applications.
• To provide a summary of concepts in quantum theory.

UNIT I	PROPERTIES OF MATTER	9
Introduction, Elasticity- Stress– strain: Types of strain– Hooke's law– Stress – Strain Diagram and uses – Yield point – Elastic limit, Elastic moduli , Types of elastic moduli , Relation between elastic constants, Poisson's Ratio , Factors affecting elasticity – Bending of beam, Expression for bending moment and depression – Cantilever: Theory and Experimental determination– Expression for Young's modulus by Non uniform, Uniform bending and experimental determination– I– shape girders, Other states of matter.		
UNIT II	**LASER AND FIBER OPTICS**	**9**
LASER: Interaction of radiation with matter (Quantum mechanical view) : Principle of spontaneous emission and stimulated emission- Einstein Coefficients, Derivation, Difference between spontaneous emission and stimulated emission, Basic components in Laser, Principle of laser, properties of laser – Types of lasers: Nd– YAG laser, CO_2 laser, Semiconductor laser-Homojunction, Heterojunctions, Application of laser. FIBER OPTICS: Principle of optical fibers, acceptance angle, total internal reflection, numerical aperture, types of optical fibre- losses in fibres: scattering losses, absorption losses – fiber optics sensors: Displacement sensors, pressure sensor with micro bending concept, application of fiber optic sensors, characteristics advantages of fiber optical sensors.		
UNIT III	**THERMAL PHYSICS**	**9**
Transfer of heat energy -conduction, convection, radiation -Thermal expansion of solids: Relation between α and β,Thermal expansion of liquids- Thermal Conduction/Conductivity: Heat conduction in solids, Heat Conduction through Compound media Series and Parallel, Radial flow of Heat, Analogy between thermal and electrical conduction – Experimental Measurement of Thermal Conductivity: Forbes Method (Good Conductor), Lee's Disc		

Method for finding Thermal Conductivity (Bad Conductor) – Convection: Thermal insulation, U– values– Radiation: High temperature furnace, Heat Exchangers, Greenhouse effect, Solar power, Refrigerators, Ovens.		
UNIT IV	**SEMICONDUCTOR AND ITS APPLICATION**	**9**
Introduction – Basics of the band theory of solids, Types of semiconductors, Hall effect, determination of Hall coefficient – P– N junction diode – voltage – current characteristics of a P– N junction diode - Introduction to optoelectronic devices: LED– construction, working and applications - OLED, construction, working and applications – Solar cell: construction, working and applications.		
UNIT V	**QUANTUM PHYSICS**	**9**
Introduction - Black body radiation - Compton effect: theory and experimental verification – wave particle duality, electron diffraction, concept of wave function and its physical significance - Schrödinger's wave equation ,time independent and time dependent equations, particle in a one, dimensional box – Tunneling, Scanning tunneling microscope.		
Total: 45 Hours		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Apply the knowledge of properties of matter to engineering applications.
CO2: Analyze and characterize fiber optics and laser beams.
CO3: Develop the behavior of thermal system.
CO4: Analyze and explain the semiconductor materials and application.
CO5: Gain a basic understanding of quantum theory and its principles.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	2	2						2	1	
CO2	3	2	2	1	2	2	2					1	2	1	
CO3	3	2	2	2	2	2	1				1		2	1	
CO4	3	2	2	2	2	2	2					1	2	1	
CO5	3	2	1	2	2	2	2						2	1	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Avathanulu, M.N and Kshirsagar, P.G, "A text book of Engineering Physics", 11th Edition, S. Chand and company, 2014.
T2.	Bhattacharya, D.K and Poonam, T., "Engineering Physics", Oxford University Press,

	2017.
T3.	Halliday, D., Resnick, R. and Walker, J., "Principles of Physics", 9th Edition, Wiley, 2010.

REFERENCE BOOK(S)	
R1.	Arthur Beiser, "Concepts of Modern Physics", 9th Edition, Tata McGraw Hill, 2021.
R2.	Gaur, R. K. and Gupta, S. L., "Engineering Physics", Dhanpat Rai Publications, Edition 2014.
R3.	Muhammad H. Rashid, "Power Electronics", Pearson Education / PHI, 4th Edition 2014.

Course Code: 24ESC101	Course Title: Basic Electrical and Electronics Engineering	
Course Category: ESC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks: 100

COURSE OBJECTIVES
• To introduce the basics of electrical fundamentals.
• To explain about Electrical Safety.
• To understand the concepts of electrical machines.
• To impart the knowledge of various Measuring Instruments.
• To study the basics of electronics and digital electronics.

UNIT I	ELECTRICAL FUNDAMENTALS	9
Current, Voltage, Types, Resistor, Inductor, Capacitor, Ohm's law - Fuse, Characteristics of fuse element, fuse materials, Types, Current carrying capacity – A.C fundamentals, single phase and three phase connections, Domestic wiring – Earthing: Methods of earthing- Protective devices– Circuit Breaker – Types – Efficient use of electricity– Tariff – Types – Energy calculation.		
UNIT II	**ELECTRICAL SAFETY**	**9**
Terms and definitions: objectives of safety and security measures – Hazards associated with electric current and voltage- Primary and secondary electrical shocks, Possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects – Prevention of shocks, Safety precautions against contact shocks, Safety precautions and First Aid, Do's and Don'ts for safety in the use of domestic electrical appliances.		
UNIT III	**ELECTRICAL MACHINES AND TRANSFORMER**	**9**
DC Generator: Construction, Principle of Operation, EMF equation, Types. DC Motor: Principle of Operation, Types - Single Phase Transformers: Construction, Working Principle, Applications. (Qualitative Treatment only for all topics).		
UNIT IV	**MEASUREMENTS AND MEASURING INSTRUMENTS**	**9**
Introduction -Analog and Digital instruments, types, PMMC, MI instruments, Measurement of Power, Power in DC and AC circuits: Measurement in single phase circuits, Measurement of Energy. Constructional and working principles of energy meter: Megger – Multimeter, Oscilloscope – Signal generation, signal analysis and fibre optics measurements.		
UNIT V	**ELECTRONICS FUNDAMENTALS & DIGITAL**	**9**

	ELECTRONICS	
P– N junction diode: VI characteristics – Zener Diode– Half wave and Full wave rectifiers– BJT – PNP and NPN – Filters – Optoelectronic devices. Binary Number System, Logic Gates, Boolean Algebra, Full and Half Adders, A/D Conversion and D/A Conversion.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Apply the basic concepts in Electrical Engineering.
CO2: Identify the concepts of Electrical Safety.
CO3: Demonstrate the concepts of DC machines and Transformers.
CO4: Understand the applications of measuring equipment.
CO5: Analyze the operation of Electronic devices and characteristics.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1								1	1	1
CO2	2	1	2	2	1								1	2	2
CO3	1	2	2	2	1								1	1	1
CO4	2	2	3	2	1								1	2	2
CO5	3	3	3	2	1								1	2	2

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Kothari, D.P. and Nagrath, I.J., "Basic Electrical and Electronics Engineering", 2nd Edition, McGraw Hill Education, 2020.
T2.	Bhattacharya, S.K., "Basic Electrical and Electronics Engineering", 2nd Edition, Pearson Education, 2020.
T3.	Sedha, R.S., "A textbook book of Applied Electronics", S. Chand & Co., 2008.

REFERENCE BOOK(S)

R1.	Kothari, D. P. and Nagrath, I.J., "Basic Electrical Engineering" , 4th Edition, McGraw Hill Education, 2019.
R2.	Thomas L. Floyd, "Digital Fundamentals", 11th Edition, Pearson Education, 2017.
R3.	Albert Malvino and David Bates, "Electronic Principles", 9th Edition, McGraw Hill Education, 2017.

Course Code: 24ESC103	Course Title: Engineering Graphics	
Course Category: ESC	Credits: 4	
L:T:P (Hours/Week) 2:0:4	Total Contact Hours: 90	Max Marks: 100

COURSE OBJECTIVES
• To apply knowledge of engineering drawings.
• To impart skill on orthographic projections.
• To familiarize on projection of planes and simple solids.
• To enhance the knowledge on section of solids.
• To develop skills on conversion of isometric view.

UNIT I	CONCEPTS AND PLANE CURVES	6+12
Definition: standards, drawing tools, drawing sheets, scales, line and its types. Practices on lettering, numbering, dimension of drawings. Construction of conic sections: ellipse, parabola and hyperbola using eccentricity method – Cycloid and involute of circle and square.		
UNIT II	**PROJECTION OF POINTS, LINES AND PLANE SURFACE**	**6+12**
Orthographic projection: principles, Principal planes – First angle projection: projection of points. Projection of straight lines inclined to both the principal planes – Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes inclined to both the principal planes by rotating object method (Square, Circle, Polygonal surfaces).		
UNIT III	**PROJECTION OF SOLIDS AND FREE HAND SKETCHING**	**6+12**
Projection of simple solids like prisms: pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method- Layout of views – Freehand sketching of multiple views from pictorial views of objects by free hand sketching.		
UNIT IV	**PROJECTION OF SECTIONED SOLIDS AND DEVLOPMENT OF SURFACES**	**6+12**
Introduction to section of solids: Section of simple solids in simple vertical position, when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section-Development of lateral surfaces of truncated prisms, pyramids, cylinders and cones. Application of sections of solids and development of lateral surfaces.		

UNIT V	ISOMETRIC AND PERSPECTIVE PROJECTION	6+12

Principles of isometric projection: isometric scale – Isometric projections of simple solids and truncated solids – Prisms, pyramids, cylinders, cones – combination of two solid objects in simple vertical positions – Applications of isometric projection-Perspective projection of simple solids – Prisms, pyramids and cylinders by visual ray method – Applications of perspective projection.

COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY NOT FOR EXAMINATION)

Introduction to computer aided drafting and dimensioning using appropriate software - 2D drawing commands: Zoom, Picture editing commands, Dimensioning, Isometric drawing, Isoplanes and 3D drafting- Plotting of drawing-Practice includes drawing the projection of lines and solids- Prepare isometric view of simple solids like prisms, pyramids, cylinders and cones.

Total : 90 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Develop the fundamentals of engineering drawings.
CO2: Construct the shape projections.
CO3: Design the shape projection models
CO4: Identify the development of projection models for solids.
CO5: Demonstrate the orthographic, isometric view and perspective projections.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	1	1						1	1	1	1	1
CO2	2	1	2	1	1						1	1	1	1	1
CO3	2	1	2	1	1						1	1	1	1	1
CO4	2	1	2	1	1						1	1	1	1	1
CO5	2	1	2	1	1						1	1	1	1	1

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Venugopal, K. and Prabhu Raja, V., "Engineering Graphics", New Age International (P) Limited, 2019.
T2.	Natrajan, K.V., " A text book of Engineering Graphics" , Dhanalakshmi Publishers, Chennai, 2019.

T3.	Parthasarathy, N. S. and Vela Murali, “Engineering Drawing”, Oxford University Press, 2015.

REFERENCE BOOK(S)	
R1.	Bhatt, N.D, “Engineering Drawing”, 25st Edition, Charotar Publishing House, 2025.
R2.	Basant Agarwal and Agarwal C.M., “Engineering Drawing”, 1st Edition, Tata McGraw Hill Publishing Company Limited, 2023.
R3.	K Leo Dev Wins., “Engineering Drawing”, Pearson (Wins) Publications, 2019.

Course Code: 24HSM104	Course Title: Heritage of Tamil	
Course Category: HSMC	Credits: 1	
L:T:P (Hours/Week) 1:0:0	Total Contact Hours: 15	Max Marks: 100

அலகு I	நெசவு மற்றும் பானைத் தொழில் நுட்பம்	3
சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில் நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள்- பாண்டங்களில் கீறல் குறியீடுகள்.		
அலகு II	வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்:	3
சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோவில்கள் மற்றும் பிற வழிப்பாட்டுத் தலங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டி நாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ - சாரோசெனிக் கட்டிடக்கலை.		
அலகு III	உற்பத்தித் தொழில் நுட்பம்	3
கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல் மணிகள், கண்ணாடி மணிகள் - சுருமம் மணிகள் - சங்கு மணிகள் - எலும்புத்துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.		
அலகு IV	வேளாண்மை மற்றும் நீர்ப் பாசனத்	3

	தொழில் நுட்பம்	
அணை, ஏரி, குளங்கள், மதகு - சோழர் காலக் குமிழிகள் கூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.		
அலகு V	**அறிவியல் தமிழ் மற்றும் கணினித்தமிழ்**	**3**
அறிவியல் தமிழ் வளர்ச்சி - கணினித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின் பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற் குவைத் திட்டம்.		

UNIT I	**WEAVING AND CERAMIC TECHNOLOGY**	**3**
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.		
UNIT II	**DESIGN AND CONSTRUCTION TECHNOLOGY**	**3**
Designing and Structural construction House & Designs in household materials during Sangam Age – Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram – Sculptures and Temples of Mamallapuram – Great Temples of Cholas and other worship places – Temples of Nayaka Period – Type study (Madurai Meenakshi Temple)– Thirumalai Nayakar Mahal – Chetti Nadu Houses, Indo – Saracenic architecture at Madras during British Period.		
UNIT III	**MANUFACTURING TECHNOLOGY**	**3**
Art of Ship Building – Metallurgical studies – Iron industry – Iron smelting, steel – Copper and gold – Coins as source of history – Minting of Coins – Beads making – industries Stone beads – Glass beads – Terracotta beads – Shell beads/ bone beats – Archeological evidences – Gem stone types described in Silappathikaram.		
UNIT IV	**AGRICULTURE AND IRRIGATION TECHNOLOGY**	**3**
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal		

Husbandry – Wells designed for cattle use – Agriculture and Agro Processing – Knowledge of Sea – Fisheries – Pearl – Conche diving – Ancient Knowledge of Ocean – Knowledge Specific Society.		
UNIT V	**SCIENTIFIC TAMIL & TAMIL COMPUTING**	**3**
Development of Scientific Tamil – Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.		
		Total: 15 Hours

TEXT BOOK(S)	
T1.	தமிழக வரலாறு –மக்களும் பண்பாடும் – கே .கே . பிள்ளை வெளி மீது : தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்.
T2.	கணினித் தமிழ் – முனைவர் இல .சுந்தரம் விகடன் பிரசுரம்
T3.	பொருநை –ஆற்றங்கரை நாகரிகம் தொல்லியல் துறை வெளியீடு

REFERENCE BOOK(S)	
R1.	Social Life of the Tamils – The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies -2021.

Course Code: 24BSC121	Course Title: Engineering Physics Laboratory	
Course Category: BSC	Credits: 2	
L:T:P(Hours/Week): 0:0:4	Total Contact Hours: 60	Max Marks : 100

COURSE OBJECTIVES
• To understand the knowledge in bending methods.
• To present and interpret the data in a clear and concise manner.
• To analyze the physics principles and interpretation of experimental data.
• To determine error in experimental measurements and technique.
• To develop the skills in electrical and mechanical experiments.

LIST OF EXPERIMENTS	
1.	Determination of Young's modulus – Uniform bending method.
2.	Determination of Rigidity modulus – Torsion Pendulum.
3.	Determination of Young's modulus – Cantilever method.
4.	Determination of thickness of a thin wire – Air Wedge.
5.	Determination of Young's modulus – Non– uniform bending method.
6.	Determination of band gap of a semiconductor.
7.	Determination of thermal conductivity of a bad conductor.
8.	Determination of the wavelength of the laser using grating–Laser.
9.	Determination of acceleration due to gravity– Compound Pendulum.
10.	Semiconductor Laser: a. Determination of wavelength of laser. b. Determination acceptance angle and numerical aperture of an optical fiber.
	Total: 60 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Analyze the performance of bending methods.

CO2: Evaluate the graphical models to analyze laboratory data.
CO3: Interpret and summarize the experimental results.
CO4: Estimate the optical knowledge and scientific information.
CO5:Obtain the skills in electrical and mechanical experiments

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1									1		1
CO2	2	1	1	1									1		1
CO3	2	1	1	1									1		1
CO4	2	1	1	1									1		1
CO5	2	1	1	1									1		1

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Jayaraman, “Engineering Physics laboratory manual”, 2013.
T2.	Sesha Saikumar Vemula, “Engineering Physics laboratory Lab manual”, 2017.
T3.	Bhattacharya, D.K and Poonam Tandon, “Engineering Physics”, 2015.

REFERENCE BOOK(S)

R1.	Naidu, “Engineering Physics”, Pearson, 2012.
R2.	Malik and Singh, “Engineering Physics”, Tata McGraw– Hill Education Pvt. Ltd., 2018.

SEMESTER II

Course Code: 24HSM103	**Course Title: Professional English II**	
Course Category: HSMC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks: 100**

COURSE OBJECTIVES
• To explain cause-and-effect relationships through different skills.
• To enhance skills in comparing and contrasting information effectively.
• To analyzing problems, proposing solutions and communicating ideas clearly.
• To acquire proficiency in accurately reporting events and information.
• To strengthen capabilities in delivering effective presentations and communication.

UNIT I	**CAUSE AND EFFECT**	**9**
Listening: Listening to longer technical talks and completing exercises– formal speeches, speaking – Role play exercises based on workplace contexts– asking for and giving directions -**Reading:** an excerpt from a travelogue– Journal articles on issues like Global Warming-**Writing:** Instructions, Official letter / email -**Grammar:** If conditionals, Imperatives, Cause and effect expressions, prefix and suffixes, Articles.		
UNIT II	**COMPARE AND CONTRAST**	**9**
Listening: Product reviews and gap fill exercises, Short Talks (like TED Talks) for specific information-**Speaking:** discussing progress towards goals, talking about experience -**Reading: Graphical** content (table / chart / graph) and making inferences, bio– note-**Writing:** Compare and Contrast Essay, writing responses to complaints, Making recommendations- **Grammar:** Degrees of Comparison; infinitives and gerunds, prepositional phrases.		
UNIT III	**PROBLEM AND SOLUTION**	**9**
Listening: online discussions on current issues and role play, situational dialogues -**Speaking:** discussing news stories, talking about travel procedures- **Reading :**Visual content (Pictures on social issues / natural disasters) for comprehension, business letters-**Writing:** checklists, cause and effect essays, Problem and Solution Essay-**Grammar:** singular and plural, Reported speech, Relative pronoun.		
UNIT IV	**REPORTING**	**9**
Listening: Telephone interview, Oral news report- **Speaking:** discussing forecasts and		

scenarios, discussing likes and dislikes -**Reading:** Newspaper report on survey findings, annual reports- **Writing:** report writing, accident report, Survey report- **Grammar:** Active and passive voice, conjunction, Homophones & Homonyms.		
UNIT V	**PRESENTATION**	**9**
Listening: Job interview, music review- **Speaking:** describing natural environment, explaining rules and regulations -**Readin**g: company profiles, an excerpt of interview with professionals-**Writing:** Job application (cover letter and CV), transcoding- **Grammar:** Collocations, Numerical adjectives, content and function words.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Identify cause and effect relationships accurately through different skills.
CO2: Compare the effective use of contrasting information from various skills
CO3: Analyze problems and communicate ideas clearly through writing skills.
CO4: Interpret events and information accurately through writing skills.
CO5: Apply skills in delivering effective presentations and communicating clearly.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						2	1	3	3	2	3		1		1
CO2						3	1	3	3	3	3		2		2
CO3						3	1	3	3	3	3		2		2
CO4						3	1	3	3	3	3		2		2
CO5						3	1	3	3	3	3		2		2

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Meenakshi Raman and Sangeetha Sharma, *"*Technical Communication: Principles and Practice*",* Fourth edition by Oxford University Press, 2022.
T2.	Mary Ellen Guffey and Dana Loewy, "Business Communication: Process and Product", 11th Edition, Cengage Learning, 2025.
T3.	English for Science & Technology – II, Cambridge University Press, 2023.

REFERENCE BOOK(S)	
R1.	Phillip A. Laplante, "Technical Writing: A Practical Guide for Engineers, Scientists, and Nontechnical Professionals", CRC Press.
R2.	Adrian Wallwork, "English for Academic Correspondence and Socializing", Springer, 2011.
R3.	Chaturvedi, P.D. and Mukesh Chaturvedi., "Business Communication: Concepts, Cases,

	and Applications", Pearson publication.

Course Code: 24BSC104	**Course Title: Random Process and Linear Algebra**	
Course Category: BSC	**Credits: 4**	
L:T:P (Hours/Week) 3:1:0	**Total Contact Hours: 60**	**Max Marks: 100**

COURSE OBJECTIVES
• To apply probability measures in random variables and distribution functions.
• To implement the concepts of joint distributions with regression analysis.
• To analyze the techniques in random processes and limiting distributions.
• To illustrate the concepts of vector space, subspaces , bases and dimension
• To acquire the concepts of linear transformations Gram Schmidt orthogonalization.

UNIT I	**PROBABILITY AND RANDOM VARIABLES**	**9+3**
Axioms of probability – Conditional probability – Baye's theorem – Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.		
UNIT II	**TWO – DIMENSIONAL RANDOM VARIABLES**	**9+3**
Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).		
UNIT III	**RANDOM PROCESSES**	**9+3**
Classification – Stationary process – Markov process – Poisson process – Discrete parameter Markov chain – Chapman Kolmogorov equations (Statement only) – Limiting distributions.		
UNIT IV	**VECTOR SPACES**	**9+3**
Vector spaces: Subspaces – Linear combinations and linear system of equations: Linear independence and linear dependence – Bases and dimensions**.**		
UNIT V	**LINEAR TRANSFORMATION AND INNER PRODUCT SPACES EQUATIONS**	**9+3**
Linear transformation – Null spaces and ranges – Dimension theorem – Matrix representation of a linear transformations – Inner product – Norms – Gram Schmidt orthogonalization process – Adjoint of linear operations.		
		Total: 60 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Explain the various fundamental concepts of probability.
CO2: Illustrate the basic concepts of one- and two-dimensional random variables
CO3: Use the properties of random processes in real world situations.
CO4: Execute the concept of vector spaces, linear independence and linear dependence.
CO5: Interpret the concept of matrix representation of linear Transformation.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1								1	2	1	
CO2	2	2	1	1								1	2	1	
CO3	2	1	1	1								1	2	1	
CO4	2	2		1								1			
CO5	2	1	1	1								1	1	1	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Gross, D., Shortle, J.F., Thompson, J.M., and Harris. C.M., "Fundamentals of Queuing Theory", 4th Edition, Wiley Student 2014.
T2.	Ibe, O.C., "Fundamentals of Applied Probability and Random Processes", 1st Edition, Elsevier, Indian Reprint, 2007.
T3.	Friedberg. A.H., Insel. A.J. and Spence. L., "Linear Algebra", 4th Edition, Prentice Hall of India, New Delhi, 2004.

REFERENCE BOOK(S)

R1.	Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New Delhi, 2004.
R2.	Trivedi, K.S., "Probability and Statistics with Reliability, Queuing and Computer Science Applications", 2nd Edition, John Wiley and Sons, 2002.
R3.	Yates, R.D. and Goodman. D. J., "Probability and Stochastic Processes", 2nd Edition, Wiley India Pvt. Ltd., Bangalore, 2012.
R4.	Kolman. B. Hill. D.R., "Introductory Linear Algebra", Pearson Education, New Delhi, First Reprint, 2009.

Course Code: 24BSC103	Course Title: Engineering Chemistry	
Course Category: BSC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks: 100

COURSE OBJECTIVES
• To inculcate water quality parameters and water treatment techniques.
• To impart knowledge on the basic principles and preparatory methods of Nano materials.
• To familiarize the preventive methods of corrosion and inculcate the working process.
• To acquire knowledge in synthetic methods of fuels and combustion characteristics.
• To gain knowledge about fuels and science of polymer and polymer reactions.

UNIT I	WATER TECHNOLOGY	9
Water: Sources and impurities, Water Quality Parameters: Definition and Significance of Colour, Odour, Turbidity, pH, Hardness, Alkalinity, TDS, COD and BOD, Flouride and Arsenic. Domestic water treatment: Sedimentation with Coagulant– Sand Filtration – Disinfection methods (UV, Ozonation, Break– point Chlorination). Desalination of Brackish water: Reverse Osmosis. Boiler troubles: Scale and Sludge, Boiler Corrosion, Caustic Embrittlement, Priming and Foaming. Treatment of Boiler Feed Water: Internal Treatment (Phosphate, Colloidal, Sodium Aluminate and Calgon Conditioning) and External Treatment – Ion Exchange demineralization and Zeolite process.		
UNIT II	**NANO CHEMISTRY**	**9**
Basics: Distinction between Molecules, Nano materials and Bulk materials; Size– Dependent Properties (Optical, Electrical, Mechanical and Magnetic); Types of Nanomaterial's: Definition, Properties and Uses of – Nanoparticle, Nano cluster, Nano rod, Nanowire and Nanotube. Preparation of Nanomaterial: Sol–Gel, Solvothermal, Laser Ablation, Chemical Vapour Deposition, Electrochemical Deposition and Electro Spinning, Applications of nanomaterial's in Medicine, Agriculture, Energy, Electronics and Catalysis.		
UNIT III	**BATTERIES AND CORROSION**	**9**
Batteries: Introduction – Types of Batteries – Primary battery (Dry Cell) – Secondary battery (Lead Acid battery, Lithium– Ion– battery) – Fuel cells H2– O2 Fuel cell, Microbial fuel cell. Corrosion – Causes– Factors – Types – Chemical, Electrochemical Corrosion (Galvanic, Differential Aeration Theory) – corrosion control – material selection and design aspects –		

Electrochemical protection– Sacrificial anode method and impressed current cathodic method, Paints – constituents and function. Electroplating of copper and electroless plating of nickel.		
UNIT IV	**FUELS AND COMBUSTION**	**9**
Fuels – Solid Fuel: Coal – analysis of coal (Proximate analysis only) – Carbonization, Manufacture of Metallurgical Coke (Otto Hoffmann Method) – Liquid fuel – Manufacture of synthetic Petrol (Bergius process) – Octane Number, Cetane Number, Knocking in Engines – Anti Knocking Agents, Gasoline Additives, Gaseous fuel: Compressed Natural Gas(CNG) – Liquefied Petroleum Gases(LPG) – composition only – Liquid Hydrogen fuel. Combustion: Calorific value – higher and lower calorific values – Flue gas analysis (ORSAT method).		
UNIT V	**POLYMER TECHNOLOGY**	**9**
Introduction – Terminologies – Thermoplastics and Thermosetting Plastics – Types and mechanism of Polymerization: Addition (free radical)– Condensation and Copolymerization – Properties and applications of polymers – some commercial thermosetting resin – Phenol Formaldehyde resin, Amino resins, Silicone resins – some thermoplastics – Polyethylene, PVC, Polyvinyl acetate – Conducting polymer – application – LED and Liquid crystals.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Implement the quality of water, and its treatment methods.
CO2: Investigate the basic principles and preparatory methods of Nano materials.
CO3: Apply the principles of electro chemistry and corrosion in engineering.
CO4: Categorize the types of fuels properties and combustion Characteristics.
CO5: Apply the science of polymer and its application.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1				1	1					2	1	1	1
CO2	1	1		1		1	2					1	1		
CO3	2	1		1		1	1					1	1		
CO4	2					1	2					1	1		
CO5	2	1		1		1	2					1	1	1	1

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Jain, P. C. and Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
T2.	Sivasankar, B., "Engineering Chemistry", Tata McGraw – Hill Publishing Company Ltd, New Delhi, 2008.
T3.	Dara, S. S., "A text book of Engineering Chemistry", 12th Edition, S. Chand Publishing, 2018.

REFERENCE BOOK(S)	
R1.	Murty, B. S., Shankar, P., Baldev Raj, Rath, B. B. and James Murday, "Text book of Nano science and Nanotechnology" , Universities Press – IIM Series in Metallurgy and Materials Science, 2018.
R2.	Palanna, O.G., "Engineering Chemistry", 2nd Edition, McGraw Hill Education (India) Private Limited, 2017.
R3.	Friedrich Emich, "Engineering Chemistry", Scientific International PVT. LTD, New Delhi, 2014.

Course Code: 24ESC111	Course Title: Problem Solving and Python Programming	
Course Category: ESC	Credits: 4	
L:T:P (Hours/Week) 3:0:2	Total Contact Hours: 60	Max Marks: 100

COURSE OBJECTIVES
• To educate the basics of algorithmic problem solving.
• To learn Python conditionals and loops.
• To use Python functions and function calls
• To interpret lists, tuples and dictionaries
• To know files and executions in Python.

UNIT I	COMPUTATIONAL THINKING AND PROBLEM SOLVING	9
Fundamentals of Computing – Identification of Computational Problems – Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion), Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.		
UNIT II	**DATA TYPES, EXPRESSIONS, STATEMENTS**	**9**
Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list: variables, expressions, statements, tuple assignment, precedence of operators, comments: Illustrative programs, exchange the values of two variables, circulate the values of n variables, distance between two points.		
UNIT III	**CONTROL FLOW, FUNCTIONS, STRINGS**	**9**
Conditionals: Boolean values and operators, conditional (if), alternative (if– else), chained conditional (if– else if - else), Iteration: state, while, for, break, continue, pass - Fruitful functions: return values, parameters, local and global scope, function composition, recursion, Strings: string slices, Immutability, string functions and methods, string module- Lists as arrays- Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.		
UNIT IV	**LISTS, TUPLES, DICTIONARIES**	**9**
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters- Tuples: tuple assignment, tuple as return value: Dictionaries: operations and		

methods, advanced list processing – list comprehension, Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.		
UNIT V	**FILES, MODULES, PACKAGES**	**9**
Files and exceptions: text files, reading and writing files, format operator: command line arguments, errors and exceptions, handling exceptions, modules, packages- Illustrative programs: Word count, Copy file, Voter's age validation, Marks range validation (0– 100).		

PRACTICALS	
1.	Write an algorithm, pseudo-code, and flowchart for: a) Finding the minimum in a list b) Inserting a card in a sorted list c) Solving the Towers of Hanoi problem
2.	a) Write a Python program to exchange the values of two variables. b) Write a Python program to circulate the values of *n* variables (e.g., rotating [1, 2, 3, 4] to [4, 1, 2, 3]).
3.	Write a Python program to find the GCD of two numbers using: a) Loops b) Recursion
4.	a) Implement **Linear Search** and **Binary Search** in Python. b) Implement **Bubble Sort** and **Selection Sort** algorithms.
5.	Write a Python function to calculate the square root of a number using the Newton-Raphson method.
6.	a) Write a Python program to count the number of vowels and consonants in a given string. b) Implement a Python program to check if a string is a palindrome.
7.	a) Implement a program to generate and display a **student mark sheet** using lists and dictionaries. b) Implement a **retail bill preparation system** using lists and dictionaries.
8.	a) Write a Python program to **copy the contents of one text file into another.** b) Implement a program to **count the number of words in a file.**
9.	a) Write a Python program to validate voter age using exception handling. b) Implement a program to validate student marks (0-100) using exception handling.
10.	a) Create a **Python module** that includes basic mathematical functions (addition, subtraction, multiplication, division).

	b) Write a Python program to **import and use the module.**
	Total: 60 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Design algorithmic solutions for fundamental computational problems.
CO2: Implement and execute basic Python programs.
CO3: Utilize conditionals, loops, and functions to develop structured Python programs.
CO4: Apply Python data structures such as lists, tuples, and dictionaries for problem-solving.
CO5: Execute operations for data processing in Python.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2		2				1		1	2			
CO2	2	3	2		2				1		1	2			
CO3	2	3	2		2				1		1	1			
CO4	2	2	2		1				1		1	1			
CO5	1	2	2		1				1		1	1			

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
T2.	Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCE BOOK(S)	
R1.	Paul Deitel and Harvey Deitel, "Python for Programmers", 1st Edition, Pearson Education, 2021.
R2.	Venkatesh, G and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
R3.	John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", 3rd Edition, MIT Press, 2021.
R4.	Eric Matthes, "Python Crash Course, A Hands – on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.

Course Code: 24ECC111	Course Title: Electric Circuit Analysis	
Course Category: PCC	Credits: 4	
L:T:P (Hours/Week) 3:0:2	Total Contact Hours: 60	Max Marks: 100

COURSE OBJECTIVES
• To introduce the basic concepts of DC and AC circuits behavior.
• To provide the different methods of circuit analysis using Network theorems.
• To educate the resonance and coupled circuits.
• To analyze the behavior of transient analysis.
• To interpret the concept of port networks.

UNIT I	BASIC CIRCUITS ANALYSIS AND NETWORK TOPOLOGY	9
Fundamentals concepts of R, L and C elements– Kirchhoff 's Laws – D.C Circuits – Resistors in series and parallel circuits – A.C Circuits – Average and RMS Value –Complex Impedance – Phasor diagram – Real and Reactive Power, Power Factor, Energy –Mesh current and node voltage methods of analysis D.C and A.C Circuits– Network reduction: Voltage and Current division, Source transformation – Star to Delta and Delta to Star conversions.		
UNIT II	**NETWORK THEOREMS FOR DC AND AC CIRCUITS**	**9**
Superposition theorem, Thevenin theorem, Norton theorem, Reciprocity theorem and Maximum power Transfer theorem– Millman's theorem– D.C and A.C Circuits – Applications of Network theorems		
UNIT III	**RESONANCE AND COUPLED CIRCUITS**	**9**
Series and Parallel resonance – frequency response – Bandwidth – Quality factor – Selectivity –Applications – Self– inductance – Mutual inductance – Coupling Coefficient – Series, Parallel connection of Coupled inductors – Single Tuned Coupled circuits.		
UNIT IV	**TRANSIENT ANALYSIS**	**9**
Introduction – Laplace transforms and inverse Laplace transforms– standard test signals – Natural response – Forced response – Transient response of RL, RC and RLC circuits for exponential, DC and AC (Sinusoidal) excitations using Laplace transformation technique		
UNIT V	**TWO PORT NETWORKS**	**9**

Two port networks, Z parameters, Y parameters, Transmission (ABCD) parameters, Hybrid (H) Parameters, Interconnection of two port networks, Symmetrical properties of T and π networks.

PRACTICALS	
1.	Verifications of Ohm's law.
2.	Verifications of KVL & KCL.
3.	Verifications of Thevenin's theorem.
4.	Verification of Norton theorem.
5.	Verification of Superposition Theorem.
6.	Verification of maximum power transfer Theorem.
7.	Verification reciprocity theorem.
8.	Transient analysis of RL and RC circuits.
	Total: 60 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Explain the concepts of basic electrical engineering.
CO2: Apply network theorems by using network reduction techniques.
CO3: Compute the concept of resonance and coupled circuits.
CO4: Analyse the transient analysis of RL, RC, and RLC circuits.
CO5: Apply the characteristics of two port networks for engineering applications.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2						1		1	1	1		1
CO2	3	2	2						1		1	1			1
CO3	3	2	2						1		1	1	2		
CO4	3	2							1		1	1	2	2	
CO5	3	2							1		1	1	1	2	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	William H. Hayt, Jr. Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis II", 8th Edition, McGraw Hill Science Engineering, 11th Reprint 2018.
T2.	Joseph Edminister and Mahmood Nahvi, "Electric Circuits II, Schaum's Outline Series", 5th Edition, Tata McGraw Hill Publishing Company, New Delhi, Reprint 2018.

REFERENCE BOOK(S)	
R1.	Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", 5th Edition, McGraw Hill, 9th Reprint 2019.
R2.	Bruce Carlson, A., "Circuits: Engineering Concepts and Analysis of Linear Electric Circuits", 2nd Edition, Cengage Learning, India Indian Reprint 2017.
R3.	Allan H. Robbins, Wilhelm C. Miller, "Circuit Analysis Theory and Practice", 5th Edition, Cengage Learning, 1st Indian Reprint 2013.

Course Code: 24HSM104	Course Title: Tamils and Technology	
Course Category: HSMC	Credits: 1	
L:T:P (Hours/Week) 1:0:0	Total Contact Hours: 15	Max Marks: 100

அலகு I	நெசவு மற்றும் பானைத் தொழில் நுட்பம்	3
சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில் நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள்- பாண்டங்களில் கீறல் குறியீடுகள்.		
அலகு II	வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்:	3
சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோவில்கள் மற்றும் பிற வழிப்பாட்டுத் தலங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டி நாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ - சாரோசெனிக் கட்டிடக்கலை.		
அலகு III	உற்பத்தித் தொழில் நுட்பம்	3
கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல் மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத்துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.		
அலகு IV	வேளாண்மை மற்றும் நீர்ப் பாசனத் தொழில் நுட்பம்	3
அணை, ஏரி, குளங்கள், மதகு - சோழர் காலக் குமிழிகள் கூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும்		

முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.		
அலகு V	**அறிவியல் தமிழ் மற்றும் கணினித்தமிழ்**	**3**
அறிவியல் தமிழ் வளர்ச்சி - கணினித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின் பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற் குவைத் திட்டம்.		

UNIT I	**WEAVING AND CERAMIC TECHNOLOGY**	**3**
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.		
UNIT II	**DESIGN AND CONSTRUCTION TECHNOLOGY**	**3**
Designing and Structural construction House & Designs in household materials during Sangam Age – Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram – Sculptures and Temples of Mamallapuram – Great Temples of Cholas and other worship places – Temples of Nayaka Period – Type study (Madurai Meenakshi Temple)– Thirumalai Nayakar Mahal – Chetti Nadu Houses, Indo – Saracenic architecture at Madras during British Period.		
UNIT III	**MANUFACTURING TECHNOLOGY**	**3**
Art of Ship Building – Metallurgical studies – Iron industry – Iron smelting, steel – Copper and gold – Coins as source of history – Minting of Coins – Beads making – industries Stone beads – Glass beads – Terracotta beads – Shell beads/ bone beats – Archeological evidences – Gem stone types described in Silappathikaram.		
UNIT IV	**AGRICULTURE AND IRRIGATION TECHNOLOGY**	**3**
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry – Wells designed for cattle use – Agriculture and Agro Processing – Knowledge of Sea – Fisheries – Pearl – Conche diving – Ancient Knowledge of Ocean – Knowledge Specific Society.		
UNIT V	**SCIENTIFIC TAMIL & TAMIL COMPUTING**	**3**
Development of Scientific Tamil – Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.		
		Total: 15 Hours

TEXT BOOK(S)	
T1.	தமிழக வரலாறு –மக்களும் பண்பாடும் – கே .கே .பிள்ளை வெளி மீது : தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்.
T2.	கணினித் தமிழ் – முனைவர் இல .சுந்தரம் விகடன் பிரசுரம்
T3.	பொருநை –ஆற்றங்கரை நாகரிகம் தொல்லியல் துறை வெளியீடு

REFERENCE BOOK(S)	
R1.	Social Life of the Tamils – The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies.

Course Code: 24BSC122	Course Title: Engineering Chemistry Laboratory	
Course Category: BSC	Credits: 2	
L:T:P(Hours/Week): 0:0:4	Total Contact Hours: 60	Max Marks : 100

COURSE OBJECTIVES
• To gain the experimental knowledge of water quality parameters.
• To familiarize the electro analytical techniques and determination of aqueous solutions.
• To gain the knowledge of Nano particles and influence of rate of corrosion of materials.
• To infer the quality of some solid and liquid fuels.
• To experiment impurities in solution by electro analytical techniques.

LIST OF EXPERIMENTS	
1.	Determination of Total, Permanent and Temporary hardness of water by EDTA method.
2.	Estimation of Chloride content in water by Argentometric method and Determination of strength of given Hydrochloric acid by pH meter
3.	Determination of strength of Acid by Conductometric titration (Strong acid vs Strong base / Strong base vs Mixture of acids).
4.	Preparation of Gold / ZnO Nano particles by Sol– Gel Method
5.	Estimation of ferrous ion content of the given solution using Potentiometer.
6.	Determination of DO content of water sample by Winkler Method.
7.	Determination of Rate of Corrosion of Mild steel by Weight Loss Method.
8.	Determination of Efficiency of Corrosion in Mild steel.
9.	Determination of calorific value of fuel using Bomb Calorimeter.
10.	Determination of viscosity of oil using Redwood Viscometer.
	Total: 60 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Analyze the quality of water samples through volumetric techniques.
CO2: Apply knowledge in designing the engineering materials against corrosion.
CO3: Examine the preparation of Nano particles by sol-gel method.

CO4: Experimenting the property and characteristics of solid and liquid fuels.
CO5: Analyse the impurities in solution by electro analytical techniques through quantitative method.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1								1			1			
CO2	1								1			1			
CO3									1			1			
CO4									1			1			
CO5	1								1			1			

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Vogel's, "Text Book of Quantitative Chemical Analysis", Pearson Publications, 2014.

REFERENCE BOOK(S)

R1.	Daniel C. Harris, "Quantitative Chemical Analysis", 7th Edition, W. H. Freeman and Company, New York, Edition 11th,2018.

Course Code: 24ESC121	Course Title: Engineering Practices Laboratory	
Course Category: ESC	Credits: 2	
L:T:P(Hours/Week): 0:0:4	Total Contact Hours: 60	Max Marks : 100

COURSE OBJECTIVES
• To develop practical skills in plumbing, woodwork, welding, machining, and sheet metal work.
• To apply techniques for various household, industrial fittings and connections.
• To demonstrate the assembly and operation of common mechanical systems .
• To educate various electrical joints in common household electrical wire work.
• To know soldering and testing of simple electronic circuits

LIST OF EXPERIMENTS	
	GROUP– A (CIVIL AND MECHANICAL)
1.	**I CIVIL ENGINEERING PRACTICE** **Plumbing Works:** a) Basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings. Preparation of plumbing line sketches. b) Laying pipe connection to the suction & delivery side of a pump – inlet & outlet c) Practice in mixed pipe connections: Metal, plastic and flexible pipes used in household appliances. **Carpentry Works :** a) Sawing, planning and making common joints: T– Joint, Mortise and Tennon joint, Dovetail joint. Study a) Study of joints in door panels, wooden furniture. b) Study of common industrial trusses using models.
	II MECHANICAL ENGINEERING PRACTICE
	Welding:

	a) Arc welding of butt joints, lap joints, tee joints. b) Gas welding Practice. **Basic Machining:** a) Simple turning, drilling and tapping operations. **Sheet Metal Work:** a) Forming & Bending. b) Model making – Trays, funnels, etc. c) Different type of joints. **Demonstration only:** Study and assembling the following: a) Centrifugal pump. b) Submersible pump sets. **Demonstration only:** a) Basics of Smithy operations. b) Foundry operation like mould preparation for grooved pulley. c) Refrigeration and Air– Conditioning System.
	GROUP– B (ELECTRICAL AND ELECTRONICS)
	I ELECTRICAL ENGINEERING PRACTICE Introduction to switches, fuses, indicators and lamps – Basic switch board wiring with lamp, fan and three pin socket. Staircase wiring. Fluorescent Lamp wiring with introduction to CFL and LED types. Energy meter wiring and related calculations/ calibration. Study of Iron Box wiring and assembly. Study of Fan Regulator (Resistor type and Electronic type using Diac/ Triac/ quadrac) Study of emergency lamp wiring/Water heater.
	II ELECTRONICS ENGINEERING PRACTICE **SOLDERING WORK:** a) Soldering simple electronic circuits and checking continuity. **ELECTRONIC ASSEMBLY AND TESTING WORK:** a) Assembling and testing electronic components on a small PCB. **ELECTRONIC EQUIPMENT STUDY:** a) Study an element of smart phone. b) Assembly and dismantle of LED TV.

	c) Assembly and dismantle of computer/ laptop
	Total: 60 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Perform basic plumbing, carpentry, welding, machining, and sheet metal tasks.
CO2:Examine technical sketches for household ,industrial fittings and connections
CO3: Execute basic mechanical systems and components.
CO4: Analyze electrical joints in common household electrical wire work.
CO5: Use soldering and testing of simple electronic circuits

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1						1			1	2		1
CO2	2	2	1						1			1	2		
CO3	2	2	1						2			1	2		
CO4	2	2	1						1			1	2		1
CO5	2	2	1						1			1	2		

(1 – Low, 2 – Medium, 3 – High)

SEMESTER III

Course Code: 24BSC201	Course Title: Transforms and Partial Differential Equations	
Course Category: BSC	Credits: 4	
L:T:P (Hours/Week) 3:1:0	Total Contact Hours: 60	Max Marks: 100

COURSE OBJECTIVES
• To Introduce basic concepts and standard solution methods of partial differential equations.
• To present Fourier series analysis in different intervals.
• To Familiarize students with Fourier series methods for solving wave and heat flow problems.
• To Provide a solid foundation in Laplace and Fourier Transform techniques.
• To develop Z-transform techniques for discrete-time systems.

UNIT I	PARTIAL DIFFERENTIAL EQUATIONS	9+3
Formation of partial differential equations – Solutions of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.		
UNIT II	**FOURIER SERIES**	**9+3**
Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root means square value – Parseval's identity – Harmonic analysis.		
UNIT III	**APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS**	**9+3**
Classification of PDE – Method of separation of variables – Fourier series solutions of one-dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction.		
UNIT IV	**FOURIER AND LAPLACE TRANSFORMS**	**9+3**
Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity – Laplace transform – Existence Criterion for the Laplace Transform – Laplace transform of basic functions – Fundamental properties.		
UNIT V	**Z - TRANSFORMS AND DIFFERENCE EQUATIONS**	**9+3**
Z- transforms – Elementary properties – Convergence of Z-transforms – Initial and final value		

theorems – Inverse Z-transform using partial fraction and convolution theorem – Formation of difference equations – Solution of difference equations using Z - transforms.

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Recognize and solve higher order partial differential equations.
CO2: Express the given function and data in terms of Fourier series.
CO3: Apply Fourier series and separation of variables to solve PDEs in engineering contexts.
CO4: Apply Fourier and Laplace transforms to solve engineering problems.
CO5: Possess the knowledge of Z transforms to analyze linear time invariant systems.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		1								2	3		
CO2	3	2		1								2	3	2	
CO3	3	3	2	2								1	3	2	
CO4	3	3	2	2								1	3	2	
CO5	3	2	2	2								2	3	2	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Veera Rajan T., "Transforms and Partial Differential Equations", 3rd Reprint published in 2016 by Tata McGraw Hill Education Pvt.Ltd, New Delhi.
T2.	Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018.
T2.	Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, 2018.

REFERENCE BOOK(S)	
R1.	Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi Publications Pvt. Ltd, 2021.
R2.	James. G., "Advanced Modern Engineering Mathematics", 4thEdition, Pearson Education, New Delhi, 2016.
R3.	Narayanan. S., Manicavachagom Pillay, T. K and Ramanaiah.G "Advanced Mathematics for Engineering Students Vol. II & III ", S. Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

Course Code: 24ESC211	Course Title: C Programming and Data Structures	
Course Category: ESC	Credits: 4	
L: T:P (Hours/Week) 2:0:2	Total Contact Hours: 60	Max Marks: 100

COURSE OBJECTIVES
• To introduce the basics of C programming language.
• To learn the concepts of advanced features of C.
• To provide a strong foundation in handling complex data structures.
• To know the concepts of non-linear data structure and hashing.
• To familiarize the concepts of sorting and searching techniques.

UNIT I	C PROGRAMMING FUNDAMENTALS	6
Data Types – Variables – Operations – Expressions and Statements – Conditional Statements – Functions – Recursive Functions – Arrays.		
UNIT II	**C PROGRAMMING - ADVANCED FEATURES**	**6**
Structures – Union – Enumerated Data Types – Pointers: Pointers to Variables, Arrays and Functions – File Handling.		
UNIT III	**LINEAR DATA STRUCTURES**	**6**
Abstract Data Types (ADTs) – List ADT – Array-Based Implementation – Linked List – Doubly- Linked Lists – Circular Linked List – Stack ADT – Queue ADT – Applications.		
UNIT IV	**NON-LINEAR DATA STRUCTURES**	**6**
Trees – Binary Trees – Tree Traversals – Expression Trees – Binary Search Tree – Hashing - Hash Functions – Separate Chaining – Open Addressing – Linear Probing– Quadratic Probing.		
UNIT V	**SORTING AND SEARCHING TECHNIQUES**	**6**
Insertion Sort – Quick Sort – Heap Sort – Merge Sort –Linear Search – Binary Search.		

PRACTICALS	
1.	Practice of C programming using statements and expressions, decision making and iterative statements.

2.	Practice of C programming using Functions and Arrays.
3.	Implement C programs using Pointers and Structures.
4.	Implement C programs using Files.
5.	Applications of List, Stack and Queue ADTs.
6.	Implementation of Binary Trees and operations of Binary Trees.
7.	Implementation of Binary Search Trees.
8.	Implementation of Sorting algorithms: Insertion Sort, Quick Sort, Merge Sort.
	Total: 60 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Develop C programs for any real world/technical application.
CO2: Apply advanced features of C in solving problems.
CO3: Write functions to implement linear and non–linear data structure operations.
CO4: Apply suitable linear or non-linear data structure operations to solve a given problem.
CO5: Appropriately use sort and search algorithms for a given application.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3											1	3	-	
CO2	3	2			1							1	3	2	
CO3	3	3	3	2	2						2	1	3	3	
CO4	3	2	3	2	2						2	1	3	3	
CO5	3	3	2	1	3						2	2	3	3	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2020.
T2.	Reema Thareja, "Programming in C", 2nd Edition, Oxford University Press, 2019.
REFERENCE BOOK(S)	
R1.	Brian W. Kernighan, Rob Pike, "The Practice of Programming", Pearson Education, 2010.
R2.	Paul J. Deitel and Harvey Deitel, "C How to Program", 10th Edition, Pearson Education, 2017.
R3.	Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, 2014.

R4.	Ellis Horowitz, Sartaj Sahni and Susan Anderson, "Fundamentals of Data Structures", Galgotia, 2008.

Course Code: 24ECC211	**Course Title: Electronic Devices & Circuits**	
Course Category: PCC	**Credits: 4**	
L: T:P (Hours/Week) 2:0:2	**Total Contact Hours: 75**	**Max Marks: 100**

COURSE OBJECTIVES
• To Provide comprehensive exposure to devices and circuits .
• To analyze the frequency response of small signal amplifiers.
• To design and analyze single stage and multistage amplifier circuits.
• To study about feedback amplifiers and oscillators principles.
• To study and compare different classes of power amplifiers and convertors.

UNIT I	**SEMICONDUCTOR DEVICES**	**9**
PN junction diode V-I characteristics- Zener diode, Zener as regulator – BJT – MOSFET – Input output characteristics DIAC, TRIAC, SCR, JFET, MOSFET, UJT – Structure, Operation and Characteristics Curves, Diffusion and Transition Capacitance.		
UNIT II	**SMALL SIGNAL ANALYSIS**	**9**
Load line, operating point, biasing methods for BJT and MOSFET – BJT small signal model – Analysis of CE, CB, CC amplifiers, Gain and frequency response – MOSFET small signal model, Analysis of CS, CG and Source follower, Gain and frequency response, High frequency analysis.		
UNIT III	**MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER**	**9**
Cascade amplifier – Differential amplifier – Common mode and Difference mode analysis – MOSFET input stages – tuned amplifiers, Gain and frequency response – Neutralization methods.		
UNIT IV	**FEEDBACK AMPLIFIERS AND OSCILLATORS**	**9**
Positive feedback Negative feedback Amplifier – Voltage / Current, Series, Shunt feedback Amplifiers – Condition for oscillations, Phase shift, Wien bridge, Hartley, Colpitts and Crystal oscillators.		
UNIT V	**POWER AMPLIFIERS AND DC/DC CONVERTERS**	**9**
Power amplifiers, class A, Class B, Class AB, Class C – DC/DC convertors, Buck, Boost,		

Buck-Boost analysis and design.

PRACTICALS	
1.	Characteristics of PN Junction Diode and Zener diode.
2.	Full Wave Rectifier with Filters.
3.	Input-output characteristics of CE, CB and CC.
4.	Frequency response of CE amplifiers.
5.	Drain current and Transfer Characteristics of MOSFET.
6.	Frequency response of CASCADE amplifiers.
7.	Simulation of Phase shift, Hartley, Colpitts & Wien bridge oscillators.
8.	Simulation of Class A Transformer Coupled Power Amplifier.
	Total: 75 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Explain the structure and working operation of basic electronic devices.
CO2: Design and analyze amplifiers.
CO3: Analyze frequency response of BJT and MOSFET amplifiers
CO4: Design and analyze feedback amplifiers and oscillator principles.
CO5: Design and analyze power amplifiers and supply circuits.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1									1	3	2	
CO2	3	3	2	2	2							1	3	2	2
CO3	3	2	2	2	2							1	3	3	2
CO4	3	3	2	1	2							2	3	2	2
CO5	3	2	3	2	2							2	3	2	3

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	David A. Bell, "Electronic Devices and Circuits", Oxford Higher Education press, 5th Edition, 2010.
T2.	Robert L. Boylestad and Louis Nasheresky, "Electronic Devices and Circuit Theory",

	11th Edition, Pearson Education / PHI, 2013.
T3.	Adel.S. Sedra and Kenneth C. Smith, "Micro Electronic Circuits", 8th Edition, Oxford University Press, 2020.

REFERENCE BOOK(S)	
R1.	Donald. A. Neamen, "Electronic Circuit Analysis and Design", 3rd Edition, Tata McGraw Hill, 2010.
R2.	Schilling and C. Belove, "Electronic Circuits", 3rd Edition, McGraw Hill, 2010.
R3.	Muhammad H. Rashid, "Power Electronics", Pearson Education / PHI, 2004.

Course Code: 24ECC201	Course Title: Electromagnetic Fields and Transmission Lines	
Course Category: PCC	Credits: 3	
L: T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks: 100

COURSE OBJECTIVES
• To impart knowledge on the basics of static electric field and the associated laws.
• To know the behavior of magnetic material and inductive elements.
• To give insight into coupling between various electric and magnetic fields.
• To learn the concept of transmission lines and signal propagation at radio frequency.
• To solve real time impedance matching problems using smith chart.

UNIT I	ELECTROSTATICS	9
Review of vector algebra, Coordinate systems - Differential length, area, volume - Line, surface and volume integrals, Gradient of a scalar field, Divergence of a vector field, Divergence theorem, Curl of a vector field, Stoke's theorem - Electric field, Coulomb's law, Gauss's law and applications, Electric potential, Electric flux density and dielectric constant, Boundary conditions, Capacitance, Electrostatic energy, Poisson's and Laplace's equations.		
UNIT II	**MAGNETOSTATICS**	**9**
Magnetic field intensity and flux density, Biot-Savart law and applications, Magnetic forces and torques, Ampere's law, Vector magnetic potential, Behaviour of magnetic materials, Boundary conditions, Inductors and Inductance, Magnetic energy,		
UNIT III	**MAXWELL'S EQUATIONS AND ELECTROMAGNETIC WAVES**	**9**
Faraday's law, Displacement current and Conduction current, Maxwell's equations, Wave equations, Uniform plane waves, Characteristic impedance, Propagation constant, Skin depth, Reflection of plane waves by a perfect conductor and perfect dielectric, Poynting vector, Poynting theorem and Electromagnetic power flow.		
UNIT IV	**TRANSMISSION LINE THEORY(**Qualitative Treatments only)	**9**
The transmission line - general solution, the infinite line, wavelength, velocity of propagation - Waveform distortion - the distortion less line - Loading and different methods of loading -		

Reflection coefficient - Input and transfer impedance - Open and short circuited lines - reflection factor and reflection loss. - Line of Zero dissipation - Standing Waves, Nodes, Standing Wave Ratio.		
UNIT V	**TRANSMISSION LINES & IMPEDANCE MATCHING AT HIGH FREQUENCY (**Qualitative Treatments only)	**9**
Transmission line equations at radio frequencies, Voltage and current on the dissipation less line- Input impedance of the dissipation less line - Open and short circuited lines - Measurement of VSWR and wavelength, Impedance matching: Quarter wave transformer, One Eighth wave line, Half wave line- Impedance matching by stubs- Single stub and double stub matching - Smith chart – Application of Smith chart, Solutions of problems using Smith chart - Single and double stub matching using Smith chart.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Apply the basic concepts of Electrostatic field.
CO2: Use the concepts and characteristics of Magneto Static field in material space
CO3: Determine the significance of Maxwell's equations and plane waves.
CO4: Apply transmission line characteristics and signal propagation at high frequencies.
CO5: Examine the various transmission lines parameters using smith chart.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1							2	3	3	
CO2	3	2	3	2	1							2	3	3	
CO3	3	3	2	2	2							2	2	3	
CO4	3	3	2	2	2							2	3	2	
CO5	3	2	2	2	3							2	2	2	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	D.K. Cheng, "Field and Wave Electromagnetics", 2nd Edition, Pearson (India), 2013.
T2.	M.N.O. Sadiku and S.V. Kulkarni, "Principles of Electromagnetics", 6th Edition, Oxford (Asian Edition), 2015.
T3.	John D Ryder, "Networks Lines and Fields", Prentice Hall of India, New Delhi,2005.

REFERENCE BOOK(S)	
R1.	Edward C. Jordan and Keith G. Balmain, "Electromagnetic Waves and Radiating

	Systems", 2nd Edition, Prentice-Hall Electrical Engineering Series, 2012.
R2.	W.H. Hayt and J.A. Buck, "Engineering Electromagnetics", 9th Edition, McGraw-Hill (India), 2019.
R3.	W. Alan Davis and Krishna Agarwal, "Radio Frequency Circuit Design", 1st Edition John willy, 2001.

Course Code: 24ECC202	**Signals and Systems**	
Course Category: PCC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES

- To introduce the fundamental types and properties of signals and systems
- To analyze for Continuous time signals.
- To examine the characteristics of Continuous Time Systems.
- To analyze Continuous time signals using Sampling.
- To analyze Discrete time signals and systems with Z transform.

UNIT I	**CLASSIFICATION OF SIGNALS AND SYSTEMS**	9

Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoidal- Signal operation - Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals, Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.

UNIT II	**ANALYSIS OF CONTINOUS TIME SIGNALS**	**9**

Fourier series analysis - Fourier and Laplace transforms in Analysis of CT Signals and its Properties.

UNIT III	**ANALYSIS OF CONTINOUS TIME SYSTEMS**	**9**

Convolution Integrals - Stability and Causality - Differential Equations - Fourier and Laplace Transform Analysis of LTICT Systems - Block Diagram representation.

UNIT IV	**SAMPLING AND DISCRETE TIME FOURIER TRANSFORM**	**8**

Representation of CT signals by samples - Impulse train sampling - Effect of under sampling - Reconstruction of CT signal from samples using interpolation - Zero-order hold Sampling – DTFT.

UNIT V	**Z TRANSFORM ANALYSIS OF DT SIGNALS AND SYSTEMS**	**9**

Z- transform - Properties - Inverse Z-transform using partial fraction methods - Analysis of LTIDT systems using DTFT and Z transform - Convolution Sum - Stability and Causality - Differential Equations - Block Diagram representation.

	Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Utilize mathematical operations to classify continuous and discrete time Signals.
CO2: Apply Fourier and Laplace transforms to analyse continuous-time signals
CO3: Interpret continuous-time system characteristics using Fourier and Laplace techniques.
CO4: Utilize Sampling to analyse and reconstruct Continuous time signals.
CO5: Utilize the z-transform to represent discrete-time signals and system characteristics.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1									1		
CO2	3	3	1	1									1		
CO3	3	3	1	1									1	1	
CO4	3	2	1	1										2	
CO5	3	3	1	1									1	1	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Alan V Oppenheim, Alan S Willsky and Hamid Nawab S, "Signals and Systems", 2nd Edition, Pearson, 2021.
T2.	V Krishnaveni, and A Rajeswari, "Signals and Systems", 1st Edition, Wiley India, 2019.

REFERENCE BOOK(S)	
R1.	Simon Haykin and Barry Van Veen, "Signals and Systems", 2nd Edition, Wiley India, 2018.
R2.	M. J. Roberts, "Signals and Systems Analysis using Transform Methods and MATLAB", McGraw- Hill Education, 2018.
R3.	HP Hsu and R Ranjan, "Signals and Systems", Schaums 's Outlines, 2nd Edition, Tata McGraw Hill, 2010.
R4.	Samir S. Soliman and Mandyam Dhati Srinath, "Continuous and Discrete Signals and Systems", 2nd Edition, Prentice Hall International, 2011.
R5.	Luis F. Chaparro, "Signals and Systems Using MATLAB", 4st Edition, Academic Press, An Imprint of Elsevier, 2024.

Course Code: 24ECC212	Course Title: Digital Systems Design	
Course Category: PCC	Credits: 4	
L:T:P (Hours/Week) 2:0:2	Total Contact Hours: 75	Max Marks: 100

COURSE OBJECTIVES
• To introduce the principles of Canonical forms to minimize the logic expression.
• To bring out the analysis and design procedures for synchronous Sequential circuits.
• To Know out the analysis and design procedures for asynchronous Sequential circuits.
• To learn integrated circuit families.
• To write Verilog code for combinational logical circuits.

UNIT I	MINIMIZATION TECHNIQUES AND COMBINATIONAL LOGIC	9
Minimization Techniques- Boolean postulates and laws - Karnaugh map Minimization – Review of logic gates - NAND–NOR implementations, Combinational Logic- Adders – Subtractors - Multiplexer/ Demultiplexer – decoder - encoder – parity generator – parity checker - Magnitude Comparator - Code converters.		
UNIT II	**SYNCHRONOUS SEQUENTIAL LOGIC**	**9**
Flip flops – SR, D, JK, T – Realization of one flip flop using other flip flops- Analysis and design of clocked sequential circuits- Moore/Mealy models, state minimization, state assignment, logic implementation – Design of Counters and Shift registers.		
UNIT III	**ASYNCHRONOUS SEQUENTIAL LOGIC**	**9**
Analysis and design Asynchronous sequential circuits- Pulse mode and fundamental mode sequential circuits- Stable and Unstable states- Cycles and Races-State reduction-Race Free State assignments- Hazards, Essential Hazards, Design of Hazard free circuits.		
UNIT IV	**MEMORY DEVICES AND LOGIC FAMILIES**	**9**
Memory Devices- Classifications of memory – ROM ,PROM , EPROM , EEPROM – RAM ,Static and dynamic RAM –Programmable Logic Devices – Implementation of combinational logic circuits using PLA, PAL and PROM, Logic Families- TTL and CMOS Logic and their characteristics.		
UNIT V	**SYSTEM DESIGN USING VERILOG HDL**	**9**

VLSI Circuit Design Flow - Basic concepts: Data types – Modules and ports for Modelling in Verilog HDL – Gate level modelling – Dataflow modelling – Behavioral modelling – structural modelling – Switch level modelling – Design examples.

PRACTICALS	
1.	Design of adders and Subtractors & code converters.
2.	Design of Multiplexers & Demultiplexers.
3.	Design of Encoders and Decoders.
4.	Design of Magnitude Comparators.
5.	Design and implementation of counters using flip-flops.
6.	Design and implementation of shift registers.
7.	Design of Adders and Subtractors Using Verilog code.
8.	Design of Multiplexers & Demultiplexers Using Verilog code.
	Total: 75 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Use Boolean algebra and simplification to digital logic for combinational circuits.
CO2: Analyse and design synchronous sequential circuits.
CO3: Analyse and design asynchronous sequential circuits.
CO4: Build logic gates and use programmable devices.
CO5: Apply Verilog code for realization of combinational logical circuits.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	1								2		
CO2	3	3	3	2	2								2		
CO3	3	3	2	2	1								2		
CO4	3	2	2	1	1								2		
CO5	3	3	3	2	3								2		

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	M. Morris Mano and Michael D. Ciletti, “Digital Design”, 5th Edition, Pearson, 2014.
T2.	S. Palnitkar, “Verilog HDL – A Guide to Digital Design and Synthesis”, Pearson, 2003.

REFERENCE BOOK(S)

R1.	Thomas L. Floyd, "Digital Fundamentals", Prentice Hall, 11th Edition, 2015.
R2.	A.Anand Kumar, "Fundamentals of Digital Circuits", 4th Edition, PHI Learning Private Limited, 2016.
R3.	D. Donald Giveon, "Digital Principles and Design", Tata McGraw Hill, 2008.
R4.	Leach D, Malvino A P and Saha, "Digital Principles and Applications", 8th Edition, Tata McGraw-Hill Publishing Company, 2014.

SEMESTER IV

Course Code: 24BSC203	**Course Title: Statistics and Numerical Methods**	
Course Category: BSC	**Credits: 4**	
L:T:P (Hours/Week) 3:1:0	**Total Contact Hours: 60**	**Max Marks: 100**

COURSE OBJECTIVES
• To explore the knowledge of testing of hypothesis for small and large samples.
• To describe how to design experiments and analyze the data.
• To interpret the basic concepts of solving algebraic and transcendental equations.
• To analyze the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration.
• To acquire the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT I	**TESTING OF HYPOTHESIS**	**9+3**
Sampling distributions - Tests for single mean - proportion and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit, Independence of attributes.		
UNIT II	**ANALYSIS OF VARIANCE**	**9+3**
One way and two way classifications – Completely randomized design – Randomized block design– Latin square design.		
UNIT III	**SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS**	**9+3**
Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method- Solution of linear system of equations, Gauss elimination method – Iterative methods of Gauss Seidal– Eigen values of a matrix by Power method.		
UNIT IV	**INTERPOLATION AND NUMERICAL INTEGRATION**	**9+3**
Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Numerical single integration's using Trapezoidal and Simpson's 1/3 rules.		
UNIT V	**NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS**	**9+3**

Single step methods: Taylor's series method, Euler's method, Modified Euler's method, Fourth order Runge-Kutta method for solving first order differential equations - Multi step methods: Milne's predictor corrector methods for solving first order differential equations.
Total: 60 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1:Apply hypothesis testing for means, proportions, and variances using appropriate statistical tools.
CO2: Analyze and interpret data using ANOVA and various experimental designs (CRD, RBD, LSD).
CO3: Solve algebraic and transcendental equations and linear systems using numerical methods like Newton-Raphson and Gauss Elimination.
CO4: Use interpolation and numerical integration techniques to estimate unknown values and definite integrals.
CO5: Apply numerical methods (Euler, RK, Milne's) to solve first-order ODEs.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2									3	2	
CO2	3	3	2	3									3	1	
CO3	3	2	1	2	3								2	3	
CO4	3	2	1	2	2								3	3	
CO5	3	3	2	3	3								2	3	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", 11th Edition, Khanna Publishers, New Delhi, 2022-2023.
T2.	Johnson, R.A., Miller, I and Freund, J., "Miller and Freund's Probability and Statistics for Engineers", 9th Edition, Pearson Education, Asia, 2023.

REFERENCE BOOK(S)

R1.	Gupta, S.C., and Kapoor, V. K., "Fundamentals of Mathematical Statistics", 12th Edition, Sultan Chand & Sons, New Delhi, 2022.
R2.	Gerald, C.F. and Wheatley. P.O., "Applied Numerical Analysis", 7th Edition, Pearson Education, Asia, New Delhi, 2017.

R3.	Devore, J. L., "Probability and Statistics for Engineering and the Sciences", 9th Edition, Cengage Learning, international versions published around 2020–2021

Course Code: 24BSC207	**Course Title: Environmental Science and Sustainability**	
Course Category: BSC	**Credits: 2**	
L:T:P (Hours/Week) 2:0:0	**Total Contact Hours: 30**	**Max Marks: 100**

COURSE OBJECTIVES
• To explain the relationship and the unity of life in all its forms, the implications of lifestyle on the environment.
• To evaluate the environmental resources and causes for degradation.
• To summarize the renewable and non-renewable resources
• To explicit the impact of individuals' contribution in the environmental pollution.
• To mitigate the various pollution control protocols at the global and local environment.

UNIT I	**ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY**	**6**
Key environmental problems, their basic causes and sustainable solutions, IPAT equation - Ecosystem, earth - life support system and ecosystem components, Food chain, food web, Energy flow in ecosystem - Ecological succession, stages involved, Primary and secondary succession, Hydrarch, mesarch, xerarch, Importance, types, mega-biodiversity, Threats due to natural and anthropogenic activities and Conservation methods.		
UNIT II	**SUSTAINING NATURAL RESOURCES AND ENVIRONMENTAL QUALITY**	**6**
Environmental hazards: causes and solutions - Biological hazards, AIDS, Malaria - Chemical hazards, BPA, PCB, Phthalates, Mercury - Nuclear hazards, Risk and evaluation of hazards - Water footprint; virtual water, blue revolution - Water quality management and its conservation - Solid and hazardous waste, types and waste management methods.		
UNIT III	**ENERGY RESOURCES**	**6**
Renewable, Non-renewable energy resources: Advantages and disadvantages - oil, Natural gas, Coal, Nuclear energy - Energy efficiency and renewable energy: Solar energy, Hydroelectric power, Ocean thermal energy, Wind and geothermal energy. Energy from biomass - solar- Hydrogen revolution.		
UNIT IV	**ENVIRONMENTAL IMPACT ASSESSMENT**	**6**

Introduction to environmental impact analysis - EIA guidelines - Notification of Government of India (Environmental Protection Act-Air, water, forest and wildlife) - Impact assessment methodologies - Public awareness - Environmental priorities in India.		
UNIT V	**GLOBAL CLIMATIC CHANGE AND MITIGATION**	**6**
Climate disruption - Greenhouse effect - Ozone layer depletion - Acid rain - Kyoto protocol - Carbon credits, Carbon sequestration methods and Montreal Protocol - Role of Information technology in environment - Case Studies.		
		Total: 30 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Explain key environmental problems, ecosystem components, food chains, biodiversity, and conservation methods.
CO2: Identify environmental, biological, chemical, and nuclear hazards and propose suitable control and waste management strategies.
CO3: Compare renewable and non-renewable energy sources and assess their advantages, disadvantages, and applications.
CO4: Interpret the process of Environmental Impact Assessment and relate it to national environmental protection regulations.
CO5: Analyze global climate issues such as greenhouse effect, ozone depletion, and propose mitigation measures including international protocols and IT solutions.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2					2	3	3				1	1		
CO2	2	2		2		2	3	3				2	1	1	
CO3	2	2	2	2	1	2	3	2				2	2	1	
CO4	2	1		2		2	3	2				2	1		
CO5	2	2		2	2	2	3	3				3	2	2	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers, 2018.
T2.	G. Tyler Miller, Scott E. Spoolman and (co-authored with Danielle Andrews-Brown) "Environmental Science", 17th Edition, Cengage learning, 2023-2024.

REFERENCE BOOK(S)	
R1.	George Tyler Miller, Jr. and Scott Spoolman, "Living in the Environment – Principles Connections and Solutions", 20th Edition, Brooks/Cole, USA, 2020–2021.
R2.	David M. Hassenzahl, Mary Catherine Hager and Linda R. Berg, "Visualizing Environmental Science", 5th Edition, John Wiley & Sons, USA, 2019–2020.
R3.	Gilbert M. Masters, "Introduction to Environmental Engineering and Science", 3rd Edition, Pearson Education, 2007–2013.

Course Code: 24ECC213	Course Title: Linear Integrated Circuits	
Course Category: PCC	Credits: 4	
L:T:P (Hours/Week) 3:0:2	Total Contact Hours: 75	Max Marks: 100

COURSE OBJECTIVES
• To learn the basic building blocks and characteristics of Operational Amplifiers.
• To learn and design applications using Operational Amplifiers.
• To introduce the theory and applications of analog multipliers, PLL and Timer ICs.
• To learn the theory of ADC and DAC.
• To Design waveform generators using operational amplifiers and voltage regulators.

UNIT I	BASICS OF OPERATIONAL AMPLIFIERS	9
Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References - BJT Differential amplifier with active loads, Basic information about op-amps, Ideal Operational Amplifier, General operational amplifier stages and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations. Operational Amplifiers – LF155 and TL082.		
UNIT II	**APPLICATIONS OF OPERATIONAL AMPLIFIERS**	**9**
Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor - Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier - Comparators, Schmitt trigger - Precision rectifier, peak detector, clipper and clamper - Low-pass, high-pass and band-pass Butterworth filters.		
UNIT III	**ANALOG MULTIPLIER, PLL AND TIMER ICS**	**9**
Analog Multiplier using Emitter Coupled Transistor Pair, Gilbert Multiplier cell, Variable transconductance technique, Analog multiplier ICs and their applications - Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565 - application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing and clock synchronization-Timer IC 555.		
UNIT IV	**ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS**	**9**

Analog and Digital Data Conversions, D/A converter – specifications, weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R, 2R Ladder types, switches for D/A converters, high speed sample-and-hold circuits - A/D Converters, specifications, Flash type - Successive Approximation type, Single Slope type, Dual Slope type, A/D Converter using Voltage-to-Time Conversion.		
UNIT V	**WAVEFORM GENERATORS AND VOLTAGE REGULATORS**	**9**
Sine-wave generators, Multivibrators, Triangular wave generator and Sawtooth wave generator, ICL8038 function generator - IC Voltage regulators: Three terminal fixed and adjustable voltage regulators, IC 723 general purpose regulator, Monolithic switching regulator, Low Drop, Out (LDO) Regulators.		

PRACTICALS	
1.	Design and test the clippers and clampers using op-amp.
2.	Design and test the Instrumentation amplifier using op-amp.
3.	Design and test the Active low-pass, High-pass and band-pass filters.
4.	Design Phase shift and Wien bridge oscillators using op-amp.
5.	Design and test the Hartley Oscillator and Colpitts Oscillator using op-amp.
6.	Design and test the Astable and Monostable multivibrators.
7.	Simulate Full wave precision rectifier, Astable ,Monostable and A/D converter.
8.	Design and simulate Voltage Controlled Oscillator, Analog Multiplier, and PLL as frequency multiplier.
	Total: 75 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Explain the basic internal structure, characteristics and operation of operational amplifiers like IC 741, LF155 and TL082.
CO2: Apply operational amplifiers in linear circuits such as filters, amplifiers, converters and signal modifiers.
CO3: Describe the operation and applications of analog multipliers, PLL circuits, and timer ICs in electronic systems.
CO4: Apply knowledge of data converters to select appropriate A/D and D/A converters for given specifications.
CO5: Analyze the working of waveform generators and voltage regulators using linear ICs.

COURSE ARTICULATION MATRIX															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3		2									3	2	
CO2	3	3	2	3	2								3	3	
CO3	3	3	2	3	3								2	3	
CO4	3	3		2	2								2	3	
CO5	3	3	2	3	3								3	3	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	D.Roy Choudhry and Shail Jain, "Linear Integrated Circuits", Revised 4th Edition New Age International Pvt. Ltd., 2024.
T2.	Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 4th Edition, Tata McGraw Hill, 2016.

REFERENCE BOOK(S)	
R1.	Ramakant A.Gayakwad, "Op-amp and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2015.
R2.	S.Salivahanan and V.S.Kanchana Bhaskaran, "Linear Integrated Circuits", 2nd Edition, 4th Reprint, Tata McGraw Hill, 2016.
R3.	Robert F.Coughlin and Frederick F.Driscoll, "Operational Amplifiers and Linear Integrated Circuits", 6th Edition, PHI, 2001.
R4.	Gray and Meyer, "Analysis and Design of Analog Integrated Circuits", 5th Edition, Wiley International, 2009.

Course Code: 24ECC214	Course Title: Analog and Digital Communication Systems	
Course Category: PCC	Credits: 4	
L:T:P (Hours/Week) 3:0:2	Total Contact Hours: 75	Max Marks : 100

COURSE OBJECTIVES
• To introduce the concepts of various amplitude modulations and their spectral characteristics.
• To study the concepts of various angle modulation and their spectral characteristics.
• To study the fundamentals of sampling, quantization and pulse modulation techniques.
• To understand the Digital modulation and Demodulation schemes.
• To impart knowledge in Error Detecting Codes.

UNIT I	AMPLITUDE MODULATION	9
Elements of Communication systems – Principles of Amplitude Modulation Systems: DSB, SSB and VSB Generation and Demodulation - Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals - AM Transmitters, super heterodyne Receiver, Noise in amplitude modulation systems.		
UNIT II	**ANGLE MODULATION**	**9**
Phase and frequency modulation - Narrow Band and Wide band FM - PM to FM Conversion, and FM to PM Conversion – FM Generations - Receivers - Pre-emphasis and De-emphasis - Threshold effect in angle modulation - Comparison of AM and Angle Modulation.		
UNIT III	**SAMPLING & DIGITAL TECHNIQUES**	**9**
Low pass sampling, Aliasing, Signal Reconstruction - Quantization: Uniform & non-uniform quantization, quantization noise, Nyquist criterion - Logarithmic Companding - PAM, PPM, PWM, PCM - TDM, FDM, Pulse modulation - Differential pulse code modulation, Delta modulation - Noise considerations in PCM - Digital Multiplexers.		
UNIT IV	**DIGITAL MODULATION AND DEMODULATION SCHEME**	**9**
BPSK, BFSK, & QPSK Modulation and Demodulation Techniques - PSD & BER of BPSK,		

BFSK, QAM - Carrier Synchronization, Structure of Non-coherent Receivers Synchronization and Carrier Recovery for Digital modulation - Spectrum Analysis, Occupied bandwidth, Adjacent channel power, EVM - Principle of DPSK - Elements of Detection Theory, Optimum detection of signals in noise - Coherent communication with waveforms, Probability of Error evaluations - Inter symbol Interference.		
UNIT V	**ERROR DETECTING CODES**	**9**
Entropy - Properties of Entropy - Shannon Fanon Theorem - Channel coding theorem - Linear Block codes, Hamming codes - Cyclic codes - Convolutional codes - Viterbi Decoder.		
PRACTICALS		
1.	Design Amplitude modulator and demodulator for specific application.	
2.	Design Frequency modulator and demodulator for specific application.	
3.	Pulse Code Modulation and Demodulation.	
4.	Pulse Amplitude Modulation and Demodulation.	
5.	Pulse Width Modulation and Demodulation.	
6.	Digital Modulation – ASK, PSK, FSK.	
7.	Simulation of ASK, FSK, and BPSK Generation and Detection Schemes.	
8.	Simulation of DPSK, QPSK and QAM Generation and Detection Schemes.	
		Total: 75 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Explain the basic principles of amplitude and angle modulation systems.
CO2: Apply the concepts of frequency and phase modulation to real-world systems.
CO3: Analyze sampling, quantization, and pulse modulation techniques.
CO4: Apply digital modulation and demodulation techniques in system-level communication.
CO5:Investigate the effectiveness of error detection and correction methods in digital communication systems

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2								3	2	1
CO2	3	3	2	1	2								3	3	2
CO3	3	3	2	2	2								3	3	2
CO4	3	3	3	2	3								3	3	2
CO5	3	3	2	2	2								3	3	1

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Simon Haykin & Michael Moher, "Communication Systems", 5th Edition, Wiley, January 2021.
T2.	B. P. Lathi (with Zhi Ding), "Modern Digital and Analog Communication Systems", 4th Edition (Indian), Oxford University Press, July 2017.

REFERENCE BOOK(S)	
R1.	Wayner Tomasi, "Advanced Electronic Communication System", 6th Edition, Pearson Education, 2013.
R2.	D.Roody, J.Coolen, "Electronic Communications", 4th Edition, PHI, 2006.
R3.	B.Sklar, "Digital Communications Fundamentals and Applications", 2nd Edition Pearson Education 2007.
R4.	H P Hsu, "Analog and Digital Communications", Tata McGraw Hill, Schaum Outline Series, 2006.
R5.	Couch.L, "Modern Communication Systems: Principles & Applications", 7th Edition, Pearson, 2012-2013.

Course Code: 24ECC215	Digital Signal Processing	
Course Category: PCC	Credits: 4	
L:T:P (Hours/Week) 3:0:2	Total Contact Hours: 75	Max Marks : 100

COURSE OBJECTIVES
• To learn discrete fourier transform, properties of DFT and its application to linear filtering.
• To understand the characteristics of digital filters, design digital IIR and FIR filters and apply these filters to filter undesirable signals in various frequency bands.
• To understand the effects of finite precision representation on digital filters.
• To understand the fundamental concepts of multi rate signal processing and its applications.
• To introduce the concepts of adaptive filters and its application to communication engineering.

UNIT I	DISCRETE FOURIER TRANSFORM	9
Sampling Theorem - concept of frequency in discrete-time signals - summary of analysis & synthesis equations for FT & DTFT - frequency domain sampling - Discrete Fourier transform (DFT), deriving DFT from DTFT - properties of DFT: periodicity, symmetry, circular convolution - Linear filtering using DFT - Filtering long data sequences, overlap save and overlap add method - Fast computation of DFT - Radix-2 Decimation-in-time (DIT) Fast Fourier transform (FFT), Decimation-in-frequency (DIF) Fast Fourier transform (FFT) - Linear filtering using FFT.		
UNIT II	**INFINITE IMPULSE RESPONSE FILTERS**	**9**
Characteristics of practical frequency selective filters - characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters - Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) - Approximation of derivatives, Impulse invariance method, Bilinear transformation - Frequency transformation in the analog domain - Structure of IIR filter: direct form I, direct form II, Cascade, parallel realizations.		
UNIT III	**FINITE IMPULSE RESPONSE FILTERS**	**9**
Design of FIR filters - symmetric and Anti-symmetric FIR filters - design of linear phase FIR filters using Fourier series method - FIR filter design using windows (Rectangular, Hamming		

and Hanning window), Frequency sampling method - FIR filter structures, linear phase structure, direct form realizations.		
UNIT IV	**FINITE WORD LENGTH EFFECTS**	**9**
Fixed point and floating-point number representation - ADC - quantization - truncation and rounding - quantization noise - input / output quantization - coefficient quantization error, product quantization error - overflow error - limit cycle oscillations due to product quantization and summation - scaling to prevent overflow.		
UNIT V	**DSP APPLICATIONS**	**9**
Multirate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor – Adaptive Filters: Introduction, Applications of adaptive filtering to equalization-DSP Architecture: Fixed and Floating-point architecture principles.		

PRACTICALS	
1.	Generation of elementary Discrete-Time sequences.
2.	Linear and Circular convolutions.
3.	Auto correlation and Cross Correlation.
4.	Frequency Analysis using DFT.
5.	Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrates the filtering operation.
6.	Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations.
7.	Perform MAC operation using various addressing modes.
8.	Implement an Up-sampling and Down-sampling operation in DSP Processor.
	Total: 75 Hours

COURSE OUTCOMES
At the end of this course, students will be able to:
CO1: Apply DFT for the analysis of digital signals and systems.
CO2: Design IIR filter system for process the digital signal.
CO3: Design FIR filter system for process the digital signal.
CO4: Characterize the effects of finite precision representation on digital Filters.
CO5: Implement multirate filters and apply adaptive filters appropriately in communication systems.

COURSE ARTICULATION MATRIX															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	1	3								3	2	
CO2	3	2	3	1	3								3	3	
CO3	3	2	3	1	3								3	3	
CO4	3	3	2	2	2								2	2	
CO5	3	2	3	2	3								3	3	

TEXT BOOK(S)	
T1.	John G. Proakis and Dimitris G.Manolakis, "Digital Signal Processing – Principles, Algorithms and Applications", 5th Edition, Pearson Education / Prentice Hall, July 2021 © 2022.
T2.	A. V. Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing", 3rd Edition, Pearson, July 2021 (© 2010 new edition).

REFERENCE BOOK(S)	
R1.	Emmanuel C. I feachor and Barrie. W. Jervis, "Digital Signal Processing", 2nd Edition, Pearson Education / Prentice Hall, 2002.
R2.	Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", 4th Edition Tata McGraw Hill, 2010.
R3.	Andreas Antoniou, "Digital Signal Processing", 2nd Revised Edition, Tata McGraw Hill, 2006.

SEMESTER V

Course Code: 24ECC311	Course Title: Microprocessors and Microcontrollers	
Course Category: PCC	Credits: 4	
L:T:P (Hours/Week) 2:0:2	Total Contact Hours: 60	Max Marks: 100

COURSE OBJECTIVES
• To introduce the fundamental architecture of the 8086 microprocessor.
• To familiarize the 8086's bus structure and role of coprocessor.
• To interface microprocessors with supporting chips.
• To learn 8051 microcontroller Architecture and functions.
• To identify the basics of PIC and ARM Processor applications.

UNIT I	8086 MICROPROCESSOR	6
Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming – Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.		
UNIT II	**8086 SYSTEM BUS STRUCTURE**	6
8086 signals – Basic configurations – System bus timing –System design using 8086 – I/O programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors.		
UNIT III	**I/O INTERFACING**	6
Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface – D/A and A/D Interface - Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller.		
UNIT IV	**MICROCONTROLLER & INTERFACING**	6
Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming. Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform		

generation - Comparison of Microprocessor and Microcontroller.		
UNIT V	**PIC AND ARM PROCESSOR**	6
Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming. Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation - Comparison of Microprocessor and Microcontroller.		

PRACTICALS	
1.	Program on basic arithmetic and logical operations using 8086.
2.	Program to move a data block without overlap using 8086.
3.	Interfacing on Traffic light controller with 8086.
4.	Interfacing on Key board and Display with 8086.
5.	Program on basic arithmetic and logical operations using 8051.
6.	Program to find square and cube and find 2's complement of a number using 8051.
7.	Interface on A/D and D/A converter with 8051.
8.	Interface on Stepper motor controller with 8051.
	Total: 60 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand and execute programs based on 8086 microprocessor.
CO2: Design system bus structure with multiprocessor configurations.
CO3: Design and interface I/O circuits
CO4: Design and implement 8051 microcontroller based systems.
CO5: Understand the basic concepts of PIC and ARM Processor.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	1	1							1		1	
CO2	2	1	2	1	1							1		2	
CO3	2	1	2	1	1									1	
CO4	2	1	2	1	1							1		1	1
CO5	2	1	2	1	1							1		1	1

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Ramesh S. Gaonkar, "Microprocessor Architecture Programming and Application", 6th Edition, Penram International (P) Ltd., Mumbai, 2013.
T2.	Mohamed Ali Mazidi, Janice Gillispie Mazidi and Rolin McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", 2nd Edition, Pearson Education, 2011.

REFERENCE BOOK(S)	
R1.	Yu-Cheng Liu and Glenn A.Gibson, "Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design", 2nd Edition, Prentice Hall of India, 2007.
R2.	A.K.Ray and K.M.Bhurchandi, "Advanced Microprocessors and Peripherals" 3rd Edition, Tata McGraw Hill, 2012.
R3.	Doughlas V.Hall, "Microprocessors and Interfacing, Programming and Hardware", Tata McGraw Hill, 2012

Course Code: 24ECC301	Course Title: Antenna and Wave Propagation	
Course Category: PCC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks: 100

COURSE OBJECTIVES
• To introduce fundamentals of the radiation phenomena.
• To provide the radiation characteristics of different types of antennas.
• To create awareness on different types of antenna arrays.
• To test the antennas and measure the antennas gain.
• To evaluate the models of radio wave propagation.

UNIT I	FUNDAMENTALS OF RADIATION	9
Definition of antenna parameters – Gain, Directivity, Effective aperture, Radiation Resistance, Band width, Beam width, Input Impedance. Matching – Baluns, Polarization mismatch, Antenna noise temperature, Radiation from oscillating dipole, Half wave dipole. Folded dipole, Yagi array.		
UNIT II	**APERTURE AND SLOT ANTENNAS**	**9**
Huygens' principle, radiation from rectangular aperture, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts, parabolic reflector antennas and feeding techniques, microstrip patch antenna .		
UNIT III	**ANTENNA ARRAYS**	**9**
N element linear array, Pattern multiplication, Broadside and End fire array – Concept of Phased arrays, Adaptive array, Basic principle of antenna Synthesis-Binomial array.		
UNIT IV	**SPECIAL ANTENNAS**	**9**
Principle of frequency independent antennas –Spiral antenna, Helical antenna, Log periodic. Modern antennas- Reconfigurable antenna, Active antenna, Dielectric antennas, Electronic band gap structure and applications, Antenna Measurements-Test Ranges, Measurement of Gain, Radiation pattern.		
UNIT V	**PROPAGATION OF RADIO WAVES**	**9**
Modes of propagation , Structure of atmosphere , Ground wave propagation, Tropospheric propagation, Duct propagation, Troposcatter propagation, Flat earth and Curved earth concept Sky wave propagation – Virtual height, critical frequency , Maximum usable frequency –		

Skip distance, Fading, Multi hop propagation.
Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the fundamentals of radiation.
CO2: Understand the different types of antennas and its applications.
CO3: Analyze the antenna arrays, aperture antennas and broad band.
CO4: Measure the gain of special antennas.
CO5: Evaluate the models of propagation.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	1										1	
CO2	2	1	2	2										1	1
CO3	2	1	1	1										2	
CO4	2	1	1	3								1		1	1
CO5	2	1	2	2								1		1	1

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	John D Kraus, "Antennas for all Applications", 3rd Edition, McGraw Hill, 2005.
T2.	Edward C.Jordan and Keith G.Balmain, "Electromagnetic Waves and Radiating Systems", Prentice Hall of India, 2006.
T3.	R.E.Collin, "Antennas and Radiowave Propagation", McGraw Hill, 2012.

REFERENCE BOOK(S)	
R1.	Constantine.A.Balanis, "Antenna Theory Analysis and Design", 3rd Edition, Wiley, 2006.
R2.	Rajeswari Chatterjee, "Antenna Theory and Practice", 2nd Edition, New Age International Publishers, 2006.
R3.	S. Drabowitch, "Modern Antennas", 2nd Edition, Springer Publications, 2007.
R4.	Robert S.Elliott "Antenna Theory and Design", 3rd Edition, Wiley, 2006.
R5.	H.Sizun, "Radio Wave Propagation for Telecommunication Applications", 1st Indian

	Reprint, Springer Publications, 2007.

Course Code: 24ECC312	**Course Title: VLSI Design**	
Course Category: PCC	**Credits: 4**	
L:T:P (Hours/Week) 2:0:2	**Total Contact Hours: 30**	**Max Marks: 100**

COURSE OBJECTIVES
• To study the fundamentals of CMOS circuits and its characteristics.
• To learn the design and realization of combinational circuits.
• To understand the design and realization of sequential circuits.
• To learn the different programmable devices as ROM, PLA and FPGA.
• To discuss on arithmetic building blocks and Verilog HDL.

UNIT I	**INTRODUCTION TO MOS TRANSISTOR**	**6**
MOS Transistor, CMOS logic, Inverter, Pass Transistor, ALayout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V characteristics, C-V characteristics, Non ideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model.		
UNIT II	**COMBINATIONAL MOS LOGIC CIRCUITS**	**6**
Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Circuit Pitfalls, Dynamic Power, Static Power.		
UNIT III	**SEQUENTIAL CIRCUIT DESIGN**	**6**
Static latches and Registers Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger, Monostable Sequential Circuits, Astable Sequential Circuits. Timing Issues: Timing Classification of Digital System.		
UNIT IV	**INTERCONNECT and PROGRAMMABLE LOGIC DEVICES**	**6**
Interconnect Parameters – Capacitance, Resistance, and Inductance, Logic Implementation using Programmable Devices – FPGA – introduction and architecture.		
UNIT V	**DESIGN OF ARITHMETIC BUILDING BLOCKS and HDL PROGRAMMING**	**6**
Arithmetic Building Blocks: Data Paths, Adders and types, Multipliers, Verilog HDL-Overview - structural and behavioural modeling concepts-Design examples- Carry Look		

ahead adders, ALU, Shift Registers.	
PRACTICALS	
1.	Design and simulate 5 transistor differential amplifiers.
2.	Design and Simulate a CMOS Inverting Amplifier.
3.	Design and Simulate basic Common Source, Common Gate and Common Drain Amplifiers.
4.	Design and simulate a CMOS Basic Gates & Flip-Flops.
5.	Design and simulate a CMOS inverter using digital flow.
6.	Simulate and implement carry look ahead adder with FPGA.
7.	Simulate and implement ALU with FPGA.
8.	Design and simulate an Adder and Multiplier (4 Bit) using HDL.
	Total: 60 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Realize the characteristics of MOS transistor.
CO2: Design of combinational MOS circuits and power strategies.
CO3: Design and construct Sequential Circuits and Timing systems.
CO4: Design and development of reprogrammable FPGA.
CO5: Develop HDL computational processes with improved design strategies.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1		1	2							1		1	
CO2	3	2	3	1	2									2	
CO3	2	3	2	1	2							1		2	1
CO4			1	1	2							1		2	2
CO5	1	2	2	1	2							1		2	1

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Neil H.E. Weste and David Money Harris "CMOS VLSI Design: A Circuits and Systems Perspective", 4th Edition, Pearson , 2017.
T2.	Jan M. Rabaey, Anantha Chandrakasan and Borivoje. Nikolic,"Digital Integrated Circuits: A Design perspective", 2nd Edition, Pearson, 2016.

REFERENCE BOOK(S)

R1.	M.J. Smith, “Application Specific Integrated Circuits”, Addisson Wesley, 2010.
R2.	Sung-Mo kang, Yusuf leblebici and Chulwoo Kim, “CMOS Digital Integrated Circuits: Analysis & Design”, 4th Edition, McGraw Hill Education, 2013.
R3.	Wayne Wolf, “Modern VLSI Design: System On Chip”, Pearson Education, 2007.
R4.	R.Jacob Baker, Harry W.LI. and David E.Boyee, “CMOS Circuit Design, Layout and Simulation”, Prentice Hall of India, 2005.

Course Code: 24ECC215	Course Title: Control System Engineering	
Course Category: PCC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To introduce the components and their representation of control systems.
• To understand various methods for analyzing the time response of the system.
• To analyse the frequency response of the system.
• To investigate the stability of the system.
• To explore the various approach for the state variable analysis.

UNIT I	SYSTEMS COMPONENTS AND THEIR REPRESENTATION	9
Control System - Terminology and Basic Structure - Feed forward and Feedback control theory - Electrical and Mechanical - Transfer Function Models - Block diagram Models- Signal flow graphs models - DC and AC servo systems - Multivariable control system.		
UNIT II	**TIME RESPONSE ANALYSIS**	**9**
Transient response, steady state response - Measures of performance of the standard first order and second order system - steady error constant and system, type number - PID control- Analytical design for PD, PI, and PID control systems.		
UNIT III	**FREQUENCY RESPONSE AND SYSTEM ANALYSIS**	**9**
Closed loop frequency response - Performance specification in frequency domain - Frequency response of standard second order system - Bode Plot - Polar Plot- lead, lag and lead-lag compensation - Design of compensators using Bode plots.		
UNIT IV	**CONCEPTS OF STABILITY ANALYSIS**	**9**
Concept of stability – Bounded: Input Bounded, Output stability- Routh stability criterion- Relative stability - Root locus concept - Guidelines for sketching root locus - Nyquist stability criterion.		
UNIT V	**CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS**	**9**
State variable representation - Conversion of state variable models to transfer functions - Conversion of transfer functions to state variable models - Solution of state equations - Concepts of Controllability and Observability - Stability of linear systems - Equivalence between transfer function and state variable representations.		

	Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to:
CO1: Compute the transfer function of different physical systems.
CO2: Analyse the time domain specification and calculate the steady state error.
CO3: Illustrate the frequency response characteristics of open loop and closed loop system Response.
CO4: Analyse Routh stability and root locus techniques.
CO5: Illustrate the state space model of a physical system.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1				1	1			2	1	
CO2	3	2	3	2	1				1	2			2	1	
CO3	3	3	3	2	2				2	2			2	2	
CO4	3	2	3	3	2				2	2			1	2	
CO5	2	2	3	3	2				2	2			3	2	

TEXT BOOK(S)	
T1.	M.Gopal, "Control System – Principles and Design", 4th Edition, Tata McGraw Hill, 2012.
T2.	K.Ogata, "Modern Control Engineering", 5th Edition, PHI, 2012.

REFERENCE BOOK(S)	
R1.	J.Nagrath and M.Gopal, "Control System Engineering", 5th Edition, New Age International Publishers, 2007.
R2.	S.K.Bhattacharya, "Control System Engineering", 3rd Edition, Pearson, 2013.
R3.	Benjamin.C.Kuo, "Automatic Control Systems", 7th Edition, Prentice Hall of India, 2010.

SEMESTER VI

Course Code: 24ECC302	**Microwave and Optical Communication**	
Course Category: PCC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To interpret the microwave components of Isolators and Attenuators.
• To design the microwave amplifiers and oscillators
• To educate the characteristics of optical fibers.
• To analyze the optical sources with transmitters and receivers.
• To design optical communication systems.

UNIT I	**MICROWAVE COMPONENTS**	**9**
Directional coupler – E plane Tee - H plane Tee – Magic Tee – Circulators – Isolators – Attenuators – Phase Shifters – Avalanche breakdown devices - PIN diode and TUNNEL diode, Power, VSWR, Impedance Measurement.		
UNIT II	**MICROWAVE AMPLIFIERS AND OSCILLATORS**	**9**
Introduction to microwave transmission , Applications and limitations – Klystron amplifier – Reflex Klystron Oscillator – TWT amplifiers – Magnetron Oscillator – Gunn oscillator.		
UNIT III	**INTRODUCTION TO OPTICAL FIBERS AND TRANSMISSION CHARACTERISTICS**	**9**
The propagation of light in optical waveguides – Classification of optical fibers – Numerical aperture, Step index and Graded index fiber – Modes in cylindrical fiber – Linearly polarized modes, Attenuation, Absorption, Scattering, Bending losses - Modal dispersion and chromatic dispersion – Single mode fiber - waveguide dispersion– MFD – PMD.		
UNIT IV	**OPTICAL TRANSMITTERS AND RECEIVERS**	**9**
Optical Sources: Light source materials – LED homo and hetero structures – surface and edge emitters – Quantum efficiency – Injection Laser Diode – Modes and threshold condition – Structures and Radiation Pattern - Optical detectors: Physical principles – PIN and APD diodes – Photo detector noise.		
UNIT V	**OPTICAL COMMUNICATION SYSTEMS AND DESIGN**	**9**
Transmitter module: Signal formats – Electronic driving circuit – Modulation circuit – external modulators. Amplifier: EDFA, Semiconductor Optical Amplifier - Receiver Module:		

Optical front end – Quantizer – Decision circuit - Optical Link Design: Point- to- point links – System considerations – Link Power budget – Rise time budget.
Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Recall the concept of microwave components.
CO2: Develop different types of microwave amplifiers and oscillators.
CO3: Explain the classifications and characteristics of Optical fibers.
CO4: Assess the different types of optical transmitters and receivers.
CO5: Generation of optical communication systems with transmitter and receiver module.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1										1			
CO2	2	1	1						1			1	1	1	
CO3	2	1										1		1	
CO4	2	2	2						1			1	1	1	
CO5	2	2	3	1		1			1			1	1		1

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Samuel Y. Liao, "Microwave Devices and Circuits", 4th Edition, Pearson Education, 2019.
T2.	Keiser G, "Optical Fiber Communication Systems", 5th Edition, Tata McGraw Hill, 2021.

REFERENCE BOOK(S)	
R1.	Collin.R.E, "Foundations for Microwave Engineering", 3rd Edition, Wiley IEEE Press, 2001.
R2.	Djafar.K. Mynbaev Lowell and Scheiner, "Fiber Optic Communication Technology", 6th Edition, Pearson, 2019.
R3.	John Powers, "An Introduction to Fiber optic Systems", 2nd Edition, Tata-McGraw Hill, 2010.

Course Code: 24ECC313	Embedded Systems and IoT Design	
Course Category: PCC	Credits: 4	
L:T:P (Hours/Week) 2:0:2	Total Contact Hours: 75	Max Marks : 100

COURSE OBJECTIVES
• To study the process of an Embedded System.
• To introduce interfacing I/O devices to the processor.
• To identify the evolution of the Internet of Things (IoT).
• To analyze the IoT communication models and open platforms.
• To apply the concept of Internet of Things in real world scenario.

UNIT I	EMBEDDED SYSTEMS	6
Embedded System Design Process – Model Train Controller – ARM Processor – Instruction Set Preliminaries – CPU – Programming Input and Output – Supervisor Mode – Exceptions and Trap – Models for programs – Assembly Language - Linking and Loading – Compilation Techniques – Program Level Performance Analysis.		
UNIT II	**EMBEDDED C PROGRAMMING**	6
Memory and I/O Devices Interfacing – Programming Embedded Systems in C – Need For RTOS – Multiple Tasks and Processes – Context Switching – Priority Based Scheduling Policies.		
UNIT III	**IoT AND ARDUINO PROGRAMMING**	6
Introduction to the Concept of IoT Devices – IoT Devices Versus Computers – IoT Configurations – Basic Components – Introduction to Arduino – Types of Arduino – Arduino Tool chain – Arduino Programming Structure – Sketches – Pins – Input/Output From Pins Using Sketches – Introduction to Arduino Shields – Integration of Sensors and Actuators with Arduino.		
UNIT IV	**IoT COMMUNICATION AND OPEN PLATFORMS**	6
IoT Communication Models and APIs – IoT Communication Protocols – Bluetooth – WiFi – ZigBee – GPS – GSM modules – Open Platform (like Raspberry Pi) – Architecture – Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.		
UNIT V	**APPLICATIONS AND DEVELOPMENT**	6
Complete Design of Embedded Systems – Development of IoT Applications – Home		

Automation – Smart Agriculture – Smart Cities – Smart Healthcare.

PRACTICALS	
1.	Programming on Serial Ports and On – Chip ports.
2.	Write Basic Programs Using Embedded C (LED Blinking in port 2).
3.	Write Basic Arithmetic Programs Using Embedded C with ports.
4.	Write an Arduino program to blink LED and serial communication.
5.	Explore different communication methods with IoT devices (Zigbee / GSM / Bluetooth).
6.	Write a program to blink LED using Raspberry PI platform and python programming.
7.	Interfacing of Ultrasonic and Temperature sensors with Raspberry PI.
8.	Design an IoT based system for Home Automation.
	Total: 60 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Develop a model of an embedded system with ARM Processor.
CO2: Implement Embedded C programming with I/O devices Interfacing.
CO3: Execute programming with Ardunio.
CO4: Examine the communication IOT protocols using Arduino/Raspberry Pi /open platform.
CO5: Develop IoT applications in real world scenario.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	2	1							1	1	1	1
CO2	2	1	2	2	2							1	1	1	1
CO3	2	1	2	2	2							1	1	1	1
CO4	3	2	1	2	2							1	1	1	1
CO5	3	2	3	2	2							1	1	1	1

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Mohammed Ali Mazidi, Janice Gillispie Mazidi and Rolin D.McKinlay, "The 8051 Microcontroller and Embedded Systems Using Assembly and C", 3rd Edition, Pearson Education, 2013.

T2.	Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry and Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.

REFERENCE BOOK(S)	
R1.	Michael J. Pont, "Embedded C",2nd Edition, Pearson, 2017.
R2.	Wayne Wolf, "Computers as Components: Principles of Embedded Computer System Design", Elsevier, 3rd Edition, 2012.
R3.	Andrew N Sloss, D. Symes and C. Wright, "Arm System Developer's Guide", Morgan Kauffman/ Elsevier, 2006.
R4.	Arshdeep Bahga and Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2nd Edition, 2019.

SEMESTER VII

Course Code: 24ECC411	Course Title: Wireless Communication	
Course Category: PCC	Credits: 4	
L:T:P (Hours/Week) 2:0:2	Total Contact Hours: 60	Max Marks: 100

COURSE OBJECTIVES
• To understand the fundamentals of wireless communication principles.
• To explore mobile radio propagation.
• To Introduce modulation and diversity techniques to multipath fading
• To analyze the concepts of multiple access techniques.
• To understand the concepts of Wireless Networks.

UNIT I	THE CELLULAR CONCEPT- SYSTEM DESIGN	6
Introduction-Frequency Reuse-Channel Assignment Strategies-Handoff Strategies: Prioritizing Handoffs, Practical Handoff Considerations- Interference and System Capacity: Co-Channel Interference and System Capacity-Channel Planning for Wireless Systems, Adjacent Channel Interference, Power Control for Reducing Interference, Trunking and Grade of Service. Improving Coverage and Capacity in Cellular Systems: Cell Splitting, Sectoring.		
UNIT II	**MOBILE RADIO PROPAGATION**	6
Large Scale Path Loss: Introduction to Radio Wave Propagation - Free Space Propagation Model – Three Basic Propagation Mechanism: Reflection – Brewster Angle- Diffraction- Scattering. Small Scale Fading and Multipath: Small Scale Multipath Propagation, Factors Influencing Small-Scale Fading, Doppler Shift, Coherence Bandwidth, Doppler Spread and Coherence Time. Types Of Small- Scale Fading: Fading Effects Due To Multipath Time Delay Spread, Fading Effects Due To Doppler Spread.		
UNIT III	**MODULATION TECHNIQUES, EQUALIZATION AND DIVERSITY**	6
Digital Modulation – An Overview: Factors That Influence The Choice of Digital Modulation, Linear Modulation Techniques: Minimum Shift Keying (MSK), Gaussian Minimum Shift Keying(GMSK), Spread Spectrum Modulation Techniques: Pseudo- Noise (PN) Sequences, Direct Sequence Spread Spectrum (DS-SS)- Modulation Performance in Fading and Multipath Channels- Equalization, Diversity and Channel Coding: Introduction-		

Fundamentals of Equalization- Diversity Techniques: Practical Space Diversity Considerations, Polarization Diversity, Frequency Diversity, Time Diversity.		
UNIT IV	**MULTIPLE ACCESS TECHNIQUES**	6
Introduction To Multiple Access- Frequency Division Multiple Access (FDMA)- Time Division Multiple Access (TDMA)- Spread Spectrum Multiple Access-Code Division Multiple Access (CDMA)- Space Division Multiple Access (SDMA)- Capacity of Cellular Systems: Capacity of Cellular CDMA, Capacity of CDMA With Multiple Cells.		
UNIT V	**WIRELESS NETWORKING**	6
Introduction about Wireless And Fixed Telephone Networks, The Public Switched Telephone Network (PSTN), Development Of Wireless Networks: First Generation Wireless Networks, Second Generation Wireless Networks, Third Generation Wireless Networks, Fixed Network Transmission Hierarchy, Traffic Routing in Wireless Networks: Circuit Switching, Packet Switching- Personal Communication Services/Networks(PCS/PCNs):Packet Vs Circuit Switching For PCN, Cellular Packet- Switched Architecture- Packet Reservation Multiple Access(PRMA)- Network Databases: Distributed Database For Mobility Management- Universal Mobile Telecommunication Systems(UMTS).		

PRACTICALS	
1.	Modeling of wireless communication systems.
2.	Computation of pathloss between transmitter and receiver in wireless environment.
3.	Modeling and simulation of Multipath fading channel.
4.	Design, analyze and test Wireless standards and evaluate the performance measurements such as BER, PER, BLER, throughput, capacity, ACLR, EVM for 4G and 5G.
5.	Modulation: Spread Spectrum – DSSS Modulation & Demodulation.
6.	Wireless Channel equalization: Zero-Forcing Equalizer (ZFE), MMSE Equalizer (MMSEE), Adaptive Equalizer (ADE), Decision Feedback Equalizer (DFE).
7.	Modeling and simulation of TDMA and FDMA for wireless communication.
8.	Modeling and simulation of CDMA for wireless communication.
	Total: 60 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Explain the concepts of cellular communication including frequency reuse, channel assignment, and handoff.

CO2: Study the concepts of Mobile Radio Propagation.
CO3: Analyze the concepts of modulation techniques, equalization and diversity.
CO4: Design the different types of multiple access techniques.
CO5: Explore the evolution of wireless networking and switching techniques.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2							3	2	1	1
CO2	3	3	2	2	2							3	2	1	1
CO3	3	3	3	1	2							2	3	2	1
CO4	3	2	3	2	2						2	2	2	2	2
CO5	3		2	1	2	1	1	1	2	2	2	2	2	2	1

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Rappaport, T.S., "Wireless communications", 2nd Edition, Pearson Education, 2010.
T2.	David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 2005.

REFERENCE BOOK(S)

R1.	Andrea Goldsmith, "Wireless Communication", Cambridge University Press, 2012.
R2.	Van Nee, R. and Ramji Prasad, "OFDM for wireless multimedia communications", Artech House, 2008.
R3.	Upena Dalal, "Wireless Communication", Oxford University Press, 2010.
R4.	Andreas.F. Molisch, "Wireless Communications", John Wiley – India, 2006.
R5.	William Stallings, "Wireless Communication and Networks", 2nd Edition, Pearson Education, 2013.

Course Code: 24ECC401	Course Title: MEMS Design	
Course Category: PCC	Credits: 4	
L: T:P (Hours/Week) 2:0:2	Total Contact Hours: 60	Max Marks: 100

COURSE OBJECTIVES
• To introduce the physical principles behind micro-electro-mechanical systems.
• To learn the design aspects of electrostatic sensors and actuators.
• To study about thermal sensors and actuators.
• To analyze the design of piezoelectric sensors and actuators.
• To apply multidisciplinary knowledge to analyse MEMS devices.

UNIT I	ESSENTIAL ELECTRIC AND MECHANICAL CONCEPTS	6
Conductivity of semiconductors, Crystal planes and orientations, stress and strain, flexural beam bending analysis under simple loading conditions, Dynamic system, resonant frequency and quality factor.		
UNIT II	**ELECTRO STATIC SESNING AND ACTUATION**	**6**
Parallel plate capacitor, Applications of parallel plate capacitors- inertial sensor, pressure sensor, flow sensor, tactile sensor, parallel plate actuators, interdigitated finger capacitors, applications of comb drive devices.		
UNIT III	**THERMAL SENSING AND ACTUATION**	**6**
Fundamentals of thermal transfer, Sensors and actuators based on thermal expansion, Thermo couples, Thermal resistors, Applications- Infrared sensors, flow sensors, Inertial sensors, other sensors.		
UNIT IV	**PIEZOELECTRIC SENSING AND ACTUATION**	**6**
Mathematical description of piezoelectric effects, Cantilever piezoelectric actuator model, properties of piezoelectric materials – Quartz, PZT, PVDF, ZnO, Applications – Acoustic sensors, Tactile sensors.		
UNIT V	**MAGNETIC SENSING AND ACTUATION**	**6**
Concepts and principles- magnetization and nomenclatures, principles of micromagnetic actuators, fabrication of micro magnetic components- deposition, design and fabrication of magnetic coil, MEMS magnetic actuators.		

PRACTICALS	
1.	Design and simulation of cantilever.
2.	Design and simulation of piezoelectric cantilever.
3.	Design and simulation of Pressure and flow sensor.
4.	Design and simulation of comb drive actuators.
5.	Simulation with infrared sensor for suitable application.
6.	Design and simulation of thermo couples.
7.	Simulation with acoustic sensor for suitable application.
8.	Design and Simulation of micromagnetic actuators.
	Total: 60 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Explain the mechanical and material properties relevant to MEMS design.
CO2: Apply the knowledge in the development of electro static sensors and actuators.
CO3: Explore about thermal sensors and actuators.
CO4: Develop the mathematical descriptions of piezoelectric sensors and actuators.
CO5: Design and fabricate the micro magnetic sensors and actuators.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	1							1	3	2	1
CO2	3	2	2	2	1							2	2	2	1
CO3	3	2	1	2	2							1	2	2	2
CO4	3	1	2	2	2							1	3	2	1
CO5	3	2	1	3	1							1	2	2	2

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Chang Liu, "Foundations of MEMS", 2nd Edition Pearson Education India limited, 2012.
T2.	Sergey Edward Lyshevski, "MEMS and NEMS: Systems, Devices, and Structures", CRC Press, 2002.

REFERENCE BOOK(S)	
R1.	Murty B.S, Shankar P, Raj B, Rath and B.B, Murday J, "Textbook of Nanoscience and Nanotechnology", Springer Publishing, 2016.
R2.	Tai Ran Hsu, "MEMS and Microsystems Design and Manufacture", Tata McGraw Hill,

	2002.
R3.	Vinod Kumar Khanna, “Nano sensors: Physical, Chemical, and Biological”, CRC Press, 2022.

Course Code: 24HSM401	Course Title: Professional Ethics and Human Values	
Course Category: HSMC	Credits: 2	
L: T:P (Hours/Week) 2:0:0	Total Contact Hours: 30	Max Marks: 100

COURSE OBJECTIVES
• To learn about morals, values ,work ethics and peaceful life.
• To create awareness of customs and religions for different professional roles.
• To provide depth knowledge on framing of the problem and determining the facts.
• To create awareness on safety and risk benefit analysis.
• To develop knowledge about global issues.

UNIT I	HUMAN VALUES	6
Morals, Values and Ethics - Integrity - Work Ethic - Service learning - Civic Virtue - Respect for others - Living Peacefully - Caring - Sharing - Honesty - Courage - Cooperation - Commitment - Empathy - Self Confidence Character - Spirituality - Case Study.		
UNIT II	**ENGINEERING ETHICS**	**6**
Senses of Engineering Ethics-Variety of moral issued - Types of inquiry - Moral dilemmas - Moral autonomy - Kohlberg's theory - Gilligan's theory - Consensus and controversy - Models of professional roles - Theories about right action - Self-interest - Customs and religion - Uses of Ethical theories - Valuing time - Cooperation – Commitment - Case Study.		
UNIT III	**ENGINEERING AS SOCIAL EXPERIMENTATION**	**6**
Engineering As Social Experimentation - Framing the problem - Determining the facts - Codes of Ethics - Clarifying Concepts - Application issues - Common Ground - General Principles - Utilitarian thinking respect for persons - Case study.		
UNIT IV	**ENGINEERS RESPONSIBILITY FOR SAFETY AND RISK**	**6**
Safety and risk - Assessment of safety and risk - Risk benefit analysis and reducing risk - Safety and the Engineer - Designing for the safety - Intellectual Property Rights (IPR).		
UNIT V	**GLOBAL ISSUES**	**6**
Globalization - Cross culture issues - Environmental Ethics - Computer Ethics - Computers as the instrument of Unethical behavior - Computers as the object of Unethical acts - Autonomous Computers-Computer codes of Ethics - Weapons Development - Ethics and Research - Analyzing Ethical Problems in research - Case Study.		

Total: 30 Hours
COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Analyse the essentials of human values and skills, self-exploration, happiness and prosperity.
CO2: Recognize the theories and principles of professional ethics.
CO3: Interpret engineering as a social experiment with awareness of ethical codes and professional responsibilities.
CO4: Analyse Safety and Risk benefit analysis and acquire knowledge on professional rights and responsibilities of an engineer.
CO5: Provide the sensitivity and global outlook in the contemporary world to fulfill the professional obligations effectively.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						2	1	3	1	1		2	3	2	
CO2	2					3		3				2	3		
CO3	2	2	1	2		3		3	2	1		2	3	2	
CO4	2	2		2		3	3	3				2	3	2	
CO5						3	2	3	2	1	2	2	3	2	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Mike W. Martin and Roland Scherzinger, "Ethics in Engineering", 4th Edition, McGraw-Hill Education, Delhi, 2005.
T2.	M. Govindarajan, S. Natarajan and V. S. Senthilkumar, "Professional Ethics and Human Values", PHI Learning Private Limited, 2013.

REFERENCE BOOK(S)

R1.	Jayshree Suresh and B.S. Raghavan, "Human Values and Professional Ethics", 4th Revised Edition, S. Chand & Company Limited, New Delhi, 2012.
R2.	S. B. Gogate, "Human Values and Professional Ethics", First Reprint, Vikas Publishing House Pvt. Ltd., Noida, 2014.
R3.	Charles E. Harris, Michael S. Pritchard, Ray W. James, Michael Jerome Rabins and Elaine E. Englehardt, "Engineering Ethics Concepts and Cases", 6th Edition, Wadsworth Cengage Learning, 2018.

MANDATORY COURSES:

Course Code: 24MAC001	**Course Title: Indian Constitution**	
Course Category: MC	**Credits: 0**	
L:T:P (Hours/Week) 1:0:0	**Total Contact Hours: 15**	**Max Marks : 100**

COURSE OBJECTIVES
• To understand evolution of Indian Constitution.
• To analyze the fundamental rights.
• To understand the composition of Parliament.
• To study constitution amendment procedure.
• To know about the powers of high court and supreme court.

UNIT I	**INTRODUCTION**	**2**
Evolution of Indian Constitution, Significance of Constitution, Composition, Preamble and its Philosophy.		
UNIT II	**RIGHTS, DUTIES AND DIRECTIVE PRINCIPLES**	**3**
Fundamental Rights- Writs and Duties, Directive Principles of State Policy.		
UNIT III	**COMPOSITION OF PARLIAMENT AND FEDERALISM**	**4**
Union Government, President and Vice President, Houses of the Parliament and their functions, Composition of State Legislature, Powers, Functions and Position of Governor, Function of Chief Ministers, Council of Ministers, The Indian Federal System, Administrative Relationship between Union and States.		
UNIT IV	**BILLS AND CONSTITUTION AMENDMENT PROCEDURE**	**3**
Types of Bills, Stages of passing of Bill into an Act, Veto Power, Constitution Amendment Procedure, Various Amendments made and their significance for India.		
UNIT V	**JUDICIARY**	**3**
Supreme Court and High Court, Functions and powers, Judicial Review.		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Learn the evolution of Indian Constitution.
CO2: Understand the fundamental rights and duties of state policies.
CO3: Understand the functions of Parliament and federalism.

CO4: Learn about constitution amendment procedure.
CO5: Understand the functions of High court and Supreme court.

TEXT BOOK(S)	
T1.	Subash C. Kashyap, "Our Constitution", 5th Edition, NBT, India, New Delhi, 2015.
T2.	Basu D D, "Introduction to the Constitution of India", 20th Edition, Prentice Hall of India, New Delhi, 2011.

REFERENCE BOOK(S)	
R1.	Briji Kishore Sharma, "Introduction to the Constitution of India", 8th Edition, Prentice Hall of India, New Delhi, 2017.
R2.	Hoshiar Singh, "Indian Administration", 1st Edition, Pearson Education, New Delhi, 2011.
R3.	Jain M C, "The Constitution of India", 5th Edition, State Mutual Book & Periodical Service, Limited, New Delhi, 1988.
R4.	Shukla V N, "Constitution of India", 13th Edition, Eastern Book Company Limited, New Delhi, 2017.

Course Code: 24MAC002	Course Title: Industrial Safety	
Course Category: MC	Credits: 0	
L:T:P (Hours/Week) 1:0:0	Total Contact Hours: 15	Max Marks : 100

COURSE OBJECTIVES
• To understand the Introduction and basic terminologies of safety.
• To learn about the Important Statutory Regulations and standards.
• To conduct and participate the various safety activities in the Industry.
• To have knowledge about Workplace Exposures and Hazards.
• To assess the various Hazards and consequences through various Risk Assessment Techniques.

UNIT I	SAFETY TERMINOLOGIES	3
Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS.		
UNIT II	**STANDARDS AND REGULATIONS**	**3**
Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S).		
UNIT III	**SAFETY ACTIVITIES**	**3**
Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment.		
UNIT IV	**WORKPLACE HEALTH AND SAFETY**	**3**
Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA.		
UNIT V	**HAZARD IDENTIFICATION TECHNIQUES**	**3**
Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment.		

COURSE OUTCOMES
At the end of this course, students will be able to

CO1: Learn the safety terminologies and safety policy.
CO2: Understand the occupational health and safety standards.
CO3: Understand the on-site and off-site emergency safety action plans.
CO4: Learn about the health and safety in workplace.
CO5: Expose the hazard identification techniques with qualitative and quantitative risk assessment.

TEXT BOOK(S)	
T1.	R.K. Jain and Prof. Sunil S. Rao "Industrial Safety, Health and Environment Management Systems", Khanna Publisher, 2012.
T2.	L. M. Deshmukh, "Industrial Safety Management: Hazard Identification and Risk Control", McGraw-Hill Education, 2015

REFERENCE BOOK(S)	
R1.	Frank Lees, "Loss Prevention in Process Industries", 4th Edition, Butterworth-Heinemann publications, UK, 2012.
R2.	John Ridley and John Channing, "Safety at Work: Routledge", 7th Edition, McGraw-Hill Education, 2015.
R3.	Dan Petersen, "Techniques of Safety Management: A System Approach", Khanna Publisher, 2012.

Course Code: 24MAC003	Course Title: Entrepreneurship	
Course Category: MC	Credits: 0	
L:T:P (Hours/Week) 1:0:0	Total Contact Hours: 15	Max Marks : 100

COURSE OBJECTIVES
• To develop and strengthen the entrepreneurial quality and motivation of learners.
• To impart the entrepreneurial skills and traits essential to become successful entrepreneurs.
• To apply the principles and theories of entrepreneurship and management in Technology oriented businesses.
• To empower the learners to run a Technology driven business efficiently and effectively
• To understand the emerging trends in Entrepreneurship.

UNIT I	INTRODUCTION TO ENTREPRENEURSHIP	3
Entrepreneurship- Definition, Need, Scope - Entrepreneurial Skill & Traits - Entrepreneur vs. Intrapreneur; Classification of entrepreneurs, Types of entrepreneurs -Factors affecting entrepreneurial development – Achievement Motivation – Contributions of Entreprenrship to Economic Development.		
UNIT II	**BUSINESS OWNERSHIP & ENVRIONMENT**	**3**
Types of Business Ownership – Business Environmental Factors – Political-Economic-Sociological-Technological-Environmental-Legal aspects – Human Resources Mobilization-Basics of Managing Finance- Essentials of Marketing Management - Production and Operations Planning – Systems Management and Administration.		
UNIT III	**FUNDAMENTALS OF TECHNOPRENEURSHIP**	**3**
Introduction to Technopreneurship - Definition, Need, Scope- Emerging Concepts-Principles - Characteristics of a technopreneur - Impacts of Technopreneurship on Society – Economy- Job Opportunities in Technopreneurship - Recent trends		
UNIT IV	**APPLICATIONS OF TECHNOPRENEURSHIP**	**3**
Technology Entrepreneurship - Local, National and Global practices - Intrapreneurship and Technology interactions, Networking of entrepreneurial activities – Launching - Managing Technology based Product / Service entrepreneurship –– Success Stories of Technopreneurs - Case Studies.		
UNIT V	**EMERGING TRENDS IN ENTREPRENERUSHIP**	**3**
Effective Business Management Strategies For Franchising - Sub-Contracting- Leasing-		

Technopreneurs – Agripreneurs - Netpreneurs- Portfolio entrepreneurship - NGO Entrepreneurship – Recent Entrepreneurial Developments - Local – National – Global perspectives.
Total : 15 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Learn the basics of Entrepreneurship.
CO2: Understand the business ownership patterns and environment.
CO3: Understand the Job opportunities in Industries relating to Technopreneurship.
CO4: Learn about applications of Tehnopreneurship and to become a successful Technopreneurs.
CO5: Acquaint with the recent and emerging trends in entrepreneurship.

TEXT BOOK(S)	
T1.	S.S.Khanka, "Entrepreneurial Development", S.Chand & Co. Ltd., Ram Nagar New Delhi, 2021.
T2.	Donal F Kuratko, "Entrepreneurship Theory, Process, Practice", 11th Edition, Cengage Learning, 2019.
T3.	Daniel Mankani, "Technopreneurship: The successful Entrepreneur in the new Economy", Prentice Hall, 2012.

REFERENCE BOOK(S)	
R1.	Edward Elgar, "Entrepreneurship, Cooperation and the Firm: The Emergence and Survival of High-Technology Ventures in Europe", Wiley Publication, 2010.
R2.	S.S.Khanka, "Entrepreneurial Development", S.Chand & Co. Ltd. Ram Nagar New Delhi, 2021.

Course Code: 24MAC004	Course Title: Film Appreciation	
Course Category: MC	Credits: 0	
L:T:P (Hours/Week) 1:0:0	Total Contact Hours: 15	Max Marks:100

COURSE OBJECTIVES
• To understand the historical development of film as an art and entertainment form.
• To learn the language of cinema and its evolution over a century.
• To develop the ability to read a film critically and appreciate its various nuances.
• To cultivate an appreciation for film as a text, exploring its narrative, themes, and stylistic elements.
• To foster a joyful and engaging approach to studying films.

UNIT I	THEME - A: THE COMPONENT OF FILMS	3
A-1: The material and equipment A-2: The story, screenplay and script A-3: The actors, crew members, and the director A-4: The process of film making… structure of a film		
UNIT II	**THEME - B: EVOLUTION OF FILM LANGUAGE**	**3**
B-1: Film language, form, movement etc. B-2: Early cinema… **silent film** (Particularly French) B-3: The emergence of feature films: **Birth of a Nation** B-4: Talkies		
UNIT III	**THEME - C: FILM THEORIES AND CRITICISM/APPRECIATION**	**3**
C-1: Realist theory; Autarkists C-2: Psychoanalytic, Ideological, Feminists C-3: How to read films? C-4: Film Criticism / Appreciation		
UNIT IV	**THEME – D: DEVELOPMENT OF FILMS**	**3**
D-1: Representative Soviet films D-2: Representative Japanese films D-3: Representative Italian films D-4: Representative Hollywood film and the studio system		

UNIT V	THEME - E: INDIAN FILMS	3
E-1: The early era E-2: The important films made by the directors E-3: The regional films E-4: The documentaries in India		
		Total : 15 Hours

COURSE OUTCOMES
At the end of this course, students will be able to:
CO1: Understand the historical development of film as an art and entertainment form.
CO2: Learn the language of cinema and its evolution over a century.
CO3: Develop the ability to read a film critically and appreciate its various nuances.
CO4: Cultivate an appreciation for film as a text, exploring its narrative, themes, and stylistic Elements.
CO5: Foster a joyful and engaging approach to studying films.

READING:

A Reader containing important articles on films will be prepared and given to the students. The students must read them and present in the class and have discussion on these.

Course Code: 24MAC005	Course Title: Well Being with Traditional Practices - Yoga, Ayurveda and Siddha	
Course Category: MC	Credits: 0	
L:T:P (Hours/Week) 1:0:0	Total Contact Hours: 15	Max Marks : 100

COURSE OBJECTIVES
• To enjoy life happily with fun filled new style activities that help to maintain health.
• To adapt a few lifestyle changes that will prevent many health disorders.
• To be cool and handbill every emotion very smoothly in every walk of life.
• To learn to eat cost effective but healthy foods that are rich in essential nutrients.
• To develop immunity naturally that will improve resistance against many health disorders.

UNIT I	HEALTH AND ITS IMPORTANCE	3
Health- Definition - Importance of maintaining health - More importance on prevention than treatment, Types of health, Present health status - The life expectancy-present status - mortality rate - dreadful diseases - Non-communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities. Types of diseases and disorders - Causes of the diseases / disorders - Importance of prevention of illness - Simple lifestyle modifications to maintain health - Maintaining BMI-Importance and actions to be taken.		
UNIT II	**DIET**	**3**
Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, Balanced diet and its 7 Components - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water, Food additives and their merits & demerits - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions, Definition of BMI and maintaining it with diet Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM.		
UNIT III	**ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH**	**3**
AYUSH systems and their role in maintaining health - preventive aspect of AYUSH -		

AYUSH as a soft therapy, Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life, Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - Pancheekarana Theory / **(**Five Element Theory) 96 fundamental Principles - Uyir Thathukkal **(**Tri-Dosha Theory) - Udal Thathukkal.		
UNIT IV	**MENTAL WELLNESS**	**3**
Emotional health - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioral response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long term effects of emotional disturbances, Stress management - Stress definition - Stress in daily life - How stress affects one's life - Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement.		
UNIT V	**YOGA**	**3**
Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders - What yoga can bring to our life.		
		Total : 15 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Learn the importance of different components of health.
CO2: Understand the importance of diet and workouts in maintaining health.
CO3: Learn new techniques of Ayurveda and Siddha systems.
CO4: Understand about emotional health and stress management.
CO5: Understand the concept of Yogasanas.

TEXT BOOK(S)	
T1.	Ashley Martin, "Nutrition and Dietetics", White Word Publications, New York, NY 10001, USA, 2012
T2.	Cory Martin, "Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body", Althea Press, Berkeley, California, 2015.

REFERENCE BOOK(S)

R1.	Moshe Zeidner, Gerald Matthews, and Richard D. Roberts, “What We Know About Emotional Intelligence - How It Affects Learning, Work, Relationships, and Our Mental Health”, Cambridge, Massachusetts, London, England, 2012
R2.	Kristin Neff and Christopher Germer, “A Bradford Book”, The MIT Press, Cambridge, Massachusetts, London, England, 2015

Course Code: 24MAC007	Course Title: Elements of Literature	
Course Category: MC	Credits: 0	
L:T:P (Hours/Week) 1:0:0	Total Contact Hours: 15	Max Marks : 100

COURSE OBJECTIVES
• To develop an awareness of the finer sensibilities of human existence through art.
• To appreciate the role of literature in expressing human experience.
• To explore different forms of literature as modes of human expression.
• To understand the elements of drama.

UNIT I	RELEVANCE OF LITERATURE	3
a) Enhances Reading, thinking, discussing and writing skills. b) Develops finer sensibility for better human relationship. c) Increases understanding of the problem of humanity without bias. d) Providing space to reconcile and get a cathartic effect.		
UNIT II	**ELEMENTS OF FICTION**	**3**
a) Fiction, fact and literary truth. b) Fictional modes and patterns. c) Plot character and perspective.		
UNIT III	**ELEMENTS OF POETRY**	**3**
a) Emotions and imaginations. b) Figurative language. c) (Simile, metaphor, conceit, symbol, pun and irony). d) Personification and animation. e) Rhetoric and trend.		
UNIT IV	**ELEMENTS OF DRAMA**	**3**
a) Drama as representational art. b) Content mode and elements. c) Theatrical performance. d) Drama as narration, mediation and persuasion. e) Features of tragedy, comedy and satire.		
		Total : 15 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Develop an awareness of the finer sensibilities of human existence through art
CO2: Appreciate the role of literature in expressing human experience
CO3: Explore different forms of literature as modes of human expression
CO4: Understand the features and varieties of drama

TEXT BOOK(S)	
T1.	W.H. Hudson, "An Introduction to the Study of English Literature", Atlantic, 2007.
T2.	Mario Klarer, Routledge, "An Introduction to Literary Studies", Pearson, 2013.

REFERENCE BOOK(S)	
R1.	Graham Mode, "The Experience of Poetry", Open college of Arts with Open Unv Press, 2012.
R2.	J.L.Styan, "The Elements of Drama", Literary Licensing, 2011.

MANAGEMENT ELECTIVES:

Course Code: 24HSM301	Course Title: Principles of Management	
Course Category: HSMC	Credits: 2	
L:T:P (Hours/Week) 2:0:0	Total Contact Hours: 30	Max Marks : 100

COURSE OBJECTIVES
• To outline the fundamental activities of managers.
• To apply the planning techniques and decision making.
• To understand the concept of Human Resource Management.
• To understand motivation, leadership and communication principles.
• Analyze the position of self and company goals towards business.

UNIT I	INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS	6
Definition of Management – Science or Art – Manager vs Entrepreneur- types of managers- managerial roles and skills – Evolution of Management –Scientific, human relations, system and contingency approaches– Types of Business organization- Sole proprietorship, partnership, company-public and private sector enterprises- Organization culture and Environment – Current trends and issues in Management.		
UNIT II	**PLANNING**	**6**
Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.		
UNIT III	**ORGANISING**	**6**
Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority – Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.		
UNIT IV	**DIRECTING**	**6**
Foundations of individual and group behaviour– Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT.		
UNIT V	**CONTROLLING**	**6**

System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting.
Total: 30 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the role of managers in an organization.
CO2: Understand the planning process in the organization.
CO3: Examine the managerial functions having an impact on the organizational effectiveness.
CO4: Show the ability in directing, leadership and communicate effectively.
CO5: Analyse the isolate issues and formulate best control methods.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1			1		1	2	2	2	3	3	1	1	1	
CO2	1			2	1	1	1	2	2	2	2	1	1	1	
CO3	1			1	1	1	1	1	2	3	2	1	1	1	
CO4	1			1	1	1	1	1	2	3	2	1	1	1	
CO5	1			1	1	1	1	2	2	2	2	1	1	1	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Harold Koontz and Heinz Weihrich "Essentials of Management", 11th Edition, Tata McGraw Hill, 2020.
T2.	Stephen P. Robbins and Mary Coulter, "Management", 13th Edition, Prentice Hall Pvt. Ltd., 2017.

REFERENCE BOOK(S)	
R1.	Robert Kreitner and Mamata Mohapatra, "Management", Biztantra, 2008.
R2.	Stephen A. Robbins and David A. Decenzo and Mary Coulter, "Fundamentals of Management", 7th Edition, Pearson Education, 2011.
R3.	P C Tripathi, P N Reddy and Ashish Bajpai, "Principles of Management", 7th Edition, Tata McGraw Hill, 2021.

Course Code: 24HSM302	Course Title: Total Quality Management	
Course Category: HSMC	Credits: 2	
L:T:P (Hours/Week) 2:0:0	Total Contact Hours: 30	Max Marks : 100

COURSE OBJECTIVES
• To communicate the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
• To explain the TQM Principles for application.
• To define the basics of Six Sigma and apply traditional tools, new tools, Benchmarking and FMEA.
• To describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.
• To illustrate and apply QMS and EMS in any organization.

UNIT I	INTRODUCTION	6
Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality - Definition of TQM- Basic concepts of TQM - Gurus of TQM - TQM Framework- Barriers to TQM - Benefits of TQM.		
UNIT II	**TQM PRINCIPLES**	**6**
Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning- Customer Satisfaction - Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal- Continuous process improvement - Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating and Relationship development.		
UNIT III	**TQM TOOLS & TECHNIQUES I**	**6**
The seven traditional tools of quality - New management tools - Six-sigma Process Capability- Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent , Documentation, Stages: Design FMEA and Process FMEA.		
UNIT IV	**TQM TOOLS & TECHNIQUES II**	**6**

Quality circles - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures - Cost of Quality - BPR.		
UNIT V	**QUALITY MANAGEMENT SYSTEM**	**6**
Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards – Sector - Specific Standards - AS 9100, TS16949 and TL 9000 - ISO 9001 Requirements - Implementation – Documentation - Internal Audits - Registration - Environmental Management System: Introduction - ISO 14000 Series Standards - Concepts of ISO 14001 - Requirements of ISO 14001-Benefits of EMS.		
		Total: 30 Hours

COURSE OUTCOMES

At the end of this course, students will be able to

CO1: Apply TQM concepts in a selected enterprise.

CO2: Apply TQM principles in a selected enterprise.

CO3: Understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.

CO4: Understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.

CO5: Apply QMS and EMS in any organization.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1					1	1	1	2	1	3	1	1	1	
CO2	1	1			1	1	1	2	2	1	3	1	1	1	
CO3	1	1		1	3	1	1	2	2	1	3	1	1	1	
CO4		1			1	1	1	2	2	1	3	1	1	1	
CO5					3	3	3	3	2	1	3	1	1	1	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Dale H. Besterfield, Carol Besterfield-Michna, Glen H. Besterfield, Mary Besterfield-Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Revised Third Edition, Pearson Education, Indian Reprint, 2018.
T2.	Joel. E. Ross, “Total Quality Management – Text and Cases and Readings”, Third Edition, St. Lucie Press, New York, 2017.

REFERENCE BOOK(S)	
R1.	D. R. Kiran, "Total Quality Management: Key concepts and case studies", Butterworth – Heinemann, 2016.
R2.	John S. Oakland, "Total Quality Management text with cases", Third Edition, Butterworth – Heinemann, Oxford, 2012.
R3.	L. Suganthi and Anand A. Samuel, "Total Quality Management", PHI Learning Private Limited, 2011.

Course Code: 24HSM303	Course Title: Engineering Economics and Financial Accounting	
Course Category: HSMC	Credits: 2	
L:T:P (Hours/Week) 2:0:0	Total Contact Hours: 30	Max Marks : 100

COURSE OBJECTIVES
• To understand the concepts of demand and supply analysis.
• To provide the insight on theory of production and cost analysis.
• To understand the different procedures of pricing.
• To acquire in depth knowledge of financial accounting.
• To determine the factor influencing working capital and its importance.

UNIT I	DEMAND & SUPPLY ANALYSIS	6
Managerial Economics - Relationship with other disciplines - Firms: Types, objectives and goals - Managerial decisions - Decision analysis. Demand - Types of demand - Determinants of demand - Demand function - Demand elasticity - Demand forecasting - Supply - Determinants of supply - Supply function -Supply elasticity.		
UNIT II	**PRODUCTION AND COST ANALYSIS**	**6**
Production function - Returns to scale - Production optimization - Least cost input - Isoquants - Managerial uses of production function. Cost Concepts - Cost function - Determinants of cost - Short run and Long run cost curves - Cost Output Decision - Estimation of Cost.		
UNIT III	**PRICING**	**6**
Determinants of Price - Pricing under different objectives and different market structures - Price discrimination - Pricing methods in practice.		
UNIT IV	**FINANCIAL ACCOUNTING (ELEMENTARY TREATMENT)**	**6**
Balance sheet and related concepts - Profit & Loss Statement and related concepts - Financial Ratio Analysis - Cash flow analysis - Funds flow analysis - Comparative financial statements - Analysis & Interpretation of financial statements.		
UNIT V	**CAPITAL BUDGETING (ELEMENTARY TREATMENT)**	**6**
Investments - Risks and return evaluation of investment decision - Average rate of return - Payback Period - Net Present Value - Internal rate of return.		
Total: 30 Hours		

COURSE OUTCOMES
At the end of this course, students will be able to

CO1: Describe the overall functions of Demand, Supply, Price and Income of the firms.
CO2: Evaluate the production function and identifies the least cost combination to control the costs of production.
CO3: Understand the structures of various market types and their pricing policies.
CO4: Understand the basic concepts of financial accounting and evaluation of company performance using ratio analysis.
CO5: Understand the types of business forms and also be able to evaluate the investments using capital budgeting techniques.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1		1			2		1	2	1	2	1	1	1	
CO2	1		1			2		1	2	1	2	1	1	1	
CO3	1		1			2		1	2	1	2	1	1	1	
CO4	1		1			1	1	1	2	1	3	1	1	1	
CO5	1		1			1	1	1	2	1	2	1	1	1	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	R. Panneer Selvam, "Engineering Economics", Second Edition, PHI Learning Private Limited, New Delhi, 2013.
T2.	Lila J.Truett and Dale B. Truett, "Managerial Economics: Analysis, Problems and Cases", Eighth Edition, Wiley-India, 2008.

REFERENCE BOOK(S)

R1.	Chan S. Park, "Contemporary Engineering Economics", Global Edition, Pearson Education, 2016.
R2.	Donald G. Newnan, Ted G. Eschenbach, Jerome P. Lavelle and Neal A. Lewis, "Engineering Economics and Analysis" Oxford University Press, 2017.
R3.	William G. Sullivan, Elin M.Wicks and C. Patrick Koelling, "Engineering Economy", 14th Edition, Pearson Education, 2011.

Course Code: 24HSM304	Course Title: Human Resource Management	
Course Category: HSMC	Credits: 2	
L:T:P (Hours/Week) 2:0:0	Total Contact Hours: 30	Max Marks : 100

COURSE OBJECTIVES
• To understand the functions, systems and policies of human resource management.
• To recruit and interview job candidates and appraise the performance of the employees.
• To train using various methods of training and implement management development techniques.
• To learn the factors determining the pay rates and salary administration.
• To provide knowledge about management issues related to human factors consideration and compliance with human resource requirements.

UNIT I	INTRODUCTION TO HUMAN RESOURCE MANAGEMENT	6
Importance of Human Resources - Objective of Human Resource Management - Human Resource Policies - Role of Human Resource Manager.		
UNIT II	**HUMAN RESOURCE PLANNING**	**6**
Importance of Human Resource Planning - Internal and External sources of Human Resources -Recruitment - Selection - Socialization.		
UNIT III	**TRAINING AND EXECUTIVE DEVELOPMENT**	**6**
Types of training and Executive Development methods - Purpose - Benefits.		
UNIT IV	**EMPLOYEE COMPENSATION**	**6**
Compensation plan - Reward - Motivation - Career Development - Mentor - Protege relationships.		
UNIT V	**PERFORMANCE EVALUATION AND CONTROL**	**6**
Performance evaluation - Feedback - the control process - Importance - Methods - Grievances - Causes - Redressal methods.		
		Total: 30 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Develop understanding of the basic concepts, functions and processes of human resource management.
CO2: Apply knowledge of human resource planning and implement techniques of job design.

CO3:Design HRM processes such as Recruitment/Selection/Training/Performance appraisals/Reward Systems etc.
CO4: Implement Employee benefits and Welfare measures.
CO5: Handle employee issues and evaluate the new trends in HRM.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			1	1		2	1	2	2	1	3	1	1	1	
CO2		1	1	1		1		2	2	2	3	1	1	1	
CO3	1			3	1	1		2	2	2	3	1	1	1	
CO4	1			3		1		2	2	1	3	1	1	1	
CO5		1		3	1	1	1	2	2	2	3	1	1	1	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	David A. DeCenzo and Stephen P. Robbins, "Fundamentals of Human Resource Management", 8th Edition, Wiley, 2007.
T2.	H John Bernardin, "Human Resource Management – An Experimental Approach", 5th Edition, Tata McGraw Hill, New Delhi, 2010.

REFERENCE BOOK(S)

R1.	Luis R, Gomez-Mejia, David B. Balkin and Robert L. Cardy, "Managing Human Resources", 8th Edition, Pearson Education, India, 2016.
R2.	Gary Dessler, "Human Resource Management", 13th Edition, Pearson Education, 2013.
R3.	Biswajeet Pattanayak, "Human Resource Management", 6th Edition, PHI Learning Private Limited, Delhi, 2020.

Course Code: 24HSM305	Course Title: Knowledge Management	
Course Category: HSMC	Credits: 2	
L:T:P (Hours/Week) 2:0:0	Total Contact Hours: 30	Max Marks : 100

COURSE OBJECTIVES
• To understand the basic concept of knowledge management and knowledge management systems.
• To know the Organizational Structure, Culture, Communities and KM practices, Information Technology as an enabler.
• To identify some of the key tools and techniques used in knowledge management applications.
• To analyse the recent trends in Knowledge Management.
• To formulate a framework for thinking about knowledge intensive organizations.

UNIT I	INTRODUCTION	6
Introduction to knowledge management - foundations of knowledge management - including cultural issues - technology applications organizational concepts and processes - management aspects - and decision support systems. The evolution of knowledge management: From information management to knowledge management - Key challenges facing the evolution of knowledge management - Ethics for knowledge management.		
UNIT II	**CREATING THE CULTURE OF LEARNING AND KNOWLEDGE SHARING**	**6**
Organization and Knowledge Management - Building the Learning Organization. Knowledge Markets: Cooperation among distributed technical specialists - Tacit Knowledge and Quality Assurance.		
UNIT III	**KNOWLEDGE MANAGEMENT-THE TOOLS**	**6**
Telecommunications and Networks in Knowledge Management - Internet Search Engines and Knowledge Management - Information Technology in Support of Knowledge Management - Knowledge Management and Vocabulary Control - Information Mapping in Information Retrieval - Information Coding in the Internet Environment - Repackaging Information.		
UNIT IV	**KNOWLEDGE MANAGEMENT APPLICATION**	**6**
Components of a knowledge strategy - Case Studies from Library to Knowledge Center, Knowledge Management in the Health Sciences, Knowledge Management in Developing Countries.		
UNIT V	**FUTURE TRENDS AND CASE STUDIES**	**6**

Advanced topics and case studies in knowledge management - Development of a knowledge management map/plan that is integrated with an organization's strategic and business plan - A case study on Corporate Memories for supporting various aspects in the process life - cycles of an organization.
Total: 30 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Analyse the issues in knowledge management.
CO2: Discuss the various levels in knowledge sharing and learning.
CO3: Express effectively about knowledge management systems, tools and portals.
CO4: Apply the knowledge management in library and information centers.
CO5: Create a knowledge management plan to leverage opportunities to create, capture, represent and share knowledge within an organization.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								3			3	1	1	1	
CO2	1	1				2	1	3	2	3	3	1	1	1	
CO3	1	1	1		2	2	1	3	2		3	1	1	1	
CO4	1	1	1	1	2		1	3	1	1	3	1	1	1	
CO5			1	1	1			3	1	1	3	1	1	1	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	T. Kanti Srikantaiah and Michael E.D.Koenig, "Knowledge Management for the Information Professional", Information Today, Inc., 2000.
T2.	Mohammad Nazim and Bhaskar Mukherjee, "Knowledge Management in Libraries Concepts, Tools and Approaches", Chandos Publications, 2016.

REFERENCE BOOK(S)	
R1.	Kimiz Dalkir, "Knowledge Management in Theory and Practice", 4th Edition, the MIT Press, 2023.
R2.	Donald Hislop, Rachelle Bosua and Remko Helms, "Knowledge Management in Organizations a critical Introduction", 4th Edition, Oxford University Press, 2018.

Course Code: 24HSM306	Course Title: Industrial Management	
Course Category: HSMC	Credits: 2	
L:T:P (Hours/Week) 2:0:0	Total Contact Hours: 30	Max Marks : 100

COURSE OBJECTIVES
• To study the basic concepts of management, approaches to management, contributors to management studies; various forms of business organization and professional organizations.
• To study the planning, organizing and staffing functions of management in professional organization.
• To study the leading, controlling and decision making functions of management in professional organization.
• To learn the organizational theory in professional organization.
• To learn the principles of productivity and modern concepts in management in professional organization.

UNIT I	INTRODUCTION TO MANAGEMENT	6
Management : Introduction; Definition and Functions - Approaches to the study of Management - Mintzberg's Ten Managerial Roles - Principles of Taylor; Fayol; Weber; Parker - Forms of Organization : Sole Proprietorship; Partnership; Company (Private and Public); Cooperative - Public Sector vs Private Sector Organization - Business Environment : Economic; Social; Political; Legal - Trade Union : Definition; Functions; Merits & Demerits.		
UNIT II	**FUNCTIONS OF MANAGEMENT - I**	**6**
Planning: Characteristics; Nature; Importance; Steps; Limitation; Planning Premises; Strategic Planning; Vision & Mission statement in Planning - Organizing : Organizing Theory; Principles; Types; Departmentalization; Centralization and Decentralization; Authority & Responsibility - Staffing : Systems Approach; Recruiting and Selection Process; Human Resource Development (HRD) Concept and Design.		
UNIT III	**FUNCTIONS OF MANAGEMENT – II**	**6**
Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake-Mounton, Reddin) - Communication: Purpose; Model; Barriers - Controlling: Process; Types; Levels; Guidelines; Audit (External, Internal, Merits); Preventive Control - Decision Making: Elements; Characteristics; Nature; Process; Classifications.		

UNIT IV	ORGANIZATION THEORY	6
Organizational Conflict : Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group; Conflict Management - Maslow's hierarchy of needs theory; Herzberg's motivation-hygiene theory; McClelland's three needs motivation theory; Vroom's valence-expectancy theory - Change Management : Concept of Change; Lewin's Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.		
UNIT V	**PRODUCTIVITY AND MODERN TOPICS**	**6**
Productivity : Concept; Measurements; Affecting Factors; Methods to Improve - Modern Topics (concept, feature/characteristics, procedure, merits and demerits) : Business Process Reengineering (BPR); Benchmarking; SWOT/SWOC Analysis; Total Productive Maintenance; Enterprise Resource Planning (ERP); Management of Information Systems (MIS).		
		Total: 30 Hours

COURSE OUTCOMES

At the end of this course, students will be able to

CO1: Explain basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.

CO2: Discuss the planning; organizing and staffing functions of management in professional organization.

CO3: Apply the leading; controlling and decision making functions of management in professional organization.

CO4: Discuss the organizational theory in professional organization.

CO5: Apply principles of productivity and modern concepts in management in professional organization.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1							1	2	2	3	1	1	1	
CO2	1	1		1	2	1	1	1	2	2	3	1	1	1	1
CO3	1	1		1	2	1	1	1	2	2	3	1	1	1	1
CO4	1		2	1		1		1	2	2	3	1	1	1	1
CO5	1		2	1	2	1		1	2	2	3	1	1	1	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	M. Govindarajan and S. Natarajan, "Principles of Management", PHI Learning Private Limited, New Delhi, 2012.
T2.	Harold Koontz and Heinz Weihrich and Mark V. Cannice, "Essentials of Management: An International, Innovation and Leadership Perspective", 11th Edition, Mc Graw Hill, New Delhi, 2020.

REFERENCE BOOK(S)	
R1.	Joseph L Massie, "Essentials of Management", 4th Edition, Prentice-Hall, 1987.
R2.	Saxena, P. K., "Principles of Management: a Modern Approach", Global India Publications Private Limited, New Delhi, 2009.
R3.	Samuel C. Certo and S.Trevis Certo, "Modern Management: Concepts and Skills (What's New in Management)", 15th Edition, Pearson Education, 2018.

PROFESSIONAL ELECTIVES I, II, III

Course Code: 24ECP101	Course Title: Low Power IC Design	
Course Category: PEC	Credits: 3	
L:T:P (Hours/Week) 2:0:2	Total Contact Hours: 60	Max Marks: 100

COURSE OBJECTIVES
• To learn the fundamentals of low- power and low- voltage VLSI design.
• To understand the different design approaches.
• To understand about the low - voltage and low - power adders.
• To understand the impact of power on low- voltage and low -power multipliers
• To develop the low- power and low - voltage memories

UNIT I	FUNDAMENTALS OF LOW POWER CIRCUITS	6
Need for Low Power Circuit Design, Sources of Power Dissipation – Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects –Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.		
UNIT II	**LOW-POWER DESIGN APPROACHES**	**6**
Low-Power Design through Voltage Scaling: VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining and Parallel Processing Approaches - Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, Mask level Measures.		
UNIT III	**MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER**	**6**
Introduction, Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Look-Ahead Adders, Carry Select Adders, Carry Save Adders, Low Voltage Low Power Design Techniques –Trends of Technology and Power Supply Voltage, Low Voltage Low-Power Logic Styles.		
UNIT IV	**FEEDBACK AMPLIFIERS AND OSCILLATORS**	**6**
Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh-Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier.		
UNIT V	**POWER AMPLIFIERS AND DC/DC CONVERTERS**	**6**
Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low Power SRAM		

Technologies, Basics of DRAM, Self-Refres Circuit, Future Trend and Development of DRAM.

PRACTICALS	
1.	Modeling and sources of power consumption.
2.	Power estimation at different design levels (mainly circuit, transistor, and gate).
3.	Power optimization for combinational circuits.
4.	Power optimization for sequential circuits.
5.	Design of Low Voltage - Low Power Logic styles.
6.	Design of Wallace Tree Multiplier.
7.	Power optimization for RT and algorithmic levels.
8.	Design of Low Power SRAM.
	Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the fundamentals of Low power circuit design.
CO2: Attain the knowledge of architectural approaches.
CO3: Analyze and design Low-Voltage Low-Power combinational circuits.
CO4: Learn the design of Low-Voltage Low-Power Memories
CO5: Design and develop Low Power, Low Voltage Circuits

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	1	2								1		
CO2	1	2	1	2	1								1		
CO3	1	1	1	2	2								2	2	
CO4	2	1	1	2	1							1	1	1	
CO5	1	1	1	2	2							1	1	1	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Sung-Mo Kang and Yusuf Leblebici, “CMOS Digital Integrated Circuits – Analysis and Design”, TMH, 2011.
T2.	Kiat-Seng Yeo and Kaushik Roy, “Low-Voltage, Low-Power VLSI Subsystems”, TMH Professional Engineering, 2004.

REFERENCE BOOK(S)	
R1.	Ming-BO Lin, “Introduction to VLSI Systems: A Logic, Circuit and System Perspective”, CRC Press, 2012.
R2.	Anantha Chandrakasan, “Low Power CMOS Design”, IEEE Press, /Wiley International, 2012.
R3.	Kaushik Roy and Sharat C. Prasad, “Low Power CMOS VLSI Circuit Design”, John Wiley & Sons, 2000.
R4.	Gary K. Yeap, “Practical Low Power Digital VLSI Design”, Kluwer Academic Press, 2002
R5.	Bellamour and M. I. Elamasri, “Low Power CMOS VLSI Circuit Design”, A Kluwer Academic Press, 2015.
R6	Siva G. Narendran and Anatha Chandrakasan, “Leakage in Nanometer CMOS Technologies”, Springer, 2005 .

Course Code: 24ECP102	Course Title: Validation and Testing Technology	
Course Category: PEC	Credits: 4	
L:T:P (Hours/Week) 2:0:2	Total Contact Hours: 60	Max Marks : 100

COURSE OBJECTIVES
• To understand various IC technology.
• To learn MOS theory and testing.
• To Learn CMOS circuit theory and testing.
• To expertise on CMOS characterization.
• To explore circuit and device level testing methods.

UNIT I	IC TECHNOLOGY	6
Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS Technologies. VLSI Fabrication, Oxidation, Lithography, Diffusion, Ion Implantation, Metallization, Integrated Resistors and Capacitors.		
UNIT II	**MOS THEORY ANALYSIS-I**	6
Basic Electrical Properties of MOS Circuits: Ids-Vds Relationships, MOS Transistor Threshold Voltage Vth, gm, gds, Figure of Merit ωo, Short Channel and Narrow Channel Width Effects.		
UNIT III	**MOS THEORY ANALYSIS- II**	6
Pass Transistor, Transmission Gate, NMOS Inverter, Various Pull-ups, CMOS Inverter Analysis and Design, Bi-CMOS Inverters, Latch up in CMOS Circuits.		
UNIT IV	**CMOS CIRCUIT CHARACTERISATION AND PERFORMANCE ESTIMATION**	6
Sheet Resistance RS, conductivity and its Concept to MOS, Area Capacitance Units, Calculations - Delays, Driving Large Capacitive Loads, Delay Estimation, Logical Effort and Transistor Sizing, Power Dissipation, Reliability		
UNIT V	**BASIC OF SILICON VALIDATION**	6
Need for Testing, Testing at Various Levels, Objectives of Testing - VLSI Test process and Test Equipment - Types of Testing: Functionality Tests, Silicon Debug, Manufacturing Tests, Defect during manufacturing - Fault Modelling, Observability and Controllability, Fault Coverage, Fault Sampling - ATE, Test economics.		

PRACTICALS	
1.	MOS Testing for Ids-Vds Relationships
2.	MOSFET Testing for threshold voltage like Vth, gate breakdown voltage.
3.	Design on Sheet Resistivity Measurement.

4.	Design on Conductivity Measurement.
5.	Design on Inverter Testing.
6.	Designing of CMOS inverter/ logic gate and testing of delay estimation.
7.	Design and test a **4-bit binary adder** in **Xilinx.**
8.	Design and simulate a **CMOS transmission gate** used in **multiplexers**.
	Total: 60 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Complete overview to CMOS fabrication process.
CO2: Understand the fundamental concept of MOS FET and testing.
CO3: To give the student an understanding of CMOS performance testing and estimation.
CO4: Illustrate the characteristics of transmission lines and signal propagation at high frequencies.
CO5: Explain the basics of Testing and Fault Modeling

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	1	2								1	2	
CO2	1	1	2	1	2								1	1	
CO3	1	1	2	1	2							1	2		
CO4	1	1	2	1	2							1	1	1	
CO5	1	2	1	1	3								1	2	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Kamran Ehraghian, Dauglas A. Pucknell and Sholeh Eshraghiam, "Essentials of VLSI Circuits and Systems", PHI, 2005.
T2.	Neil H. E. Weste and David. Harris Ayan Banerjee, "CMOS VLSI Design", Pearson Education, 2012.

REFERENCE BOOK(S)	
R1.	M.L. Bushnell and V.D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers, 2004.
R2.	N.K. Jha and S.G. Gupta, "Testing of Digital Systems", Cambridge University Press, 2003.
R3.	Etienne Sicard and Sonia Delmas Bendhia, "Basics of CMOS Cell Design", TMH, 2005.

Course Code: 24ECP103	Course Title: VLSI Testing and Design for Testability	
Course Category: PEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To introduce logic and fault simulation and testability measures.
• To study the design for testability.
• To know about interfacing and testing of memory.
• To introduce power management techniques in testing.
• To study testability in analog circuits.

UNIT I	TEST REQUIREMENTS AND METRICS	9
Validation platforms- SOC design methodology, IP components, Integration, Clocking, I/Os and interfaces, Device modes, Logic, memories, analog, I/Os, power management; Test requirements- Test handoffs, Testers Where DUT and DFT fit into design / framework; Test- ATPG, DFT, BIST, COF, TTR; Test cost metrics and test economics; Logic fault models- SAF, TDF, PDF, Iddq, St- BDG, Dy-BDG, SDD; Basics of test generation and fault simulation- Combinational circuits, Sequential circuits, Specific algorithmic approaches, CAD framework, Optimisations.		
UNIT II	**SCAN DESIGN AND BIST**	**9**
Scan Design- Scan design requirements, Types of scan and control mechanisms, Test pattern construction for scan, Managing scan in IPs and SOCs, Scan design optimisations, Partitioning, Clocking requirements for scan and delay fault testing, Speed of operation; BIST – Framework, Controller configurations, FSMs, LFSRs, STUMPS architecture, Scan compression and bounds, Test per cycle, Test per scan, Self-testing and self-checking circuits, Online test.		
UNIT III	**MEMORY TEST AND TEST INTERFACES**	**9**
Memory Test -Memory fault models, Functional architecture as applicable to test, Test of memories, Test of logic around memories, BIST controller configuration, Test of logic around memories, DFT and architecture enhancements, Algorithmic optimisations; Test Interfaces- Test control requirements, Test interfaces - 1500, JTAG, Hierarchical, serial control, Module / IP test, SOC test, Board test, System test, Boundary scan.		
UNIT IV	**DESIGN CONSIDERATIONS AND POWER MANAGEMENT DURING TEST**	**9**

Design Considerations, Physical design congestion, Partitioning, Clocks, Test modes, Pins, Test scheduling, Embedded test, Architecture improvements, Test in the presence of security; Power management during test- Methods for low power test, ATPG methods, DFT methods, Scan methods, Low power compression, Test of power management, Implications of power excursions, Optimisations.		
UNIT V	**ANALOG TEST**	**9**
Test requirements - DFT methods. BIST methods. Test versus measurement. Defect tests versus performance tests. Tests for specific modules - PLL, I/Os, ADC, DAC, SerDes, etc. RF test requirements.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand logic and fault simulation requirements and testability measures.
CO2: Understand the Design for Testability.
CO3: Develop interfacing and memory testing.
CO4: Perform testing with power management techniques.
CO5: Carry-out fault Detection in analog circuits.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2									2	1	
CO2	1	2	2	2									2	2	
CO3	2	1	1	2									2	1	
CO4	2	2	2	2									1	1	
CO5	1	2	2	1									1	2	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Vishwani Agrawal and Michael Bushnell, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Springer, 2002.
T2.	Zainalabedin Navabi, "Digital Design and Test: Using VHDL and System Verilog", 1st Edition, McGraw-Hill Education, 2010.

REFERENCE BOOK(S)	
R1.	K. G. Srinivasan, ""VLSI Design and Test", 1st Edition, PHI Learning, 2010.
R2.	D. K. Pradhan, "VLSI Design and Test", 1st Edition, Prentice Hall, 2006.

Course Code: 24ECP104	Course Title: Analog IC Design	
Course Category: PEC	Credits: 4	
L:T:P (Hours/Week) 2:0:2	Total Contact Hours: 60	Max Marks: 100

COURSE OBJECTIVES
• To study the basics of MOS Circuits.
• To analyse the noise characteristics of amplifiers.
• To study the performance parameters of amplifiers.
• To comprehend the compensation techniques.
• To understand the detection and testing of faults.

UNIT I	SINGLE STAGE AMPLIFIERS	6
Basic MOS physics and equivalent circuits and models, CS, CG and Source Follower, differential amplifier with active load, Cascode and Folded Cascode configurations with active load, design of Differential and Cascode Amplifiers – to meet specified SR, noise, gain, BW, ICMR and power dissipation, voltage swing, high gain amplifier structures.		
UNIT II	**HIGH FREQUENCY AND NOISE CHARACTERISTICS OF AMPLIFIERS**	**6**
Miller effect, association of poles with nodes, frequency response of CS, CG and Source Follower, Cascode and Differential Amplifier stages, statistical characteristics of noise, noise in Single Stage amplifiers, noise in Differential Amplifiers.		
UNIT III	**FEEDBACK AND SINGLE STAGE OPERATIONAL AMPLIFIERS**	**6**
Properties and types of negative feedback circuits, effect of loading in feedback networks, operational amplifier performance parameters, single stage op-amps, two-stage op-amps, input range limitations, gain boosting, slew rate, power supply rejection, noise in op-amps.		
UNIT IV	**STABILITY, FREQUENCY COMPENSATION**	**6**
Multipole Systems, Phase Margin, Frequency Compensation, Compensation Of Two Stage op-amps, Slewing In Two Stage op-amps, Other Compensation Techniques.		
UNIT V	**LOGIC CIRCUIT TESTING**	**6**
Faults in Logic Circuits- Basic Concepts of Fault Detection- Design for Testability- Ad Hoc Techniques, Level-Sensitive Scan Design, Partial Scan, Built-in Self-Test.		

PRACTICALS	
1.	Design a CMOS inverter and analyze its characteristics.

2.	Design a Common source amplifier and analyze its performance.
3.	Design a Common drain amplifier and analyze its performance.
4.	Design a Common gate amplifier and analyze its performance.
5.	Design a differential amplifier with resistive load using transistors.
6.	Design three stage and five stage ring oscillator circuit and compare its frequencies.
7.	Design a Logic circuit for fault detection.
8.	Design a circuit for Level Sensitive scan.
	Total: 60 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Design amplifiers to meet user specifications.
CO2: Analyse the frequency and noise performance of amplifiers.
CO3: Design and analyse feedback amplifiers and one stage op amps.
CO4: Analyse stability of op-amp.
CO5: Explore Testing experience of logic circuits.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	2	2								1	1	
CO2	1	1	2	2	1								1	1	
CO3	1	2	2	2	2								1	1	
CO4	1	2	1	2	2							1	1	1	
CO5	1	2	1	2	2							1	1	2	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Behzad Razavi, “Design of Analog CMOS Integrated Circuits”, Tata McGraw Hill, 2001.
T2.	Parag K.Lala, “An Introduction to Logic Circuit Testing”, Morgan & Claypool Publishers, 2009.

REFERENCE BOOK(S)	
R1.	Willey M.C. Sansen, “Analog Design Essentials”, Springer, 2006.
R2.	Grebene, “Bipolar and MOS Analog Integrated Circuit Design”, John Wiley & Sons, Inc.,2003.
R3.	Phillip E.Allen and Douglas R .Holberg, “CMOS Analog Circuit Design”, 2nd Edition, Oxford University Press, 2002.
R4.	Jacob Baker “CMOS: Circuit Design, Layout and Simulation”, 3rd Edition, Wiley IEEE Press, 2010.

Course Code: 24ECP105	Course Title: Advanced Digital Signal Processing	
Course Category: PEC	Credits: 4	
L:T:P (Hours/Week) 2:0:2	Total Contact Hours: 60	Max Marks: 100

COURSE OBJECTIVES
• To know about multirate signal processing and its applications.
• To introduce the concepts of discrete time random signal processing.
• To learn the concept of prediction theory and filtering.
• To understand the concepts of adaptive filtering and equalization techniques.
• To understand the spectrum estimation techniques.

UNIT I	MULTIRATE SIGNAL PROCESSING	6
Review of Convolution, DFT and ZT, Multirate Signal Processing - Decimation, Interpolation, Sampling Rate Conversion by a rational factor – digital filter banks, sub band coding, Quadrature Mirror Filter.		
UNIT II	**DISCRETE TIME RANDOM PROCESSES**	**6**
Stationary random processes, Autocorrelation, Rational Power Spectra, Filters for generating random Processes from white noise and inverse filter – AR, MA and ARMA processes – relationship between autocorrelation and the filter parameters.		
UNIT III	**LINEAR PREDICTION AND FILTERING**	**6**
Linear Prediction – Forward and Backward - Wiener filters for filtering and prediction – FIR Wiener Filter – IIR Wiener Filter – Kalman Filter.		
UNIT IV	**ADAPTIVE FILTERING**	**6**
FIR adaptive filters – adaptive filters based on steepest descent method – LMS algorithm – Variants of LMS algorithm – adaptive echo cancellation – adaptive channel equalization – RLS Algorithm.		
UNIT V	**SPECTRUM ESTIMATION**	**6**
Estimation of power spectra from finite duration observations of signals – Non parametric methods of spectrum estimation – the Bartlett and the Welch method – Parametric spectrum estimation – AR, MA and ARMA.		

PRACTICALS	
1.	Design of autocorrelation and Cross Correlation of random signals.
2.	Design and Implementation of Multirate Systems.
3.	Design and Implementation of Wiener Filter.
4.	Design and Implementation of FIR Linear Predictor.

5.	Design of adaptive filters using LMS algorithm.
6.	Design of adaptive filters using RLS algorithm.
7.	Design of spectrum estimation using Bartlett and Welch Methods.
8.	Design of parametric spectrum estimation by AR, MA methods
	Total: 60 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Comprehend multirate signal processing and demonstrate its applications.
CO2: Demonstrate an understanding of the power spectral density and apply to discrete random signals and systems.
CO3: Apply linear prediction and filtering techniques to discrete random signals for signal detection and estimation.
CO4: Analyze adaptive filtering problems and demonstrate its application.
CO5: Apply power spectrum estimation techniques to random signals.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2								2	2	
CO2	2	2	2	1	2								1	2	
CO3	1	2	1	2	1								2	1	
CO4	2	2	2	2	2								2	2	
CO5	2	2	1	1	2								1	1	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	John G. Proakis and Dimitris G.Manolakis, "Digital Signal Processing – Principles, Algorithms & Applications", 4th Edition, Pearson Education / Prentice Hall, 2007.
T2.	P. Vaidyanathan, "Multirate Systems and Filter Banks", Prentice Hall Inc., 2010.

REFERENCE BOOK(S)	
R1.	Monson H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons Inc. New York, Indian reprint 2008.
R2.	Haykin, "Adaptive Filter Theory", 4th Edition, Pearson Education, New Delhi, 2006.
R3.	Sophoncles J. Orfanidis, "Optimum Signal Processing ", McGraw Hill, 2000.

Course Code: 24ECP001	Course Title: Image Processing	
Course Category: PEC	Credits: 3	
L:T:P (Hours/Week) : 3	Total Contact Hours: 45	Max Marks: 100

COURSE OBJECTIVES
• To become familiar with digital image fundamentals.
• To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
• To learn concepts of degradation function and restoration techniques.
• To study the image segmentation and representation techniques.
• To become familiar with image compression and recognition methods.

UNIT I	DIGITAL IMAGE FUNDAMENTALS	9
Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms – DFT, DCT.		
UNIT II	**IMAGE ENHANCEMENT**	**9**
Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering–Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.		
UNIT III	**IMAGE RESTORATION**	**9**
Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering.		
UNIT IV	**IMAGE SEGMENTATION**	**9**
Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation –Region growing – Region splitting and merging – Morphological processing-erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.		
UNIT V	**IMAGE COMPRESSION AND RECOGNITION**	**9**
Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding,		

JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.
Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.
CO2: Operate on images using the techniques of smoothing, sharpening and enhancement.
CO3: Understand the restoration concepts and filtering techniques.
CO4: Learn the basics of segmentation, features extraction, compression and recognition methods for color models.
CO5: Comprehend image compression concepts.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2									1	2	
CO2	2	2	2	2									1	1	
CO3	1	2	2	2									1	2	
CO4	1	1	2	1									1	1	
CO5	2	2	2	2									2	2	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Pearson, 3rd Edition, 2010.
T2.	Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson, 2002.

REFERENCE BOOK(S)	
R1.	Rafael C. Gonzalez, Richard E. Woods and Steven Eddins, "Digital Image Processing using MATLAB", Pearson Education, Inc., 2011.
R2.	D.E. Dudgeon and RM. Mersereau, "Multidimensional Digital Signal Processing", Prentice Hall Professional Technical Reference, 2012.
R3.	William K. Pratt, "Digital Image Processing", John Wiley, New York, 2002
R4.	Milan Sonka, "Image Processing, Analysis And Machine Vision", Brookes/Cole, 2nd Edition, Vikas Publishing House, 2010.

Course Code: 24ECP006	**Course Title: Speech Processing**	
Course Category: PEC	**Credits: 4**	
L:T:P (Hours/Week) : 2:0:2	**Total Contact Hours: 60**	**Max Marks: 100**

COURSE OBJECTIVES
• To study the fundamentals of speech signal and extracts various speech features.
• To understand different speech features and distortion measures.
• To understand different speech coding techniques for speech compression applications
• To study about and learn to build speech enhancement.
• To learn to build text-to-speech synthesis system.

UNIT I	**FUNDAMENTALS OF SPEECH**	**6**
The Human speech production mechanism, Discrete-Time model of speech production, Speech perception - human auditory system, Phonetics - articulatory phonetics, acoustic phonetics, and auditory phonetics, Categorization of speech sounds, Spectrographic analysis of speech sounds, Pitch frequency, Pitch period measurement using spectral and cepstral domain, Formants, Evaluation of Formants for voiced and unvoiced speech.		
UNIT II	**SPEECH FEATURES AND DISTORTION MEASURES**	**6**
Significance of speech features in speech-based applications, Speech Features – Cepstral Coefficients, Mel Frequency Cepstral Coefficients (MFCCs), Perceptual Linear Prediction (PLP), Log Frequency Power Coefficients (LFPCs), Speech distortion measures–Simplified distance measure, LPC-based distance measure, Spectral distortion measure, Perceptual distortion measure.		
UNIT III	**SPEECH CODING**	**6**
Need for speech coding, Waveform coding of speech – PCM, Adaptive PCM, DPCM, ADPCM, Delta Modulation, Adaptive Delta Modulation, G.726 Standard for ADPCM, Parametric Speech Coding – Channel Vocoders, Linear Prediction Based Vocoders, Code Excited Linear Prediction (CELP) based Vocoders, Sinusoidal speech coding techniques, Hybrid coder, Transform domain coding of speech		
UNIT IV	**SPEECH ENHANCEMENT**	**6**
Classes of Speech Enhancement Algorithms, Spectral-Subtractive Algorithms - Multiband Spectral Subtraction, MMSE Spectral Subtraction Algorithm, Spectral Subtraction Based on Perceptual Properties, Wiener Filtering - Wiener Filters in the Time Domain, Wiener Filters in		

the Frequency Domain, Wiener Filters for Noise Reduction, Maximum-Likelihood Estimators, Bayesian Estimators, MMSE and Log-MMSE Estimator, Subspace Algorithms**.**		
UNIT V	**SPEECH SYNTHESIS AND APPLICATION**	**6**
A Text-to-Speech systems (TTS), Synthesizers technologies – Concatenative synthesis, Use of Formants for concatenative synthesis, Use of LPC for concatenative synthesis, HMM-based synthesis, Sinewave synthesis, Speech transformations, Watermarking for authentication of a speech, Emotion recognition from speech.		

PRACTICALS	
1.	Write Program to classify voiced and unvoiced segment of speech using various time-domain measures.
2.	Write a Program for Pitch period measurement using spectral and cepstral domain.
3.	Write a Program to calculate the MFCC for a speech signal.
4.	Write a Program to implement Adaptive Delta Modulation.
5.	Implement ITU-T G.722 Speech encoder.
6.	Write a Program to implement Wiener Filters for Noise Reduction.
7.	Design a speech emotion recognition system using DCT and WPT.
8.	Write a Program to implement sinewave synthesis.
	Total: 60 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the fundamentals of speech.
CO2: Extract various speech features for speech related applications
CO3: Choose an appropriate speech coder for a given application.
CO4: Build a speech enhancement system.
CO5: Build a text-to-speech synthesis system for various applications

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1					1		2	2	1	
CO2	2	1	2	2	1					1		2	2	1	1
CO3	1	2	1	2	2					1		2	2	1	1
CO4	1	2	2	1	2					1		2	2	2	
CO5	2	1	2	2	2	2	2			1		2	2	1	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Shaila D. Apte, “Speech and Audio Processing”, Wiley India (P) Ltd, New Delhi, 2012
T2.	Philipos C. Loizou, “Speech Enhancement Theory and Practice”, 2nd Edition, CRC Press, Inc., United States, 2013

REFERENCE BOOK(S)	
R1.	Rabiner L. R. and Juang B. H, “Fundamentals of Speech Recognition”, Pearson Education, 2003
R2.	Thomas F. Quatieri, “Discrete-Time Speech Signal Processing - Principles and Practice”, Pearson, 2012

Course Code: 24ECP107	Course Title: RF Transceivers	
Course Category: PEC	Credits: 4	
L:T:P (Hours/Week) 2:0:2	Total Contact Hours: 60	Max Marks : 100

COURSE OBJECTIVES
• To impart the fundamentals of RF system design.
• To acquaint with the various components of RF system for wireless communications.
• To know the basic techniques needed for analysis of RF systems.
• To enable the students to verify the basic principles and design aspects involved in RF systems components.
• To conduct experiments to analyze and interpret data to produce meaningful conclusion and match with theoretical concepts.

UNIT I	CMOS PHYSICS, TRANSCEIVER SPECIFICATIONS AND ARCHITECTURES	6
CMOS: Introduction to MOSFET Physics - Noise: Thermal, shot, flicker, popcorn noise - Transceiver Specifications: Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR - Phase noise - Transceiver Architectures: Receiver: Homodyne, Heterodyne, Image reject, Low-IF Architectures - Transmitter: Direct-up conversion, Two-step up conversion schemes.		
UNIT II	**IMPEDANCE MATCHING NETWORKS AND AMPLIFIERS**	**6**
Review of S-parameters and Smith chart - Passive IC components - Impedance matching networks - Amplifiers: Common Gate, Common Source Amplifiers - OC Time constants in bandwidth estimation and enhancement - High frequency amplifier design - Low Noise Amplifiers: Power match and Noise match, single-ended and differential LNAs.		
UNIT III	**FEEDBACK SYSTEMS AND POWER AMPLIFIERS**	**6**
Feedback Systems: Stability of feedback systems, Gain and phase margin, Root-locus techniques, Time and Frequency domain considerations, Compensation - Power Amplifiers: General model - Class A, AB, B, C, D, E and F amplifiers - Linearization Techniques - Efficiency boosting techniques - ACPR metric.		
UNIT IV	**FILTERS, OSCILLATORS AND MIXERS**	**6**
Overview - basic resonator and filter configuration, special filter realizations, filter implementation - Basic oscillator model, high-frequency oscillator configuration, Colpitt's		

oscillator - basic characteristics of mixers, single and double-balanced mixers.		
UNIT V	**PLL AND FREQUENCY SYNTHESIZERS**	**6**
PLL: Linearized Model, Noise properties, Phase detectors, Loop filters and Charge pumps- Frequency Synthesizers: Integer-N frequency synthesizers - Direct Digital Frequency Synthesizers.		

PRACTICALS	
1.	Design of Transceiver Architectures.
2.	Measurement of S-parameters for impedance matching circuits, and RF filters using network analyzer.
3.	Design of RF inductor and capacitor.
4.	Design and characterization of LNA.
5.	Design of impedance matching network.
6.	Design of low-pass and band-pass filter at RF.
7.	Design and characterization of mixer.
8.	Measurement of Noise properties using Direct Digital Frequency Synthesizers.
	Total: 60 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Interpret the nonlinear effects in RF circuits
CO2: Design RF circuits
CO3: Analyze the performance of RF circuits
CO4: Apply knowledge to identify a suitable architecture and systematically design an RF System.
CO5: Comprehensively record and report the measured data and analyzing, interpreting the experimentally measured data and produce the conclusions.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2								1	1	
CO2	2	2	2	2	2								1	2	
CO3	1	1	1	1	1								1	2	
CO4	2	2	2	2	2								1	1	
CO5	1	2	1	2	1								1	2	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Lee T, "Design of CMOS RF Integrated Circuits", 2nd Edition, Cambridge, 2004.
T2.	Razavi B, "RF Microelectronics", 2nd Edition, Pearson Education, 2012.
T3.	Ludwig R, and Bretchko P, "RF Circuit Design Theory and Applications", Prentice Hall, 2000.

REFERENCE BOOK(S)	
R1.	Razavi B, "Design of Analog CMOS Integrated Circuits", 2nd Edition, McGraw Hill, 2017.
R2.	Kyung-WhanYeom, "Microwave Circuit Design - A Practical Approach using ADS", Pearson Education, 2015.

Course Code: 24ECP002	Course Title: Antenna Design	
Course Category: PEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To introduce the basic concepts of antenna arrays for smart antenna design.
• To discuss the random variables and processes for angle of arrival (AOA) estimation.
• To describe different algorithms used for AOA estimation.
• To introduce the concepts of fixed weight beamforming.
• To introduce the concept of adaptive beamforming.

UNIT I	ANTENNA ARRAY FUNDAMENTALS	9
Linear arrays: Two element and Uniform N element array – Array weighting: Beam steered and weighted arrays – Circular arrays – Rectangular planar arrays – Fixed beam arrays – Butler Matrices – Fixed sidelobe cancelling – Retrodirective arrays: Passive and active retrodirective arrays.		
UNIT II	**PRINCIPLES OF RANDOM VARIABLES AND PROCESSES**	**9**
Definition of Random Variables - Probability Density Functions - Expectation and Moment - Common Probability Density Functions - Stationarity and Ergodicity - Autocorrelation and Power Spectral Density - Correlation Matrix.		
UNIT III	**ANGLE OF ARRIVAL ESTIMATION**	**9**
Fundamentals of Matrix Algebra: Vector basics - Matrix basics - Array Correlation Matrix - AOA Estimation Methods: Bartlett AOA estimate, Capon AOA estimate, Linear prediction AOA estimate, Maximum entropy AOA estimate, Pisarenko harmonic decomposition AOA estimate, Min-norm AOA estimate, MUSIC AOA estimate, Root-MUSIC AOA estimate, ESPRIT AOA estimate.		
UNIT IV	**SMART ANTENNAS: FIXED WEIGHT BEAMFORMING**	**9**
Introduction - Historical Development of Smart Antennas - Fixed Weight Beamforming Basics: Maximum signal-to-interference ratio, Minimum mean-square error, Maximum likelihood, Minimum variance.		
UNIT V	**SMART ANTENNAS: ADAPTIVE BEAMFORMING**	**9**
Adaptive Beamforming: Least mean squares, Sample matrix inversion, Recursive least squares, Constant modulus, Least squares constant modulus, Conjugate gradient method,		

Spreading sequence array weights, Description of the new SDMA receiver.
Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Describe the basics of phased array antennas
CO2: Understand random process and its application in Smart antennas
CO3: Estimate the weights of the antenna array based on the angle of arrival
CO4: Analyze the fixed weight beamforming in smart antennas
CO5: Analyze adaptive beamforming in smart antennas

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2									2	2	
CO2	2	1	2	1									2	1	1
CO3	2	2	2	2									1	2	1
CO4	2	2	2	2									2	2	1
CO5	2	1	2	1									1	1	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Frank Gross, “Smart Antennas For Wireless Communications”, McGraw Hill, 2006.
T2.	S. Chandran, “Adaptive Antenna Arrays, Trends And Applications”, Springer, 2009.
T3.	T. S. Rappaport, “Smart Antennas: Adaptive Arrays, Algorithms And Wireless Position Location”, IEEE Press, 2010.

REFERENCE BOOK(S)	
R1.	Robert A.Monzingo, Randy L. Haupt and Thomas W.Miller, “Introduction to Adaptive arrays”, 2nd Edition, IET, 2011.
R2.	Thomas Kaiser, “Smart Antennas: State of the Art”, Hindawi, 2005.

Course Code: 24ECP108	Course Title: RFID System Design and Testing	
Course Category: PEC	Credits: 4	
L:T:P (Hours/Week) 2:0:2	Total Contact Hours: 60	Max Marks : 100

COURSE OBJECTIVES
• To discuss the fundamentals of near field and far field RFID communications.
• To articulate the standards and protocols used in RFID systems.
• To describe the operating principles of RFID tag and reader.
• To introduce the security aspects and system architecture of RFID systems.
• To illustrate the industrial and scientific applications of RFID systems.

UNIT I	INTRODUCTION	6
RFID Principles: Near-field based RFID – Properties of Magnetic field – Far-field based RFID – Properties of Backscatter RF Systems – Modulation techniques – Frequency based property comparison of RFID Systems.		
UNIT II	**RFID STANDARDS AND PROTOCOLS**	**6**
RFID Industry standards: EPC global – ISO15693 Vicinity cards and RFID – ISO14443 Proximity cards and RFID – The NFC forum – Reading collocated RFID tags: Query Tree protocol – Query Slot protocol.		
UNIT III	**OPERATING PRINCIPLES**	**6**
RFID Tag components: RFID tag types – the 1-Bit Transponder and Chipless Tags – RFID readers and middleware component – Communication fundamentals: Coupling, Data encoding, multi-path effect – Tag, Reader and sensor communication.		
UNIT IV	**DATA INTEGRITY AND SECURITY**	**6**
The checksum procedure – Multiaccess procedures – Attacks on RFID Systems – Protection by Cryptographic measures.		
UNIT V	**RFID ENABLED SENSORS AND APPLICATIONS**	**6**
RFID enabled Sensors: Antenna design challenges – IC design – Integration of sensors and RFID – Power consumption and Link budget. Applications: Contactless smart cards – Access control – Electronic passport – Industrial Automation – Medical applications – Challenges and opportunities.		

PRACTICALS

1.	Design a magnetic field properties of Backscatter RF Systems.
2.	Design of a passive RFID Tag Antenna.
3.	Design of an RFID reader antenna.
4.	Determination of read range of the RFID tag at UHF and Microwave frequencies.
5.	Determination of RFID tag performance for different standards.
6.	Determination of Power consumption and Link budget.
7.	Design an industrial automation using RFID Enabled Sensors.
8.	Design an electronic passport using RFID Enabled Sensors.
	Total: 60 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Classify RFID systems based on frequency, architecture and performance
CO2: Define standards for RFID technology
CO3: Illustrate the operation of various components of RFID systems
CO4: Describe the privacy and security issues in RFID Systems.
CO5: Discuss the construction and applications of RFID enabled sensor

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1							2	2	2	
CO2	2	2	2	2	1							1	2	1	
CO3	1	2	1	2	2							2	1	2	1
CO4	2	2	2	1	1							2	2	2	2
CO5	2	2	2	-	1							1	1	1	1

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Amin Rida, Li Yang and Manos M. Tentzeris, "RFID Enabled Sensor Design and Applications", Artech House, 2010.
T2.	Klaus Finkenzeller, "RFID Handbook", 3rd Edition, Wiley, 2010.

REFERENCE BOOK(S)	
R1.	Syed Ahson and Mohammad Ilyas, "RFID Handbook", CRC Press, 2008.
R2.	Paris Kitsos, "Security in RFID and Sensor Networks", CRC Press, 2016.

Course Code: 24ECP003	Course Title: Computer Architecture and Networks	
Course Category: PEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To understand the basic structure and operation of digital computer.
• To understand the hardware-software interface.
• To understand the concept of memory and I/O systems.
• To understand the concept of layering in networks.
• To learn the functions of network layer and the various routing protocols

UNIT I	OVERVIEW & INSTRUCTIONS	9
Eight ideas – Components of a computer system – Technology – Performance – Power wall – Uniprocessors to multiprocessors; Instructions – operations and operands – representing instructions – Logical operations – control operations – Addressing and addressing modes.		
UNIT II	**MEMORY AND I/O SYSTEMS**	**9**
Memory hierarchy - Memory technologies – Cache basics – Measuring and improving cache performance - Virtual memory, TLBs - Input/output system, programmed I/O, DMA and interrupts, I/O processors.		
UNIT III	**INTRODUCTION AND APPLICATION LAYER**	**9**
Data Communication - Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Introduction to Sockets - Application Layer protocols: HTTP – FTP – Email protocols (SMTP - POP3 - IMAP - MIME) – DNS – SNMP		
UNIT IV	**NETWORK LAYER**	**9**
Switching : Packet Switching - Internet protocol - IPV4 – IP Addressing – Subnetting - IPV6, ARP, RARP, ICMP, DHCP		
UNIT V	**ROUTING**	**9**
Routing and protocols: Unicast routing - Distance Vector Routing - RIP - Link State Routing – OSPF – Path-vector routing - BGP - Multicast Routing: DVMRP – PIM.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to

CO1: Understand instructions and addressing
CO2: Understand memory and I/O systems
CO3: Explain the basic layers and its functions in computer networks.
CO4: Analyze routing algorithms.
CO5: Describe protocols for various functions in the network.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2									2	2	1
CO2	2	2	2	2									2	1	1
CO3	2	1	1	1									1	1	1
CO4	2	1	2	1									2	1	1
CO5	2	2	1	2									1	2	1

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	David A. Patterson and John L. Hennessey, "Computer Organization And Design", 5th Edition, Morgan Kauffman / Elsevier, 2014.
T2.	V.Carl Hamacher, Zvonko G. Varanesic and Safat G. Zaky, "Computer Organisation", 6th Edition, McGraw-Hill Inc, 2012.

REFERENCE BOOK(S)

R1.	James F. Kurose and Keith W. Ross, "Computer Networking, A Top-Down Approach Featuring the Internet", 8th Edition, Pearson Education, 2021.
R2.	Behrouz A. Forouzan, "Data Communications and Networking with TCP/IP Protocol Suite", 6th Edition TMH, 2022.

Course Code: 24ECP004	Course Title: Introduction to Artificial Intelligence and Machine Learning	
Course Category: PEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To study about uninformed and Heuristic search techniques.
• Learn techniques for reasoning under uncertainty
• Introduce Machine Learning and supervised learning algorithms
• Study about ensembling and unsupervised learning algorithms
• Learn the basics of deep learning using neural networks

UNIT I	PROBLEM SOLVING	9
Introduction to AI - AI Applications - Problem solving agents – search algorithms – uninformed search strategies – Heuristic search strategies – Local search and optimization problems – adversarial search – constraint satisfaction problems (CSP).		
UNIT II	**PROBABILISTIC REASONING**	**9**
Acting under uncertainty – Bayesian inference – naïve bayes models. Probabilistic reasoning – Bayesian networks – exact inference in BN – approximate inference in BN – causal networks.		
UNIT III	**SUPERVISED LEARNING**	**9**
Introduction to machine learning – Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random forests.		
UNIT IV	**ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING**	**9**
Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization.		
UNIT V	**NEURAL NETWORKS**	**9**
Perceptron - Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation, from shallow networks to deep networks –Unit saturation (aka the vanishing gradient problem) – ReLU,		

hyperparameter tuning, batch normalization, regularization, dropout.
Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Use appropriate search algorithms for problem solving.
CO2: Apply reasoning under uncertainty.
CO3: Build supervised learning models.
CO4: Expose ensembling and unsupervised models.
CO5: Practice deep learning neural network models.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2									2	2	
CO2	2	2		2									2	1	
CO3	1	2	1										1	2	1
CO4	1	2	1	2									1	1	1
CO5	2	2	2	1										1	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", 4th Edition, Pearson Education, 2021.
T2.	Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, 4th Edition, 2020.
T3.	Patrick H. Winston, "Artificial Intelligence", 3rd Edition, Pearson Education, 2006.

REFERENCE BOOK(S)

R1.	Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013.
R2.	Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
R3.	Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition,2010.
R4.	Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", MIT Press, 2012.
R5.	Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, 2016.

PROFESSIONAL ELECTIVES IV,V,VI

Course Code: 24ECP005	**Course Title: Medical Imaging Systems**	
Course Category: PEC	**Credits: 3**	
L:T:P (Hours/Week)3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To understand the generation of X-ray and its uses in Medical imaging.
• To describe the principle of Computed Tomography.
• To know the techniques used for visualizing various sections of the body.
• To learn the principles of different radio diagnostic equipment in Imaging.
• To discuss the radiation therapy techniques and radiation safety.

UNIT I	**X RAYS**	**9**
Nature of X-rays- X-Ray absorption – Tissue contrast. X- Ray Equipment (Block Diagram) – X-Ray Tube, the collimator, Bucky Grid, power supply, Digital Radiography - discrete digital detectors, storage phosphor and film scanning, X-ray Image Intensifier tubes – Fluoroscopy – Digital Fluoroscopy. Angiography, cine Angiography. Digital subtraction Angiography. Mammography.		
UNIT II	**COMPUTED TOMOGRAPHY**	**9**
Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors – Viewing systems – spiral CT scanning – Ultra fast CT scanners. Image reconstruction techniques – back projection and iterative method.		
UNIT III	**MAGNETIC RESONANCE IMAGING**	**9**
Fundamentals of magnetic resonance- properties of electromagnetic waves : speed , amplitude, phase, orientation and waves in matter - Interaction of Nuclei with static magnetic field and Radio frequency wave- rotation and precession – Induction of magnetic resonance signals – bulk magnetization – Relaxation processes T1 and T2. Block Diagram approach of MRI system – system magnet (Permanent, Electromagnet and Superconductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving) and shim coils, Electronic components, FMRI.		
UNIT IV	**NUCLEAR IMAGING**	**9**
Radioisotopes- alpha, beta, and gamma radiations. Radio Pharmaceuticals. Radiation detectors –gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors, Gamma camera – Principle of operation, collimator and photomultiplier tube, X-Y		

positioning circuit, pulse height analyzer. Principles of SPECT and PET		
UNIT V	**RADIATION THERAPY AND RADIATION SAFETY**	**9**
Radiation therapy – linear accelerator, Telegamma Machine. SRS – SRT – Recent Techniques in radiation therapy – 3D CRT – IMRT – IGRT and Cyber knife – radiation measuring instruments Dosimeter, film badges, Thermo Luminescent dosimeters – electronic dosimeter – Radiation protection in medicine – radiation protection principles		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Describe the working principle of the X-ray machine and its application.
CO2: Illustrate the principle computed tomography
CO3: Interpret the technique used for visualizing various sections of the body using Magnetic Resonance Imaging.
CO4: Demonstrate the applications of radionuclide imaging.
CO5: Analyze different imaging techniques and choose appropriate imaging equipment for better diagnosis and outline the methods of radiation safety.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	2										1	
CO2	1	1	1	2									1	1	1
CO3	1	1	1	2									1	1	
CO4	2	1	1	2											1
CO5	1	2	2	3									1		

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Isaac Bankman and I. N. Bankman , "Handbook of Medical Imaging: Processing and Analysis(Biomedical Engineering)", Academic Press, 2000.
T2.	Jacob Beutel and M. Sonka, "Medical Image Processing and Analysis", SPIE Press, 2000.
T3.	Khin Wee Lai, Dyah Ekashanti and Octorina Dewi, "Medical Imaging Technology", Springer Singapore, 2015.

REFERENCE BOOK(S)	
R1.	Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw – Hill, New Delhi, 2003.
R2.	Dougherty, Geoff (Ed.), "Medical Image Processing - Techniques and Applications', Springer, New York, 2011

Course Code: 24ECP106	Course Title: Bio Medical Instrumentation	
Course Category: PEC	Credits: 3	
L:T:P (Hours/Week)3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To understand the origin of various biological signals and electrode configurations specific to bio-potential measurements.
• To understand the characteristics of Bio signals.
• To understand the design of bio amplifiers.
• To explain the different techniques used for measurement of non-electrical bio parameters.
• To explain the biochemical measurement techniques as applicable for diagnosis and treatment.

UNIT I	ELECTRODE CONFIGURATIONS	9
Bio signals characteristics – Origin of bio potential and its propagation. Frequency and amplitude ranges. Electrode configurations: Electrode-electrolyte interface, electrode–skin interface impedance, polarization effects of electrode – non-polarizable electrodes. Unipolar and bipolar configuration, classification of electrodes.		
UNIT II	**BIOSIGNAL CHARACTERISTICS**	**9**
Bio signals characteristics – ECG-frequency and amplitude ranges – Einthoven's triangle, standard 12 lead system. EEG - EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. EMG - Electrode configuration -unipolar and bipolar mode.		
UNIT III	**BIOAMPLIFIERS**	**9**
Need for bio-amplifier - Differential bio-amplifier – Single ended amplifier - Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier, Chopper amplifier, Power line interference		
UNIT IV	**MEASUREMENT OF BIO SIGNALS**	**9**
Temperature, respiration rate and pulse rate measurements. Blood Pressure - indirect methods: auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers - systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurements		

UNIT V	BIOCHEMICAL MEASUREMENTS	9
Biochemical sensors - pH, pO2 and pCO2, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors. Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer.		
Total: 45 Hours		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Illustrate the origin of various biological signals and their characteristics.
CO2: Gain knowledge on characteristics of bio signals
CO3: Gain knowledge on various amplifiers involved in monitoring and transmission of bio signals.
CO4: Explain the different measurement techniques for non-electrical bio-parameters
CO5: Explain the biochemical measurement techniques as applicable for diagnosis and further treatment.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	2									1	2	
CO2	1	1	2	2									1	1	1
CO3	1	1	2	2									1	1	1
CO4	2	1	2	2									2	1	1
CO5	1	2	2	2									1	2	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Leslie Cromwell, "Biomedical Instrumentation and Measurement", 2nd Edition, Prentice hall of India, New Delhi, 2015.
T2.	John G. Webster, "Medical Instrumentation Application and Design", 4th Edition, Wiley India Pvt. Ltd, New Delhi, 2015.
T3.	Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2003.

REFERENCE BOOK(S)

R1.	John Enderle, Susan Blanchard and Joseph Bronzino, "Introduction to Biomedical Engineering", 2nd Edition, Academic Press, 2005.
R2.	Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.

Course Code: 24ECP109	Course Title: IoT Based Systems Design	
Course Category: PEC	Credits: 4	
L:T:P (Hours/Week)2:0:2	Total Contact Hours: 60	Max Marks : 100

COURSE OBJECTIVES
• To understand the basics of IoT.
• To get knowledge about the various services provided by IoT.
• To familiarize themselves with various communication techniques and networking
• To know the implementation of IoT with different tools.
• To understand the various applications in IoT.

UNIT I	INTRODUCTION TO INTERNET OF THINGS	6
Rise of the machines – Evolution of IoT – Web 3.0 view of IoT – Definition and characteristics of IoT – IoT Enabling Technologies – IoT Architecture -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects - IoT levels and deployment templates – A panaromic view of IoT applications.		
UNIT II	**MIDDLEWARE AND PROTOCOLS OF IoT**	**6**
Middleware technologies for IoT system (IoT Ecosystem Overview – Horizontal Architecture Approach for IoT Systems – SOA based IoT Middleware) Middleware architecture of RFID,WSN,SCADA,M2M –Interoperability challenges of IoT-Protocols for RFID,WSN,SCADA,M2M- Zigbee, KNX,BACNet,MODBUS - Challenges Introduced by 5G in IoT Middleware(Technological Requirements of 5G Systems - Perspectives and a Middleware Approach Toward 5G (COMPaaS Middleware) – Resource management in IoT.		
UNIT III	**COMMUNICATION AND NETWORKING**	**6**
IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition –Application Layer Protocols: CoAP and MQTT- Data aggregation & dissemination.		
UNIT IV	**IOT IMPLEMENTATION TOOLS**	**6**

Introduction to Python, Introduction to different IoT tools, developing applications through IoT tools, developing sensor-based application through embedded system platform, Implementing IoT concepts with python, Implementation of IoT with Raspberry Pi.		
UNIT V	**APPLICATIONS AND CASE STUDIES**	**6**
Home automations - Smart cities – Environment – Energy – Retail – Logistics – Agriculture – Industry - Health and life style – Case study.		

PRACTICALS	
1.	Connection of an Arduino board with ESP8266 wifi module.
2.	IoT based control of an LED using Arduino.
3.	IoT and cloud based data logger using LM35 and Arduino.
4.	IoT based home automation using Arduino.
5.	IoT based street light control using Arduino.
6.	IoT based DC motor speed control using Arduino.
7.	Temperature and Humidity monitoring using Node-Red and Raspberry Pi.
8.	Motion based intrusion detection system using node MCU/ Raspberry Pi.
	Total: 60 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Articulate the main concepts, key technologies, strength and limitations of IoT.
CO2: Identify the architecture, infrastructure models of IoT.
CO3: Analyze the networking and how the sensors are communicated in IoT.
CO4: Analyze and design different models for IoT implementation.
CO5: Identify and design the new models for market strategic interaction.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	2									1	2	
CO2	1	1	2	2									1	1	1
CO3	1	1	1	2									2	1	1
CO4	2	1	2	1									1	2	
CO5	1	1	2	2									1	2	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Honbo Zhou, “Internet of Things in the cloud:A middleware perspective”, CRC press,

	2012.
T2.	Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on Approach)”, 1st Edition, VPT, 2014.

REFERENCE BOOK(S)	
R1.	Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017.
R2.	Constandinos X. Mavromoustakis, George Mastorakis and Jordi Mongay Batalla, “Internet of Things (IoT) in 5G Mobile Technologies” Springer International Publishing Switzerland, 2016.
R3.	Dieter Uckelmann, Mark Harrison and Florian Michahelles, “Architecting the Internet of Things” Springer-Verilag Berlin Heidelberg, 2011.

Course Code: 24ECP110	Course Title: Fundamentals of Nanoelectronics	
Course Category: PEC	Credits: 3	
L:T:P (Hours/Week)3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To understand the concepts of nanoelectronics.
• To explain the concepts of quantum electronics devices.
• To explore the basics of nano transistors.
• To understand the various super conducting nano devices.
• To know the nano tubes and nano structures device.

UNIT I	INTRODUCTION TO NANO ELECTRONICS	9
Scaling to nano - Light as a wave and particle- Electrons as waves and particles- origin of quantum mechanics - General postulates of quantum mechanics - Time independent Schrodinger wave equation- Electron confinement - Quantum dots, wires and well-Spin and angular momentum.		
UNIT II	**QUANTUM ELECTRONICS**	**9**
Quantum electronic devices - Short channel MOS transistor - Split gate transistor - Electron wave transistor - Electron wave transistor - Electron spin transistor - Quantum cellular automata -Quantum dot array, Quantum memory.		
UNIT III	**NANO ELECTRONIC TRANSISTORS**	**9**
Coulomb blockade - Coulomb blockade in Nano capacitors - Coulomb blockade in tunnel junctions - Single electron transistors, Semiconductor nanowire FETs and SETs, Molecular SETs and molecular electronics - Memory cell.		
UNIT IV	**NANO ELECTRONIC TUNNELING AND SUPER CONDUCTING DEVICES**	**9**
Tunnel effect -Tunneling element -Tunneling diode - Resonant tunneling diode - Three terminal resonant tunneling devices- Superconducting switching devices- Cryotron-Josephson tunneling device.		
UNIT V	**NANOTUBES AND NANOSTRUCTURE DEVICES**	**9**
Carbon Nanotube - Fullerenes - Types of nanotubes – Formation of nanotubes –Assemblies – Purification of carbon nanotubes – Electronic properties – Synthesis of carbon nanotubes – Carbon nanotube interconnects – Carbon nanotube FETs and SETs –Nanotube for memory applications- Nano structures and nano structured devices.		

	Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the basics of nano electronics
CO2: Use the mechanism behind quantum electronic devices
CO3: Understand the basics of nano transistor.
CO4: Analyze the key performance aspects of tunneling and superconducting nano electronic devices
CO5: Apply the knowledge in the development of nanotubes and nanostructure devices

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1									1	1	
CO2	1	1	1	2									1	1	1
CO3	1	1	1	2									1	1	1
CO4	1	2	1	1									2	2	
CO5	1	2	1	2									1	2	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Hanson, “Fundamentals of Nano Electronics”, Pearson education, 2009.
T2.	Robert Puers, Livio Baldi, Marcel Van de Voorde and Sebastiaan E. Van Nooten, “Nanoelectronics: Materials, Devices and Applications”, Wiley, 2017.

REFERENCE BOOK(S)	
R1.	Jan Dienstuhl, Karl Goser, and Peter Glösekötter, “Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum Devices”, Springer-Verlag, 2004.
R2.	Mircea Dragoman and Daniela Dragoman, “Nanoelectronics: Principles and Devices”, Artech House, 2009.
R3	B.Rajesh Kumar Kaushik, “Nanoelectronics: Devices, Circuits and Systems”, Elsevier Science, 2018.

Course Code: 24ECP007	Course Title: Wireless Sensor Network Design	
Course Category: PEC	Credits: 3	
L:T:P (Hours/Week)3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To understand the fundamentals of wireless sensor network.
• To gain knowledge on the MAC and Routing Protocols of WSN.
• To get exposed to 6LOWPAN technology.
• To acquire knowledge on the protocols required for developing real time applications using WSN and 6LOWPAN.
• To gain knowledge about operating system related to WSN and 6LOWPAN.

UNIT I	INTRODUCTION	9
Principle of Wireless Sensor Network -Introduction to wireless sensor networks- Challenges, Comparison with ad hoc network, Node architecture and Network architecture, design principles, Service interfaces, Gateway, Short range radio communication standards-IEEE 802.15.4, Zigbee and Bluetooth. Physical layer and transceiver design considerations.		
UNIT II	**MAC AND ROUTING PROTOCOLS**	**9**
MAC protocols – fundamentals, low duty cycle protocols and wakeup concepts, contention and Schedule-based protocols - SMAC, BMAC,TRAMA, Routing protocols – Requirements, Classification -SPIN, Directed Diffusion, COUGAR, ACQUIRE, LEACH, PEGASIS.		
UNIT III	**6LoWPAN**	**9**
6LoWPAN Architecture - protocol stack, Adaptation Layer, Link layers – Addressing, Routing - Mesh-Under - Route-Over, Header Compression - Stateless header compression - Context- based header compression, Fragmentation and Reassembly , Mobility – types, Mobile IPv6, Proxy Home Agent, Proxy MIPv6, NEMO –Routing – MANET, ROLL, Border routing.		
UNIT IV	**APPLICATION**	**9**
Design Issues, Protocol Paradigms -End-to-end, Real-time streaming and sessions, Publish/subscribe, Web service paradigms, Common Protocols -Web service protocols, MQ telemetry transport for sensor networks (MQTT-S), ZigBee compact application protocol (CAP),Service discovery, Simple network management protocol (SNMP), Real-time transport and sessions, Industry- Specific protocols.		
UNIT V	**TOOLS**	**9**

TinyOS – Introduction, NesC, Interfaces, modules, configuration, Programming in TinyOS using NesC, TOSSIM, Contiki – Structure, Communication Stack, Simulation environment – Cooja simulator, Programming
Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: To be able to design solutions for WSNs applications.
CO2: To be able to develop efficient MAC and Routing Protocols.
CO3: To be able to design solutions for 6LoWPAN applications.
CO4: To be able to develop efficient layered protocols in 6LoWPAN.
CO5: To be able to use Tiny OS and Contiki OS in WSNs and 6LoWPAN applications.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	2									2	2	1
CO2	1	1	2	1								1	1	1	1
CO3	2	1	3	2								1	2	1	2
CO4	1	2	3	3									1	2	
CO5	1	2	1	1									1	2	1

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Holger Karl and Andreas willig, "Protocol and Architecture for Wireless Sensor Networks", John Wiley Publication, 2006.
T2.	Anna Forster, "Introduction to Wireless Sensor Networks", Wiley, 2017.
T3.	Zach Shelby Sensinode and Carsten Bormann, "6LoWPAN: The Wireless Embedded Internet" John Wiley and Sons, Ltd, Publication, 2009.

REFERENCE BOOK(S)

R1.	Philip Levis, "TinyOS Programming", 2006.
R2.	The Contiki Operating System.http://www.sics.se/contiki.

Course Code: 24ECP111	Course Title: Industrial IoT and Industry 4.0	
Course Category: PEC	Credits: 4	
L:T:P (Hours/Week)2:0:2	Total Contact Hours: 60	Max Marks : 100

COURSE OBJECTIVES
• To understand the concepts of IoT Nodes & Sensors.
• Analyze the communication protocols and IoT Gateways.
• To know the various controlling hardware and sensors.
• To understand the IoT Cloud Dashboards.
• Apply Challenges in IoT system Design – Hardware & Software.

UNIT I	IoT CONCEPT AND DEVELOPMENT PLATFORM	6
IoT Definition, Importance of IoT, Applications of IoT, IoT architecture, Understanding working of Sensors, Actuators, Sensor calibration, Study of Different sensors and their characteristics.		
UNIT II	**ANALYZING & DECODING OF COMMUNICATION PROTOCOL USED IN IOT DEVELOPMENT PLATFORM**	**6**
UART Communication Protocol, I2C Protocol device interfacing and decoding of signal, SPI Protocol device interfacing and decoding of signal, WIFI and Router interfacing, Ethernet Configuration, Bluetooth study and analysis of data flow, Zigbee Interfacing and study of signal flow.		
UNIT III	**IoT PHYSICAL DEVICES AND ENDPOINTS AND CONTROLLING HARDWARE AND SENSORS**	**6**
IoT Physical Devices and Endpoints- Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C), Controlling Hardware- Connecting LED, Buzzer, Switching High Power devices with transistors, Controlling AC Power devices with Relays, Sensors- Light sensor, temperature sensor with thermistor, voltage sensor, ADC and DAC, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, Wireless Bluetooth Sensors, Level Sensors, USB Sensors, Embedded Sensors, Distance Measurement with ultrasound sensor.		
UNIT IV	**CLOUD SERVICES USED IN IOT DEVELOPMENT PLATFORM**	**6**
Configuration of the cloud platform, Sending data from the IOT nodes to the gateways using different communication options, Transferring data from gateway to the cloud, Exploring the		

web services like mail, Messaging (SMS) and Twitter, Tracking of cloud data as per the requirement, Google Cloud service architect, AWS clod Services architect, Microsoft Azure cloud services Architect, OEN source Cloud Services, Initial State IoT Dashboard & Cloud Services.		
UNIT V	**CHALLENGES IN IoT SYSTEM DESIGN – HARDWARE & SOFTWARE**	**6**
Antenna design and placement, Chip-package system development, Power electronics, electromagnetic interference/compatibility (EMI/EMC), Electronics reliability, Battery simulation.		

PRACTICALS	
1.	Write a program for different sensors LDR sensor, IR sensor, Temperature Sensor, Ultrasound Sensor, Gas sensor.
2.	Write a program using IR sensor for working morning alarm and night lamp.
3.	Write a program using Temperature sensor for detecting heat / fire.
4.	Write a program to control Buzzer using Alexa Echo Dot.
5.	Capturing the live ASK Signal and decoding it.
6.	Understanding the APSK & APCO modulation & analysis
7.	Write a program to control DC motor using Google Assistance.
8.	Write a program to control Stepper motor using Google Assistance
	Total: 60 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the building blocks of IoT technology and explore the vast spectrum of IoT Applications.
CO2: Use processors & peripherals to design & build IoT hardware.
CO3: Assess, select and customize technologies for IoT applications.
CO4: Connect numerous IOT applications with the physical world of humans and real life Problem solving.
CO5: Design and implement IOT applications that manage big data.

COURSE ARTICULATION MATRIX															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	2	2	2	1								1	2	2
CO2	1	2	2	1	1								1	2	
CO3	2	2	2	2	2								2	1	
CO4	1	2	1	2	2								1	2	1
CO5	2	1	1	1									2	1	1

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Arshdeep Bahga and Vijay Madisetti, "Internet of Things - A Hands-on Approach", Universities Press, 2015.
T2.	Matt Richardson and Shawn Wallace, "Getting Started with Raspberry Pi", O'Reilly (SPD), 2014.

REFERENCE BOOK(S)	
R1.	Simon Monk, "Raspberry Pi Cookbook, Software and Hardware Problems and Solutions", O'Reilly (SPD), 2016.
R2.	N. Ida, "Sensors, Actuators and Their Interfaces", SciTech Publishers, 2014.
R3.	Peter Waher, "Learning Internet of Things", Packet Publishing, 2015.

Course Code: 24ECP112	Course Title: IoT Processors	
Course Category: PEC	Credits: 4	
L:T:P (Hours/Week) 2:0:2	Total Contact Hours: 60	Max Marks: 100

COURSE OBJECTIVES
• To acquire the concept and features of ARM.
• To study the exception handling and interrupts in CORTEX M3.
• To train to write a program in CORTEX M3.
• To expose the architecture of STM 32L15XXX ARM CORTEX M3/M4 microcontroller.
• To understand the concepts of System – On – Chip (SoC).

UNIT I	OVERVIEW OF ARM AND CORTEX-M3	6
ARM Architecture – Versions, Instruction Set Development, Thumb 2 and Instruction Set Architecture, Cortex M3 Basics: Registers, Stack Pointer, Link Register, Program Counter, Special Registers, Operation Mode, Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Reset Sequence , CORTEX M3 Instruction Sets: Assembly Basics, Instruction List, Instruction Descriptions, CORTEX M3 – Implementation Overview: Pipeline, Block Diagram. Bus Interfaces, I – Code Bus, D – Code Bus, System Bus- External PPB and DAP Bus.		
UNIT II	**CORTEX EXCEPTION HANDLING AND INTERRUPTS**	**6**
Exception Types, Priority, Vector Tables, Interrupt Inputs and Pending behaviour, Fault Exceptions, Supervisor Call and Pendable Service Call, NVIC: Nested Vector Interrupt Controller, Overview, Basic Interrupts, SYSTICK Time, Interrupt Behaviourm Interrupt/Exception Sequences, Exception Exits, Nested Interrupts, Tail – Chaining Interrupts, Late Arrivals and Interrupt Latency.		
UNIT III	**CORTEX M3/M4 PROGRAMMING**	**6**
Cortex M3/M4 Programming: Overview, Typical Development Flow, Using C, CMSIS Using Assembly, Excepiton Programming Using Interrupts, Exception/Interrupt Handlers, Software Interrupts, Vector Table Relocation, Memory Protection Unit and other CORTEX M3 Features, MPU Registers, Setting up the MPU, Power Management, Multiprocessor Configuration.		
UNIT IV	**STM32L15XXX ARMCORTEX M3/M4 MICROCONTROLLER AND DEBUGGING TOOLS**	**6**
STM32L15XXX ARM CORTEX M3/M4 Microcontroller: Memory and Bus Architecture,		

Power Control, Reset and Clock Control, STM32L15XXX Peripherals: GPIOs, System Configuration Controller, NVIC, ADC, Comparators, GP Timers, USART Development and Debugging Tools: Software and Hardware tools like Cross Assemblerm Compiler, Debugger, Simulator, In – Circuit Emulator (ICE), Logic Analyzer.		
UNIT V	**INTRODUCTION TO SYSTEM – ON – CHIP**	**6**
System Architecture: An Overview, Components of the System Processors, Memories and Interconnects, Processor Architectures, Memory and Addressing, System Level Interconnection – An Approach for SOC Design – Chip basics – Cycle Time – Die Area – Power and Cost – Area, Power and Time Trade – Offs in Processor Design – Reliability and Configurability – SOC Design Approach – Application Studies – AES, 3D Graphics Processor. Image Compression and Video Compression.		

PRACTICALS	
1.	Write a program to add two 32-bit numbers stored in r0 and r1 registers and write the result to r2. The result is stored to a memory location. a) Run the program with breakpoint and verify the result b) Run the program with stepping and verify the content of registers at each stage.
2.	Write ARM assembly to perform the function of division. Registers r1 and r2 contain the dividend and divisor, r3 contains the quotient, and r5 contains the remainder.
3.	Write a program to turn on green LED (Port B.6) and Blue LED (Port B.7) on STM32L-Discovery by configuring GPIO.
4.	Transmit a string “Programming with ARM Cortex” to PC by configuring the registers of USART2 by using polling method.
5.	Write a program to toggle the LEDs at the rate of 1 sec using standard peripheral library. Use Timer for Delay.
6.	Transmit a string “Programming with ARM Cortex” to PC by using standard peripheral library with the help of USART3 by using polling method.
7.	Write a program to interface 3D Graphics Processor.
8.	Write a program to compress an image and video.
	Total: 60 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Explain the architecture and features of ARM.

CO2: List the concepts of exception handling.
CO3: Write a program using ARM CORTEX M3/M4.
CO4: Learn the architecture of STM32L15XXX ARM CORTEX M3/M4.
CO5: Design an SoC for any application.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	2	2								2	1	1
CO2	2	1	1	1	2								1	2	
CO3	1	2	2	1	2								1	1	2
CO4	1	1	1	2	2								1	1	1
CO5	2	1	1	2	2								2	1	1

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Joseph Yiu, "The Definitive Guide to the ARM CORTEX M3/M4", 2nd Edition, Elsevier, 2010.
T2.	Andrew N Sloss, Dominic Symes and Chris Wright, "ARM System Developers Guide Designing and Optimising System Software", Elsevier, 2006.
T3.	Michael J Flynn and Wayne Luk, "Computer System Design, System On Chip", Wiley India, 2011.

REFERENCE BOOK(S)

R1.	Steve Furber, "ARM System – on – Chip Architecture", 2nd Edition, Pearson, 2015.
R2.	CORTEX M Series ARM Reference Manual.
R3.	CORTEX M3 Technical Reference Manual.
R4.	STM32L152XX ARM CORTEX M3 Microcontroller Reference Manual 5/97.

Course Code: 24ECP008	Course Title: Remote Sensing	
Course Category: PEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To understand the fundamentals of remote sensing.
• To analyze the interaction of electromagnetic radiation with atmosphere and earth materials.
• To understand planetary, satellite motion and remote sensing platforms.
• To explore remote sensing techniques and sensor technologies
• To interpret remote sensing data and image processing techniques

UNIT I	REMOTE SENSING AND ELECTROMAGNETIC RADIATION	9
Definition – components of RS – History of Remote Sensing – Merits and demerits of Data Collation between conventional and remote sensing methods - Electromagnetic Spectrum – Radiation principles - Wave theory, Planck‘s law, Wien’s Displacement Law, Stefan’s Boltzmann law, Kirchoff‘s law – Radiation sources: active & passive – Radiation Quantities.		
UNIT II	**EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL**	**9**
Standard atmospheric profile – main atmospheric regions and its characteristics – interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows – Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance– Spectroradiometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water – solid surface scattering in microwave region.		
UNIT III	**ORBITS AND PLATFORMS**	**9**
Motions of planets and satellites – Newton ‘s law of gravitation – Gravitational field and potential - Escape velocity - Kepler ‘s law of planetary motion - Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms - Ground based, Air borne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Legrange Orbit.		
UNIT IV	**SENSING TECHNIQUES**	**9**
Classification of remote sensors – Resolution concept: spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal sensors – microwave sensors – Calibration of sensors – High Resolution Sensors - LIDAR, UAV – Orbital and sensor characteristics of live Indian earth observation satellites.		

UNIT V	DATA PRODUCTS AND INTERPRETATION	9
Photographic and digital products – Types, levels and open-source satellite data products – selection and procurement of data – Visual interpretation: basic elements and interpretation keys - Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: To understand the principles of electromagnetic radiation.
CO2: To learn the atmospheric radiation interactions.
CO3: To study the laws of planetary motion.
CO4: To classify the different types of resolution.
CO5: To know the concepts of digital interpretation.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	1									1	1	2
CO2	2	2	1	1									2	2	1
CO3	1	1	1	1									1	1	1
CO4	2	2	1	1									2	2	1
CO5	2	2	2	1									2	2	2

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Thomas M. Lillesand, Ralph W. Kieferand and Jonathan W. Chipman, "Remote Sensing and Image interpretation", John Wiley and Sons, New York, 2015.
T2.	George Joseph and C Jeganathan, "Fundamentals of Remote Sensing", 3rd Edition, Universities Press (India) Private Limited, Hyderabad, 2018.
T3.	Basudeb Bhatta, "Remote Sensing and GIS", 3rd Edition, Oxford University Press, 2020.

REFERENCE BOOK(S)

R1.	Stanley A Morain, Amelia M Budge and Michael S Renslow. "Manual of Remote Sensing", 4th Edition, American Society for Photogrammetry and Remote Sensing, Virginia, USA,2019.
R2.	Charles Elachi and Jacob Van Zyl, "Introduction to Physics and Techniques of Remote Sensing", 3rd Edition, Wiley Publication, 2021.
R3.	Verbyla, David, "Satellite Remote Sensing of Natural Resources", 1st Edition, CRC Press,2022.

Course Code: 24ECP009	Course Title: Satellite Communication	
Course Category: PEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To understand the basics of satellite orbits.
• To study the satellite segment and earth segment.
• To acquire knowledge on Link Power budget calculation.
• To study the various satellite access and coding technology.
• To expose the applications of satellite.

UNIT I	SATELLITE ORBITS	9
Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, geo stationary and non-Geo-stationary orbits – Look Angle Determination- Limits of visibility – eclipse-Sub satellite point –Sun transit outage-Launching Procedures - launch vehicles and propulsion.		
UNIT II	**SATELLITE LINK DESIGN**	**9**
Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command-Transponders Antenna Subsystem.		
UNIT III	**SATELLITE LINK DESIGN**	**9**
Basic link analysis, Uplink and Downlink Design equation, Free space loss-Atmospheric effects, Ionospheric scintillation, Rain induced attenuation and interference, system noise temperature, Link Design with and without frequency reuse.		
UNIT IV	**SATELLITE ACCESS AND CODING TECHNIQUES**	**9**
Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, PAMA and DAMA Assignment Methods, compression – encryption, Coding Schemes.		
UNIT V	**SATELLITE APPLICATIONS**	**9**
INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, LEO, MEO, Satellite Navigational System. GPS-Position Location Principles, Differential GPS, Direct Broadcast satellites (DBS/DTH).		
Total: 45 Hours		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Identify the satellite orbits.
CO2: Analyze the satellite subsystems.
CO3: Evaluate the satellite link power budget.
CO4: Access the coding technology for satellite.
CO5: Design various satellite types and applications.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1									1	1	1
CO2	2	1	2	1									2	1	2
CO3	1	1	1	1									1	1	1
CO4	1	1	2	2									1	2	2
CO5	1	1	1	1									1	1	2

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Dennis Roddy, "Satellite Communication", 4th Edition, McGraw Hill International, 2017.
T2.	Timothy Pratt, Charles, W.Bostain and Jeremy E.Allnutt, "Satellite Communication", 3rd Edition, Wiley Publications,2021.
T3.	Tri T. Ha, "Digital Satellite Communications", 2nd Edition, McGraw Hill Education, 2017.

REFERENCE BOOK(S)	
R1.	Wilbur L.Pritchard, Hendri G. Suyderhoud and Robert A. Nelson, "Satellite Communications Systems Engineering", 2nd Edition , Prentice Hall, 2013.
R2.	M.Richharia, "Satellite Communication Systems-Design Principles", Macmillan, 2010.
R3.	Bruce R. Elbert, "The Satellite Communication Applications", Artech House, Bostan, London, 2003.

Course Code: 24ECP010	Course Title: Wireless Broad Band Networks	
Course Category: PEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To study the various network layer and transport layer protocols for wireless networks.
• To understand the architecture and interference mitigation techniques in 3G standards.
• To comprehend on 4G technologies and LTE-A in mobile cellular network.
• To know about the layer level functionalities in interconnecting networks.
• To study the emerging techniques in 5G network.

UNIT I	WIRELESS PROTOCOLS	9
Mobile network layer- Fundamentals of Mobile IP, data forwarding procedures in mobile IP, IPv4, IPv6, IP mobility management, IP addressing - DHCP, Mobile transport layer- Traditional TCP, congestion control, slow start, fast recovery/fast retransmission, classical TCP improvements- Indirect TCP, snooping TCP, Mobile TCP.		
UNIT II	**3G EVOLUTION**	**9**
IMT-2000 - W-CDMA, CDMA 2000 - radio & network components, network structure, packet-data transport process flow, Channel Allocation, core network, interference-mitigation techniques, UMTS-services, air interface, network architecture of 3GPP, UTRAN – architecture, High Speed Packet Data-HSDPA, HSUPA.		
UNIT III	**4G EVOLUTION**	**9**
Introduction to LTE-A – Requirements and Challenges, network architectures – EPC, E-UTRAN architecture - mobility management, resource management, services, channel - logical and transport channel mapping, downlink/uplink data transfer, MAC control element, PDU packet formats, scheduling services, random access procedure.		
UNIT IV	**LAYER-LEVEL FUNCTIONS**	**9**
Characteristics of wireless channels - downlink physical layer, uplink physical layer, MAC scheme -frame structure, resource structure, mapping, synchronization, reference signals and channel estimation, SC-FDMA, interference cancellation – CoMP, Carrier aggregation, Services - multimedia broadcast/multicast, location-based services.		
UNIT V	**5G EVOLUTION**	**9**
5G Roadmap - Pillars of 5G - 5G Architecture, The 5G internet - IoT and context awareness -		

Networking reconfiguration and virtualization support - Mobility QoS control - emerging approach for resource over provisioning, Small cells for 5G mobile networks- capacity limits and achievable gains with densification - Mobile data demand, Demand Vs Capacity, Small cell challenges, conclusion and future directions.
Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Design and implement the various protocols in wireless networks.
CO2: Analyze the architecture of 3G network standards.
CO3: Analyze the difference of LTE-A network design from 4G standard.
CO4: Design the interconnecting network functionalities by layer level functions.
CO5: Explore the current generation (5G) network architecture.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	1									1	2	1
CO2	2	1	2	1									2	1	2
CO3	1	2	1	1									1	2	1
CO4	2	1	2	2									2	1	2
CO5	1	2	1	2									1	2	1

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Kaveh Pahlavan, "Principles of Wireless Networks", Prentice-Hall of India, 2008
T2.	Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", John Wiley, 2015.
T3.	Sassan Ahmadi, "LTE-Advanced – A practical systems approach to understanding the 3GPP LTE Releases 10 and 11 radio access technologies", Elsevier, 2014.

REFERENCE BOOK(S)

R1.	Vijay K.Garg, "Wireless Network Evolution - 2G & 3G", Prentice Hall, 2008.
R2.	Clint Smith,P.E and Dannel Collins, "3G Wireless Networks", 2nd Edition, Tata McGraw- Hill, 2011.
R3.	Erik Dahlman, Stefan Parkvall and Johan Skold, "5G NR: The Next Generation Wireless Access Technology", Academic Press, 2018.

Course Code: 24ECP113	Course Title: 4G / 5G Communication Networks	
Course Category: PEC	Credits: 4	
L:T:P (Hours/Week) 2:0:2	Total Contact Hours: 30	Max Marks : 100

COURSE OBJECTIVES
• To study the evolution of wireless networks.
• To get acquainted with the fundamentals of 5G networks.
• To understand the processes associated with 5G architecture.
• To study spectrum sharing and spectrum trading.
• To know the security features in 5G networks.

UNIT I	EVOLUTION OF WIRELESS NETWORKS	6
Networks evolution: 2G,3G,4G, evolution of radio access networks, need for 5G. 4G versus 5G, Next Generation core(NG-core), visualized Evolved Packet core(vEPC).		
UNIT II	**5G CONCEPTS AND CHALLENGES**	**6**
Fundamentals of 5G technologies, overview of 5G core network architecture,5G new radio and cloud technologies, Radio Access Technologies (RATs), EPC for 5G.		
UNIT III	**NETWORK ARCHITECTURE AND THE PROCESSES**	**6**
5G architecture and core, network slicing, multi access edge computing(MEC)visualization of 5G components, end-to-end system architecture, service continuity, relation to EPC, and edge computing. 5G protocols: 5G NAS-NGAP, GTP-U, IPSec and GRE.		
UNIT IV	**DYNAMIC SPECTRUM MANAGEMENT AND MM-WAVES**	**6**
Mobility management, Command and control, spectrum sharing and spectrum trading, cognitive radio based on 5G, millimeter waves.		
UNIT V	**SECURITY IN 5G NETWORKS**	**6**
Security features in 5G networks, network domain security, user domain security, flow based QoS framework, mitigating the threats in 5G.		

PRACTICALS	
SIMULATION USING MATLAB	
1.	5G-Compliant waveform generation and testing.
2.	Modeling of 5G Synchronization signal blocks and bursts.
3.	Channel modeling in 5G networks.
4.	Multiband OFDM demodulation.

5.	Perfect Channel estimation.
6.	Design spectrum sharing and spectrum coding in 5G.
7.	Development of 5G New Radio Polar Coding.
8.	Design the security features in 5G Network.
	Total: 60 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: To understand the evolution of wireless networks.
CO2: To learn the concepts of 5G networks.
CO3: To comprehend the 5G architecture and protocols.
CO4: To understand the dynamic spectrum management.
CO5: To learn the security aspects in 5G networks.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	1	2								2	1	2
CO2	1	2	2	1	2							1	1	2	2
CO3	1	1	1	1	2							1	1	1	1
CO4	2	2	1	2	2							1	2	2	2
CO5	1	2	1	2	2								2	1	1

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Stephen Rommer, "5G Core networks: Powering Digitalization", Academic Press, 2019
T2.	Saro Velrajan, "An Introduction to 5G Wireless Networks: Technology, Concepts and Use cases", 1st Edition, Springer Publications, 2020.
T3.	Jyrki. T.J.Penttinen, "5G Simplified: ABCs of Advanced Mobile Communications", Academic Press, 2015 .

REFERENCE BOOK(S)	
R1.	Wan Lee Anthony, "5G system Design: An end to end Perspective", Springer Publications, 2019.
R2.	Erik Dahlma, Stefan Parkvall and Johan Skold "5G NR: The Next Generation Wireless Access Technology", Academic Press, 2018.
R3.	Afif Osseiran, José F. Monserrat and Patrick Marsch "5G Mobile and Wireless Communications Technology", Cambridge University Press, 2016.

Course Code: 24ECP114	Course Title: Network and Security	
Course Category: PEC	Credits: 4	
L:T:P (Hours/Week) 2:0:2	Total Contact Hours: 30	Max Marks : 100

COURSE OBJECTIVES
• To learn the Network Models and datalink layer functions.
• To understand routing in the Network Layer.
• To explore methods of communication and congestion control by the Transport Layer.
• To study the Network Security Mechanisms.
• To learn various hardware security attacks and their countermeasures**.**

UNIT I	NETWORK MODELS AND DATA LINK LAYER	6
Overview of Networks and its Attributes – Network Models – OSI, TCP/IP, Addressing – Introduction to Datalink Layer – Error Detection and Correction – Ethernet (802.3)- Wireless LAN – IEEE 802.11, Bluetooth – Flow and Error Control Protocols – HDLC – PPP.		
UNIT II	**NETWORK LAYER PROTOCOLS**	**6**
Network Layer – IPv4 Addressing – Network Layer Protocols (IP, ICMP and Mobile IP) Unicast and Multicast Routing – Intradomain and Interdomain Routing Protocols – IPv6 Addresses – IPv6 – Datagram Format - Transition from IPv4 to IPv6.		
UNIT III	**TRANSPORT AND APPLICATION LAYERS**	**6**
Transport Layer Protocols – UDP and TCP Connection and State Transition Diagram - Congestion Control and Avoidance (DEC bit, RED) - QoS - Application Layer Paradigms – Client – Server Programming – Domain Name System – World Wide Web, HTTP, Electronic Mail.		
UNIT IV	**NETWORK SECURITY**	**6**
OSI Security Architecture – Attacks – Security Services and Mechanisms – Encryption – Advanced Encryption Standard – Public Key Cryptosystems – RSA Algorithm – Hash Functions – Secure Hash Algorithm – Digital Signature Algorithm.		
UNIT V	**HARDWARE SECURITY**	**6**
Introduction to hardware security, Hardware Trojans, Side – Channel Attacks – Physical Attacks and Countermeasures – Design for Security. Introduction to Blockchain Technology.		

PRACTICALS	
1.	Implement the Data Link Layer framing methods (i) Bit stuffing, (ii) Character stuffing
2.	Implementation of Error Detection / Correction Techniques i) LRC, (ii) CRC, (iii) Hamming cod
3.	Implementation of Stop and Wait, and Sliding Window Protocols.
4.	Implementation of Go back-N and Selective Repeat Protocols.
5.	Implementation of Distance Vector Routing algorithm (Routing Information Protocol) (Bellman-Ford).
6.	Implementation of Link State Routing algorithm (Open Shortest Path First) with 5 nodes (Dijkstra's).
7.	Data encryption and decryption using Data Encryption Standard algorithm.
8.	Data encryption and decryption using RSA (Rivest, Shamir and Adleman) algorithm.
	Total: 60 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Explain the Network Models, layers and functions.
CO2: Categorize and classify the routing protocols.
CO3: List the functions of the transport and application layer.
CO4: Evaluate and choose the network security mechanisms.
CO5: Discuss the hardware security attacks and countermeasures.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	2	1								1	2	1
CO2	2	1	1	2	2								2	1	1
CO3	1	2	1	1	2								1	2	1
CO4	1	2	2	1	1								1	1	2
CO5	2	2	2	1	1								2	2	2

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Behrouz. A.Forouzan, "Data Communication and Networking", 5th Edition, TMH, 2017.
T2.	William Stallings, "Cryptography and Network Security", 7th Edition, Pearson Education, 2017.
T3.	Bhunia Swarup, "Hardware Security A Hands On Approach", 1st Edition, Morgan

	Kaufmann, 2018.

REFERENCE BOOK(S)	
R1.	James.F.Kurose and Keith.W.Ross, "Computer Networking A Top Down Approach", 6th Edition, Pearson, 2017.
R2.	Doughlas E.Comer, "Computer Networks and Internets with Internet Applications", 4th Edition, Pearson Education, 2008.
R3.	James F. Kurose and Keith W. Ross "Computer Networking: A Top-Down Approach", 8th Edition, Pearson, 2021.

OPEN ELECTIVES OFFERED BY PARENT (ECE) DEPARTMENT

Course Code: 24ECO001	Course Title: Introduction To Control Engineering	
Course Category: OEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To introduce the control system components and transfer function model with their graphical representation
• To understand the analysis of system in time domain along with steady state error.
• To introduce frequency response analysis of systems.
• To accord basic knowledge in design of compensators.
• To introduce the state space models.

UNIT I	MATHEMATICAL MODELLING	9
Introduction – transfer function – simple electrical, mechanical, ,pneumatic , hydraulic and thermal systems–analogies		
UNIT II	**FEEDBACK CONTROL SYSTEMS**	**9**
Control system components - Block diagram representation of control systems, Reduction of block diagrams, Signal flow graphs, Output to input ratios		
UNIT III	**TIME DOMAIN ANALYSIS**	**9**
Response of systems to different inputs viz., Step impulse, pulse, parabolic and sinusoidal inputs, Time response of first and second order systems, steady state errors and error constants of unity feedback circuit.		
UNIT IV	**STABILITY ANALYSIS**	**9**
Necessary and sufficient conditions, Routh - Hurwitz criteria of stability, Root locus and Bode techniques ,Concept and construction, frequency response.		
UNIT V	**STATE SPACE TECHNIQUE**	**9**
State vectors–state space models-Digital Controllers–design aspects.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Represent and develop systems in different forms using the knowledge gained.
CO2: Analyses the system in time and frequency domain and the stability of physical

systems.
CO3: Ability to Derive Transfer function Model of Electrical and Mechanical Systems.
CO4: Ability to Obtain the transfer Function by the Reduction of Block diagram & Signal flow graph.
CO5: Acquire and analyze knowledge in State variable model for MIMO systems.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3				1		1		1			
CO2	3	3	3	2				1		1		1			
CO3	2	1	2	1				1		1		1			
CO4	3	3	3	3				1		1		1			
CO5	3	3	3	2				1		1		1			

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Nagarath, I.J. and Gopal, M., "Control Systems Engineering", New Age International Publishers, 2017.
T2.	Benjamin C. Kuo, "Automatic Control Systems", Wiley, 2014

REFERENCE BOOK(S)

R1.	Katsuhiko Ogata, "Modern Control Engineering", Pearson, 2015.
R2.	John J.D., Azzo Constantine, H. and HoupisSttuart, N Sheldon, "Linear Control System Analysis and Design with MATLAB", CRC Taylor& Francis Reprint 2009.
R3.	Rames C.Panda and T. Thyagarajan, "An Introduction to Process Modelling Identification and Control of Engineers", Narosa Publishing House, 2017.

Course Code: 24ECO002	Course Title: SEMICONDUCTOR MANUFACTURING	
Course Category: OEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks: 100

COURSE OBJECTIVES
• To understand basic semiconductor manufacturing technology
• To know Integrated Circuit Fabrication
• To introduce the basic semiconductor manufacturing processes
• To familiarize with steps involved in CMOS IC chip fabrication
• To explain major processing technology used IC manufacturing.

UNIT I	INTRODUCTION TO SEMICONDUCTOR MANUFACTURING	9
Historical perspective, processing overview, semiconductor materials, semiconductor devices, process technology, fabrication steps.		
UNIT II	**MANUFACTURING PROCESS: CRYSTAL GROWTH, SILICON OXIDATION, PHOTOLITHOGRAPHY**	**9**
Silicon crystal growth, material characterization, thermal oxidation process, impurity redistribution, masking properties of silicon dioxide, oxidation thickness characteristics.		
UNIT III	**MANUFACTURING PROCESS: ETCHING, DIFFUSION, ION IMPLANTATION, FILM DEPOSITION**	**9**
Wet chemical etching, Dry etching, basic diffusion process, extrinsic diffusion, lateral diffusion, Photolithography, Ion Implantation, implanted damage and annealing, epitaxial growth techniques, structures and defects, dielectric deposition, metallization.		
UNIT IV	**PROCESS INTEGRATION**	**9**
Passive components, bipolar technology, MOSFET Technology, MESFET Technology, MEMS Technology.		
UNIT V	**IC MANUFACTURING**	**9**
Electrical testing, packing, statistical process control, computer integrated manufacturing, challenges for integration, system-on-a-chip.		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Relate technology changes from semiconductor manufacturing industry.

CO2: Explain steps for making silicon wafers from sand.
CO3: Apply various technology involved in manufacturing.
CO4: Analyze the integration of steps in CMOS IC chip fabrication.
CO5: Build CMOS-based used in the electronics industry.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1									1	2	
CO2	1	1	2	1										2	
CO3	1	2	1	1										2	
CO4	2	1	2	2									1	1	
CO5		2	2	1									1		

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	G. S. May and S. M. Sze, "Fundamentals of Semiconductor Fabrication", Wiley India, 2004.
T2.	Hong Xiao, "Introduction to Semiconductor Manufacturing Technology", 2nd Edition, SPIE Press, 2012.

REFERENCE BOOK(S)

R1.	W. R. Runyan and K. E. Bean, "Semiconductor Integrated Circuit Processing Technology", Addison Wesley Publishing Company, 2010.
R2.	S. A. Campbell, "The Science and Engineering of Microelectronic Fabrication", Oxford University Press, 2012.
R3.	M. J. Madou, "Fundamentals of Micro fabrication", CRC Press, 2nd Edition, 2011.
R4.	S. M. Sze, "Semiconductor Devices: Physics and Technology", 2nd Edition., Wiley India, 2011.

Course Code: 24ECO003	Course Title: Mechatronics	
Course Category: OEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks: 100

COURSE OBJECTIVES
• To illustrate the selecting the sensors to develop mechatronics systems.
• To explain the architecture and timing diagram of microprocessor, and also interpret and develop programs.
• To design appropriate interfacing circuits to connect I/O devices with microprocessor.
• To apply PLC as a controller in mechatronics system.
• To design and develop the apt mechatronics system for an application.

UNIT I	INTRODUCTION AND SENSORS	9
Introduction to Mechatronics – Systems – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and Dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance Sensors – Strain Gauges – Eddy Current Sensor – Hall Effect Sensor –Temperature Sensors – Light Sensors.		
UNIT II	**8085 MICROPROCESSOR**	**9**
Introduction – Pin Configuration - Architecture of 8085 – Addressing Modes – Instruction set, Timing diagram of 8085.		
UNIT III	**PROGRAMMABLE PERIPHERAL INTERFACE**	**9**
Introduction – Architecture of 8255, Keyboard Interfacing, LED display – Interfacing, ADC and DAC Interface, Temperature Control – Stepper Motor Control – Traffic Control Interface.		
UNIT IV	**PROGRAMMABLE LOGIC CONTROLLER**	**9**
Introduction – Architecture – Input / Output Processing – Programming with Timers, Counters and Internal relays – Data Handling – Selection of PLC.		
UNIT V	**ACTUATORS AND MECHATRONICS SYSTEM DESIGN**	**9**
Types of Stepper and Servo motors – Construction – Working Principle – Characteristics, Stages of Mechatronics Design Process – Comparison of Traditional and Mechatronics Design Concepts with Examples – Case studies of Mechatronics Systems – Pick and Place Robot – Engine Management system – Automatic Car Park Barrier.		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Select sensors to develop mechatronics systems.
CO2: Explain the architecture and timing diagram of microprocessor, and also interpret and develop programs.
CO3: Design appropriate interfacing circuits to connect I/O devices with microprocessor.
CO4: Apply PLC as a controller in mechatronics system.
CO5: Design and develop the apt mechatronics system for an application.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	1								2			
CO2	1	2	1	1								2			
CO3	1	2	1	1								2			
CO4	1	2	1	1								2			
CO5	2	2	1	1								2			

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Bolton W., “Mechatronics”, 6th Edition, Pearson Education, 2015.
T2.	Ramesh S Gaonkar, “Microprocessor Architecture, Programming and Applications with the 8085”, 6th Edition, Penram International Publishing Private Limited, 2013.

REFERENCE BOOK(S)	
R1.	Bradley D.A., Dawson D., Buru N.C. and Loader A.J., “Mechatronics”, Chapman and Hall, 2012.
R2.	Davis G. Alciatore and Michael B. Histand, “Introduction to Mechatronics and Measurement systems”, McGraw Hill Education, 2011.
R3.	Devadas Shetty and Richard A. Kolk, “Mechatronics Systems Design”, Cengage Learning, 2010.

Course Code: 24ECO004	Course Title: Sensors and Actuators	
Course Category: OEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks: 100

COURSE OBJECTIVES
• To illustrate the fundamental concepts of Instrument types and its Sensors
• To analyze the variable resistance and the Inductance Sensors
• To study about the Variable Sensors and the Special Sensors.
• To understand about the Automotive Actuators
• To study about the Automatic Temperature Control Actuators .

UNIT I	INTRODUCTION TO MEASUREMENTS AND SENSORS	9
Sensors: Functions- Classifications- Main technical requirement and trends Units and standards-Calibration methods- Classification of errors- Error analysis- Limiting error- Probable error-Propagation of error- Odds and uncertainty- principle of transduction- Classification. Static characteristics- mathematical model of transducers- Zero, First and Second order transducers-Dynamic characteristics of first and second order transducers for standard test inputs.		
UNIT II	**VARIABLE RESISTANCE AND INDUTANCE SENSORS**	**9**
Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezo resistive sensors Inductive potentiometer- Variable reluctance transducers:- EI pick up and LVDT		
UNIT III	**VARIABLE AND OTHER SPECIAL SENSORS**	**9**
Variable air gap type, variable area type and variable permittivity type- capacitor microphone Piezoelectric, Magnetostrictive, Hall Effect, semiconductor sensor- digital transducers- Humidity Sensor. Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor.		
UNIT IV	**AUTOMOTIVE ACTUATORS**	**9**
Electromechanical actuators- Fluid-mechanical actuators- Electrical machines- Direct-current machines- Three-phase machines- Single-phase alternating-current Machines - Duty-type ratings for electrical machines. Working principles, construction and location of actuators viz. Solenoid, relay, stepper motor etc.		
UNIT V	**AUTOMATIC TEMPERATURE CONTROL ACTUATORS**	**9**
Different types of actuators used in automatic temperature control- Fixed and variable displacement temperature control- Semi Automatic- Controller design for Fixed and variable		

displacement type air conditioning system.

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: List common types of sensor and actuators used in vehicles.
CO2: Design measuring equipment's for the measurement of pressure force, temperature and flow.
CO3: Generate new ideas in designing the sensors and actuators for automotive application
CO4: Understand the operation of the sensors, actuators and electronic control.
CO5: Design temperature control actuators for vehicles.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2										1			
CO2	3	2		2	1										
CO3	3	2		2	1										
CO4	3	2		2	1										
CO5	3	2		2	1		2					1			

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Doebelin, Ernest O. Doebelin Dhanesh N. Manik, " Measurement Systems", 7th Edition, McGraw Hill Publishers, 2019.
T2.	Robert Brandy, "Automotive Electronics and Computer System", Prentice Hall, 2001.
T3.	Bosch, "Automotive Electrics, Automotive Electronics Systems and Components, Networking and Hybrid Drive", 5th Edition, McGraw Hill Publishers, 2007.

REFERENCE BOOK(S)

R1.	James D Halderman, " Automotive Electrical and Electronics", Prentice Hall, USA, 2013.
R2.	Tom Denton, "Automotive Electrical and Electronics Systems," 3rd Edition, SAE International, 2004.
R3.	William Ribbens, "Understanding Automotive Electronics -An Engineering Perspective," 7th Edition, Elsevier Butterworth-Heinemann Publishers, 2012.

Course Code: 24ECO005	Course Title: Wireless Networks	
Course Category: OEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks: 100

COURSE OBJECTIVES
• To understand the concept about Wireless networks, protocol stack and standards
• To understand and analyze the network layer solutions for Wireless networks
• To study about fundamentals of 3G Services, its protocols and applications
• To have in depth knowledge on internetworking of WLAN and WWAN
• To learn about evolution of 4G Networks, its architecture and applications

UNIT I	WIRELESS LAN	9
Introduction-WLAN technologies: - IEEE802.11: System architecture, protocol architecture, 802.11b, 802.11a – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth: Architecture, WPAN – IEEE 802.15.4, Wireless USB, Zigbee, 6LoWPAN, WirelessHART.		
UNIT II	**MOBILE NETWORK LAYER**	**9**
Introduction - Mobile IP: IP packet delivery, Agent discovery, tunneling and encapsulation, IPV6-Network layer in the internet- Mobile IP session initiation protocol - mobile ad-hoc network: Routing: Destination Sequence distance vector, IoT: CoAP.		
UNIT III	**3G OVERVIEW**	**9**
Overview of UTMS Terrestrial Radio access network-UMTS Core network Architecture: 3GPP Architecture, User equipment, CDMA2000 overview- Radio and Network components, Network structure, Radio Network, TD-CDMA, TD – SCDMA.		
UNIT IV	**INTERNETWORKING BETWEEN WLANS AND WWANS**	**9**
Internetworking objectives and requirements, Schemes to connect WLANS and 3G Networks, Session Mobility, Internetworking Architecture for WLAN and GPRS, System Description, Local Multipoint Distribution Service, Multichannel Multipoint Distribution System		
UNIT V	**4G & BEYOND**	**9**
Introduction – 4G vision – 4G features and challenges - Applications of 4G – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, IMS Architecture, LTE, Advanced Broadband Wireless Access and Services, MVNO.		

COURSE OUTCOMES

At the end of this course, students will be able to
CO1: Identify and choose wireless transmission standard, physical layer protocol and MAC layer protocol on the basis of various network applications.
CO2: Understand and explain mobile IP and data routing using it. Classify ad hoc network Protocols
CO3: Understand the TCP protocol for wireless networks and able to do congestion free transmission over wireless networks.
CO4: Understand the major concepts involved in wireless wide-area networks and its architecture.
CO5: Have knowledge of 4G technologies and analyze various smart antenna techniques, modulation and coding techniques used in 4G technology.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3													
CO2	3	3													
CO3	3	3													
CO4	2	3													
CO5	2														

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Jochen Schiller, ”Mobile Communications”, 2nd Edition, Pearson Education 2012.
T2.	Vijay Garg, “Wireless Communications and Networking”, 1st Edition, Elsevier 2007.

REFERENCE BOOK(S)

R1.	Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband”, 2nd Edition, Academic Press, 2008.
R2.	Anurag Kumar, D.Manjunath, Joy kuri, “Wireless Networking”, 1st Edition, Elsevier 2011.
R3.	Simon Haykin , Michael Moher, David Koilpillai, “Modern Wireless Communications”, 1st Edition, Pearson Education 2013

OPEN ELECTIVES OFFERED BY MECHANICAL DEPARTMENT

Course Code: 24MEO001	Course Title: Drone Technologies	
Course Category: OEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To understand the basics of drone technology concepts.
• To learn and understand the fundamental of design, fabrication and programming of drone.
• To impart the knowledge of a flying and operation of drone.
• To know about the various applications of drone.
• To understand the safety risks and guidelines of fly safely.

UNIT I	INTRODUCTION TO DRONE TECHNOLOGY	9
Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability.		
UNIT II	**DRONE DESIGN, FABRICATION AND PROGRAMMING**	**9**
Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program - Install program on computer-Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.		
UNIT III	**DRONE FLYING AND OPERATION**	**9**
Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-Onboard storage capacity -Removable storage devices- Linked mobile devices and applications.		
UNIT IV	**DRONE COMMERCIAL APPLICATIONS**	**9**
Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcel sand other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing.		
UNIT V	**FUTURE DRONES AND SAFETY**	**9**

The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone License-Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms.
Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO 1: Understand the various types of drone technology, drone fabrication and programming.
CO 2: Apply the suitable operating procedures for functioning a drone.
CO 3: Understand appropriate sensors and actuators for Drones.
CO 4: Apply the drone mechanism for specific applications.
CO 5: Create the programs for various drones.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1					2			1		1	
CO2	3	3	1	1					2			1		1	
CO3	3	3	1	1					2			1		1	
CO4	3	3	1	1					2			1		1	
CO5	3	3	1	1					2			1		1	

(1 -Low, 2 -Medium, 3 -High)

TEXT BOOK(S)	
T1.	Daniel Tal and John Altschuld, “Drone Technology in Architecture, Engineering and construction a Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation”, John Wiley & Sons, Inc, 2021.
T2.	Terry Kilby and Belinda Kilby, “Make: Getting Started with Drones”, Maker Media, Inc, 2016.

REFERENCE BOOK(S)	
R1.	John Baichtal, “Building Your Own Drones: A Beginners Guide to Drones, UAVs, and ROVs”, Que Publishing, 2020.

Course Code: 24MEO002	Course Title: Introduction to Six Sigma	
Course Category: OEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To understand the core concepts of Six Sigma, including its history, philosophy, and principles.
• To explore various tools and techniques used in Six Sigma for defining, measuring, analysing, improving, and controlling processes.
• To learn Six Sigma methodologies like DFSS and FMEA for designing and optimizing processes.
• To comprehend the strategies for effective implementation of Six Sigma and the challenges faced during its deployment.
• To examine evaluation strategies and continuous improvement techniques, focusing on lean manufacturing and waste reduction.

UNIT I	SIX SIGMA BACKGROUND AND FUNDAMENTALS	9
Historical Overview -Definition of quality -What is six sigma -TQM and Six sigma - lean manufacturing and six sigma- six sigma and process tolerance -Six sigma and cultural changes -six sigma capability -six sigma need assessments - implications of quality levels, Cost of Poor Quality (COPQ), Cost of Doing Nothing -assessment questions.		
UNIT II	**THE SCOPE OF TOOLS AND TECHNIQUES**	**9**
Tools for definition -IPO diagram, SIPOC diagram, Flow diagram, CTQ Tree, Project Charter -Tools for measurement -Check sheets, Histograms, Run Charts, Scatter Diagrams, Cause and effect diagram, Pareto charts, Control charts, Flow process charts, Process Capability Measurement, Tools for analysis -Process Mapping, Regression analysis, RU/CS analysis, SWOT, PESTLE, Five Whys, interrelationship diagram, overall equipment effectiveness, TRIZ innovative problem solving -Tools for improvement -Affinity diagram, Normal group technique, SMED, 5S, mistake proofing, Value stream Mapping, forced field analysis -Tools for control -Radar chart, PDCA cycle, Milestone tracker diagram, Earned value management.		
UNIT III	**SIX SIGMA METHODOLOGIES**	**9**
Design For Six Sigma (DFSS), Design for Six Sigma Method - Failure Mode Effect Analysis		

(FMEA), FMEA process - Risk Priority Number (RPN) - Six Sigma and Leadership, committed leadership -Change Acceleration Process (CAP) - Developing communication plan -Stakeholder.		
UNIT IV	**SIX SIGMA IMPLEMENTATION AND CHALLENGES**	**9**
Tools for implementation -Supplier Input Process Output Customer (SIPOC) -Quality Function Deployment or House of Quality (QFD) -alternative approach –implementation -leadership training, close communication system, project selection -project management and team -champion training -customer quality index -challenges -program failure, CPQ vs six sigma, structure the deployment of six sigma -cultural challenge -customer/internal metrics.		
UNIT V	**EVALUATION AND CONTINUOUS IMPROVEMENT METHODS**	**9**
Evaluation strategy -the economics of six sigma quality, return on six Sigma (ROSS), ROI, poor project estimates -continuous improvement -lean manufacturing -value, customer focus, Perfection, focus on waste, overproduction -waiting, inventory in process (IIP), processing waste, transportation, motion, making defective products, underutilizing people -Kaizen -5S.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the concepts of Six Sigma and various tools.
CO2: Analyze the solutions and corrective actions to improve process performance and reduce defects using tools like DOE and mistake-proofing.
CO3: Evaluate and develop the control plans and monitor key performance indicators (KPIs) to ensure sustained improvement in processes.
CO4: Create the process documentation, Standard Operating Procedures (SOPs), and regular reviews to maintain improvements over time.
CO5: Understand about the Gain leadership and team management skills for leading Six Sigma projects, including project planning, execution, and resource management.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1					2			1			
CO2	3	3	1	1					2			1			
CO3	3	3	1	1					2			1			
CO4	3	3	1	1					2			1			
CO5	3	3	1	1					2			1			

(1 -Low, 2 -Medium, 3 -High)

TEXT BOOK(S)	
T1.	Thomas Pyzdek and Paul A. Keller, “The Six Sigma Handbook”, McGraw-Hill, 2018.
T2.	Mikel Harry and Richard Schroeder, “Six Sigma the Breakthrough Management Strategy Revolutionizing the World's Top Corporations”, double day, 2006.

REFERENCE BOOK(S)	
R1.	Michael George, David Rowlands, and Bill Kastle, “What is Lean Six Sigma”, McGraw -Hill 2003.
R2.	Thomas Pyzdek, “The Six Sigma Handbook”, McGraw-Hill, 2000.
R3.	Fred Soleimannejed, “Six Sigma, Basic Steps and Implementation”, Author House, 2004.
R4.	Forrest W. Breyfogle, III and James M. Cupello, Becki Meadows, “Managing Six Sigma a Practical Guide to Understanding, Assessing, and Implementing the Strategy That Yields Bottom-Line Success”, John Wiley & Sons, 2000.

Course Code: 24MEO003	Course Title: Sustainable Engineering	
Course Category: OEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To be acquainted with sustainability in engineering and its evaluation.
• To provide knowledge in environment and social sustainability.
• To provide the student with the knowledge of strategy to achieve sustainability.
• To familiarize with trends in sustainable operations.
• To create awareness in current sustainable practices in manufacturing industry.

UNIT I	ECONOMIC SUSTAINABILITY	9
Industrial Revolution-Economic sustainability: globalization and international issues Sustainability status - Emerging issues- Innovative products- Reconfiguration manufacturing enterprises - Competitive manufacturing strategies - Performance evaluation- Management for sustainability -Assessments of economic sustainability.		
UNIT II	**SOCIAL AND ENVIRONMENTAL SUSTAINABILITY**	**9**
Social sustainability -Introduction-Work management -Human rights - Societal Commitment-Customers -Business practices -Modelling and assessing social sustainability. Environmental issues pertaining to the manufacturing sector: Pollution - Use of resources - Pressure to reduce costs - Environmental management: Processes that minimize negative environmental impacts - environmental legislation and energy costs - need to reduce the carbon footprint of manufacturing Operations-Modelling and assessing environmental sustainability.		
UNIT III	**SUSTAINABILITY PRACTICES**	**9**
Sustainability awareness - Measuring Industry Awareness-Drivers and barriers -Availability of sustainability indicators -Analysis of sustainability practicing -Modeling and assessment of sustainable practicing -Sustainability awareness -Sustainability drivers and barriers - Availability of sustainability indicators- Designing questionnaires- Optimizing Sustainability Indexes-Elements –Cost and time model.		
UNIT IV	**MANUFACTURING STRATEGY FOR SUSTAINABILITY**	**9**
Concepts of competitive strategy and manufacturing strategies and development of a strategic improvement programme - Manufacturing strategy in business success strategy formation and formulation - Structured strategy formulation - Sustainable manufacturing system design		

options - Approaches to strategy formulation - Realization of new strategies/system designs.		
UNIT V	**TRENDS IN SUSTAINABLE OPERATIONS**	**9**
Principles of sustainable operations - Life cycle assessment manufacturing and service activities - Influence of product design on operations - Process analysis -Capacity management - Quality management -Inventory management - Just-In-Time systems -Resource efficient design - Consumerism and sustainable well-being.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO 1: Apply the importance of economic sustainability.
CO 2: Understand the importance of sustainable practices.
CO 3: Analyze the drivers and barriers for the given conditions.
CO 4: Apply strategy in sustainable manufacturing.
CO 5: Create the plan for sustainable operation of industry with environmental, cost consciousness.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1					2			1	1	2	
CO2	3	3	1	1					2			1	1	2	
CO3	3	3	1	1					2			1	1	2	
CO4	3	3	1	1					2			1	1	2	
CO5	3	3	1	1					2			1	1	2	

(1 -Low, 2 -Medium, 3 -High)

TEXT BOOK(S)	
T1.	Davim J.P., "Sustainable Manufacturing", John Wiley & Sons., United States, 2019.
T2.	Ibrahim Garbie, "Sustainability in Manufacturing Enterprises Concepts, Analyses and Assessments for Industry 4.0", Springer International Publishing., United States, 2021.

REFERENCE BOOK(S)	
R1.	Jovane F., Ęmper, W.E. and Williams, D.J., "The Manufuture Road towards Competitive and Sustainable High-Adding-Value Manufacturing", Springer, United States, 2019.

R2.	Kutz M., “Environmentally Conscious Mechanical Design”, John Wiley & Sons., United States, 2021
R3.	Seliger G., “Sustainable Manufacturing: Shaping Global Value Creation”, Springer, United States, 2020.

Course Code: 24MEO004	Course Title: Foundation Skills in Integrated Product Development	
Course Category: OEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To understand the fundamentals of product development, including global trends and product decision-making.
• To explore requirement engineering, system design, and modelling for effective product development.
• To learn various design, testing, and prototyping techniques for product development.
• To understand the concepts of sustenance engineering, product validation, and end-of-life (EoL) support.
• To comprehend the business dynamics of the engineering services industry.

UNIT I	FUNDAMENTALS OF PRODUCT DEVELOPMENT	9
Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economic Trends -Environmental Trends - Political/Policy Trends - Introduction to Product Development Methodologies and Management - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle - Product Development Planning and Management.		
UNIT II	**REQUIREMENTS AND SYSTEM DESIGN**	**9**
Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis -Requirement Management - System Design & Modeling - Introduction to System Modeling - System Optimization -System Specification - Sub-System Design - Interface Design.		
UNIT III	**DESIGN AND TESTING**	**9**
Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques –Challenges in Integration of Engineering Disciplines -Concept Screening & Evaluation - Detailed Design -Component Design and Verification -Mechanical, Electronics and Software Subsystems - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing -Prototyping - Introduction to Rapid Prototyping and Rapid Manufacturing -		

System Integration, Testing, Certification and Documentation		
UNIT IV	**SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT**	**9**
Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation- Sustenance -Maintenance and Repair -Enhancements - Product EoL -Obsolescence Management -Configuration Management - EOL Disposal.		
UNIT V	**BUSINESS DYNAMICS -ENGINEERING SERVICES INDUSTRY**	**9**
The Industry - Engineering Services Industry - Product Development in Industry versus Academia -The IPD Essentials - Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems - Product Development Trade-offs -Intellectual Property Rights and Confidentiality -Security and Configuration Management.		
Total: 45 Hours		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1. Apply product life cycle concepts to plan and manage product development effectively.
CO2. Analyse system design and optimization techniques for subsystem and interface design.
CO3. Understand the concepts using concept generation techniques.
CO4. Formulate the strategies for product maintenance, repair, and enhancements.
CO5. Evaluate the integration of mechanical, embedded, and software systems in product manufacturing and assembly.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1					2			1	2	1	
CO2	3	3	1	1					2			1	2	1	
CO3	3	3	1	1					2			1	2	1	
CO4	3	3	1	1					2			1	2	1	
CO5	3	3	1	1					2			1	2	1	

(1 -Low, 2 -Medium, 3 -High)

TEXT BOOK(S)	
T1.	Ulrich, Karl T.; Eppinger, Steven D.; Yang, Maria C.; *Product Design and*

	Development; 7th Edition; McGraw-Hill Education; 2020.
T2.	Pugh, Stuart; *Total Design: Integrated Methods for Successful Product Engineering*; 1st Edition; Addison-Wesley Publishing; 1990.

REFERENCE BOOK(S)	
R1.	Cross, Nigel*; Engineering Design Methods: Strategies for Product Design*; 4th Edition; John Wiley & Sons; 2008.
R2.	Otto, " *Product Design: Techniques in Reverse Engineering and New Product Development"* 1st Edition; Pearson Education; 2000.

Course Code: 24MEO005	Course Title: Maintenance Engineering	
Course Category: OEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To understand the principles, objectives and importance of maintenance adopted in industry for successful progress.
• To introduce different maintenance categories, its merits and types of lubrication.
• To expose the idea of condition monitoring, methods and instruments used for allied measurements.
• To learn about failure analysis and repair methods for few mechanical elements.
• To promote computerization in maintenance and inventory management.

UNIT I	PRINCIPLES OF MAINTENANCE PLANNING	9
Basic principles of maintenance planning - Objectives and principles of planned maintenance activity - Importance and benefits of sound maintenance systems - Maintenance organization - Maintenance economics.		
UNIT II	**MAINTENANCE CATEGORIES AND LUBRICATION**	**9**
Maintenance categories - Comparative merits of each category - Preventive maintenance, Maintenance schedules, Repair cycle - Total Productive Maintenance - Principles and methods of lubrication.		
UNIT III	**CONDITION MONITORING**	**9**
Condition based maintenance - Cost comparison with and without Condition Monitoring - Methods and instruments for condition monitoring - Noise, vibration, wear and temperature measurement.		
UNIT IV	**FAILURE ANALYSIS AND REPAIR METHODS**	**9**
Failure analysis - Failures and their development - Role of Non Destructive Testing in failure analysis - Repair methods for bearings, cylinder block, fuel pump, shaft.		
UNIT V	**COMPUTER AIDED MAINTENANCE MANAGEMENT**	**9**
Approach towards Computerization in maintenance - computer-aided maintenance management system (CAMMS) - Advantages of CAMMS - spare parts and inventory centre performance reporting.		
Total: 45 Hours		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Explain the principles, objectives and importance of maintenance adopted in industry.
CO2: Select the suitable maintenance category and lubrication type.
CO3: Apply the appropriate methods and instruments for condition monitoring.
CO4: Analyze the failures of mechanical systems and select suitable repair methods.
CO5: Utilize computers in maintenance and inventory management.

COURSE ARTICULATION MATRIX															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	1	1					2			1	2	1	
CO2	3	3	1	1					2			1	2	1	
CO3	3	3	1	1					2			1	2	1	
CO4	3	3	1	1					2			1	2	1	
CO5	3	3	1	1					2			1	2	1	

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Srivastava S.K, “Maintenance Engineering”, S Chand and Company, 2010.
T2.	Mishra R.C, Pathak K, “Maintenance Engineering and Management”, Second edition, Prentice Hall India Learning Pvt. Ltd., 2012.

REFERENCE BOOK(S)	
R1.	Keith Mobley R, Lindley R. Higgins and Darrin J. Wikoff, “Maintenance Engineering” , Seventh edition, McGraw-Hill Professional, 2008.
R2.	Davies A, “Handbook of Condition Monitoring: Techniques and Methodology”, Springer, 2012.
R3.	Otegui Jose Luis, “Failure Analysis, Fundamentals and Applications in Mechanical Components”, Nineteenth edition, Springer, 2014.

OPEN ELECTIVE OFFERED BY CIVIL DEPARTMENT

Course Code: 24CEO001	Course Title: Environment and Agriculture	
Course Category: OEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks: 100

COURSE OBJECTIVES
• To understand the environmental basis of agriculture and the impact of globalization on agro-ecosystems.
• To analyze the environmental impacts of irrigation, mechanized agriculture, and urbanization on land and water resources.
• To study the effects of climate change, global warming, and water cycle disruptions on agricultural systems
• To examine the relationship between ecological diversity, agricultural biotechnology, and sustainable farming practices.
• To explore emerging agricultural environmental concerns, including global policies, alternative farming methods, and sustainable agricultural solutions.

UNIT I	ENVIRONMENTAL CONCERNS	9
Environmental basis for agriculture and food - land use and landscape changes - water quality issues - changing social structure and economic focus - globalization and its impacts - agro ecosystems.		
UNIT II	**ENVIRONMENTAL IMPACTS**	**9**
Irrigation development and watersheds - mechanized agriculture and soil cover impacts - erosion and problems of deposition in irrigation systems - agricultural drainage and downstream impacts - agriculture versus urban impacts.		
UNIT III	**CLIMATE CHANGE**	**9**
Global warming and changing environment - ecosystem changes - changing blue – green - grey water cycles - water scarcity and water shortages - desertification.		
UNIT IV	**ECOLOGICAL DIVERSITY AND AGRICULTURE**	**9+3**
Ecological diversity, wild life and agriculture - GM crops and their impacts on the environment - insets and agriculture - pollination crisis - ecological farming principles - forest fragmentation and agriculture - agricultural biotechnology concerns.		
UNIT V	**EMERGING ISSUES**	**9+3**
Global environmental governance - alternate culture systems - mega farms and vertical farms		

- virtual water trade and its impacts on local environment - agricultural environment policies and its impacts - sustainable agriculture distributed GIS.
Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the environmental basis of agriculture, land use changes, and the impact of globalization on agro-ecosystems.
CO2: Analyze the environmental impacts of irrigation, mechanized agriculture, soil erosion, and urbanization on land and water resources.
CO3: Evaluate the effects of climate change, global warming, and water cycle disruptions on agricultural sustainability.
CO4: Assess the role of ecological diversity, GM crops, and agricultural biotechnology in sustainable farming practices.
CO5: Explore emerging environmental challenges in agriculture and assess policies, alternative farming methods, and sustainable agricultural solutions.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1				2	2						2	1	1
CO2	2	2	1	2	2	2	2					1	2	2	2
CO3	2	2	2	2	1	2	2					1			
CO4	2	2	2	2	2	2	2	1				2	2		
CO5	2	2	2	2	2	2	2	1				2	2		

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	M.Lakshmi Narasaiah, Environment and Agriculture, Discovery Pub. House, 2006.
T2.	Arvind Kumar, Environment and Agriculture, ABH Publications, New Delhi, 2005.

REFERENCE BOOK(S)	
R1.	T.C. Byerly, Environment and Agriculture, United States. Dept. of Agriculture. Economic Research Service, 2006.
R2.	Environment and agriculture: environmental problems affecting agriculture in the Asia and Pacific region; World Food Day Symposium, Bangkok, Thailand. 1989

Course Code: 24CEO002	Course Title: Green Building Design	
Course Category: OEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks: 100

COURSE OBJECTIVES
• To understand the environmental implications of buildings, including energy use, carbon emissions, water consumption, and waste disposal
• To analyze the impact of building technologies and materials, considering embodied energy, resource utilization, and sustainable alternatives.
• To evaluate thermal comfort in buildings by examining heat transfer characteristics and the effects of geographical location.
• To explore the role of solar energy in buildings, focusing on solar passive cooling and heating techniques through case studies
• To apply green building principles by implementing efficient water management, waste disposal, and urban sustainability practices.

UNIT I	ENVIRONMENTAL IMPLICATIONS OF BUILDINGS	9
Energy use - carbon emissions - water use, waste disposal; building materials: sources, methods of production and environmental implications - embodied energy in building materials: transportation energy for building materials; maintenance energy for buildings.		
UNIT II	**IMPLICATIONS OF BUILDING TECHNOLOGIES EMBODIED ENERGY OF BUILDINGS**	**9**
Framed construction - masonry construction - resources for building materials, alternative concepts - recycling of industrial and buildings wastes - biomass resources for buildings.		
UNIT III	**COMFORTS IN BUILDING**	**9**
Thermal comfort in buildings issues; heat transfer - characteristic of building materials and building techniques - incidence of solar heat on buildings - implications of geographical locations.		
UNIT IV	**UTILITY OF SOLAR ENERGY IN BUILDINGS**	**9**
Utility of solar energy in buildings - concepts of solar passive cooling and heating of buildings - low energy cooling - case studies of solar passive cooled and heated buildings.		
UNIT V	**GREEN COMPOSITES FOR BUILDINGS**	**9**
Concepts of green composites - water utilisation in buildings - low energy approaches to water management - management of solid wastes - management of sullage water and sewage.		

urban environment and green buildings - green cover and built environment.
Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Explain the environmental implications of buildings, including energy use, carbon emissions, and waste disposal.
CO2: Examine the impact of building technologies and construction materials on sustainability and embodied energy.
CO3: Assess thermal comfort in buildings and determine the influence of heat transfer characteristics of materials.
CO4: Demonstrate the utility of solar energy in buildings and implement solar passive cooling and heating techniques.
CO5: Develop green building solutions incorporating water management, solid waste disposal, and urban environmental sustainability strategies.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1			2	2	1				1	2	1	2
CO2	2	2	2	2	1	2	2	1		1	1	1	2		
CO3	1	1	2	1		2	2			1		1	2		
CO4	2	2	2	2	1	2	2	1		1	1	2	2		
CO5	2	1	1	1		2	2	1					2	1	2

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	K.S.Jagadish, B. U. Venkataramareddy and K. S. Nanjundarao. Alternative Building Materials and Technologies. New Age International, 2007.
T2.	Low Energy Cooling For Sustainable Buildings. John Wiley and Sons Ltd, 2009.
T3.	Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.

REFERENCE BOOK(S)	
R1.	Osman Attmann, “Green Architecture Advanced Technologies and Materials”, McGraw. Hill, 2010.
R2.	Jerry Yudelson, McGraw Hil “Green building Through Integrated Design”. 2009.

Course Code: 24CEO003	Course Title: Geographical Information System	
Course Category: OEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks: 100

COURSE OBJECTIVES
• To understand the basic concepts and significance of GIS.
• To understand different database structures, including relational and object-oriented models
• To understand different methods of spatial data input, including scanning and digitization.
• To understand the importance of metadata in GIS.
• To explore various data management functions and their significance.

UNIT I	FUNDAMENTALS OF GIS	9
Introduction to GIS - basic spatial concepts - coordinate systems - GIS and information systems - definitions - history of GIS - components of a GIS - hardware, software, data, people, methods - proprietary and open source software - types of data - spatial, attribute data- types of attributes - scales/ levels of measurements.		
UNIT II	**SPATIAL DATA MODELS**	**9**
Database structures - relational, object oriented - entities - ER diagram - data models - conceptual, logical and physical models - spatial data models - raster data structures - raster data compression - vector data structures - raster vs vector models- tin and grid data models.		
UNIT III	**DATA INPUT AND TOPOLOGY**	**9**
Scanner - raster data input - raster data file formats - geo referencing - vector data input - digitizer - datum projection and reprojection -coordinate transformation - topology - adjacency, connectivity and containment - topological consistency - non topological file formats - attribute data linking - linking external databases - GPS data integration.		
UNIT IV	**DATA QUALITY AND STANDARDS**	**9+3**
Data quality - basic aspects - completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage - metadata - GIS standards –interoperability - OGC - spatial data infrastructure		
UNIT V	**DATA MANAGEMENT AND OUTPUT**	**9+3**
Import/Export - data management functions- raster to vector and vector to raster conversion - data output - map compilation - chart/graphs - multimedia - enterprise vs desktop GIS -		

distributed GIS.
Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the fundamental principles and components of a Geographic Information System (GIS).
CO2: Analyze differentiate between raster and vector data models and analyze their suitability for specific applications.
CO3: Apply data input techniques to create and manage spatial data, including establishing topological relationships.
CO4: Evaluate spatial data quality based on established standards and recommend appropriate data sharing practices.
CO5: Create design and produce effective GIS outputs, including maps and reports, to communicate spatial information.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		1									1	1	1	1
CO2	2		2	1	1							1	1		
CO3	2		2	1	1							1	1		
CO4	2	1	2	2	1							1			
CO5	2	1	2	2	2							1	1	1	1

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	Kang - Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition, 2011.
T2.	Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, "An Introduction Geographical Information Systems, Pearson Education, 2nd Edition, 2007.

REFERENCE BOOK(S)	
R1.	Lo. C. P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers, 2006.

Course Code: 24CEO004	Course Title: Climate Change and its Impacts	
Course Category: OEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks: 100

COURSE OBJECTIVES
• To explore key climate parameters such as temperature, rainfall, humidity, and wind
• To identify greenhouse gases and their impact on climate change.
• To assess the effects of climate change on human health, malnutrition, and migration.
• To identify various adaptation options for mitigating climate change effects.
• To understand the importance of conducting an energy audit to improve energy efficiency.

UNIT I	ENVIRONMENTAL IMPLICATIONS OF BUILDINGS	9
Energy use - carbon emissions - water use - waste disposal; Building materials: sources, methods of production and environmental Implications - Embodied Energy in Building Materials: Transportation Energy for Building Materials - Maintenance Energy for Buildings.		
UNIT II	**IMPLICATIONS OF BUILDING TECHNOLOGIES EMBODIED ENERGY OF BUILDINGS**	**9**
Framed Construction - Masonry Construction - Resources for Building Materials - Alternative concepts - Recycling of Industrial and Buildings Wastes - Biomass Resources for buildings.		
UNIT III	**COMFORTS IN BUILDING**	**9**
Thermal Comfort in Buildings - Issues; Heat Transfer Characteristic of Building Materials and Building Techniques - Incidence of Solar Heat on Buildings - Implications of Geographical Locations.		
UNIT IV	**UTILITY OF SOLAR ENERGY IN BUILDINGS**	**9**
Utility of Solar energy in buildings - concepts of Solar Passive Cooling and Heating of Buildings - Low Energy Cooling - Case studies of Solar Passive Cooled and Heated Buildings.		
UNIT V	**GREEN COMPOSITES FOR BUILDINGS**	**9**
Concepts of Green Composites - Water Utilisation in Buildings - Low Energy Approaches to Water Management - Management of Solid Wastes - Management of Sullage Water and Sewage - Urban Environment and Green Buildings - Green Cover and Built Environment.		

COURSE OUTCOMES

At the end of this course, students will be able to
CO1: Understand the environmental implications of buildings, including energy use, carbon emissions, and waste disposal.
CO2: Analyze the impact of building technologies and construction materials on sustainability and embodied energy
CO3: Evaluate thermal comfort in buildings and the influence of heat transfer characteristics of materials.
CO4: Assess the utility of solar energy in buildings and explore solar passive cooling and heating techniques.
CO5: Apply green building concepts, including water management, solid waste disposal, and urban environmental sustainability.

COURSE ARTICULATION MATRIX															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	1			2	2	1					2	1	2
CO2	2	2	2	1	1	2	2			1	1	1	2		
CO3	1	1	2			2	2	1		1		1	1		
CO4	2	2	2	1	1	2	2	1			1	2			
CO5	2	1	1			2	2	1				1	2	1	2

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	K.S.Jagadish, B. U. Venkataramareddy and K. S. Nanjundarao. Alternative Building Materials and Technologies. New Age International, 2007.
T2.	Low Energy Cooling For Sustainable Buildings. John Wiley and Sons Ltd, 2009.
T3.	Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.

REFERENCE BOOK(S)	
R1.	Osman Attmann Green Architecture Advanced Technologies and Materials. McGraw Hill, 2010.
R2.	Jerry Yudelson Green building Through Integrated Design. McGraw Hill, 2009.
R3.	Fundamentals of Integrated Design for Sustainable Building By Marian Keeler, Bill Burke.

Course Code: 24CEO005	Course Title: Disaster Management	
Course Category: OEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks: 100

COURSE OBJECTIVES
• To provide students an exposure to disasters, their significance and types.
• To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.
• To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR).
• To enhance awareness of institutional processes in the country.
• To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.

UNIT I	INTRODUCTION TO DISASTERS	9
Definition: disaster, hazard, vulnerability, resilience, risks - disasters: types of disasters - earthquake, landslide, flood, drought, fire etc - classification, causes, impacts including social, economic, political, environmental, health, psychosocial, etc.- differential impacts- in terms of caste, class, gender, age, location, disability - global trends in disasters: urban disasters, pandemics, complex emergencies, climate change- dos and don'ts during various types of disasters.		
UNIT II	**APPROACHES TO DISASTER RISK REDUCTION (DRR)**	**9**
Disaster cycle - phases, culture of safety, prevention, mitigation and preparedness community based DRR, structural- non-structural measures, roles and responsibilities of- community, panchayat raj institutions/urban local bodies(PRIS/ULBS), states, centre, and other stakeholders- institutional processes and framework at state and central level- state disaster management authority(SDMA) - early warning system - advisories from appropriate agencies.		
UNIT III	**INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT**	**9**
Factors affecting vulnerabilities, differential impacts, impact of development projects such as dams, embankments, changes in land-use etc. - climate change adaptation- IPCC scenario and scenarios in the context of India - relevance of indigenous knowledge, appropriate technology and local resources.		
UNIT IV	**DISASTER RISK MANAGEMENT IN INDIA**	**9**

Hazard and vulnerability profile of India, components of disaster relief: water, food, sanitation, shelter, health, waste management, institutional arrangements (mitigation, response and preparedness, disaster management act and policy - other related policies, plans, programmes and legislation - role of GIS and information technology components in preparedness, risk assessment, response and recovery phases of disaster - disaster damage assessment		
UNIT V	**DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS**	**9**
Landslide hazard zonation: case studies, earthquake vulnerability assessment of buildings and infrastructure: case studies, drought assessment: case studies, coastal flooding: storm surge assessment, floods: fluvial and pluvial flooding: case studies; forest fire: case studies, man-made disasters: case studies, space based inputs for disaster mitigation and management and field works related to disaster management.		

COURSE OUTCOMES

At the end of this course, students will be able to

CO1: Explain key concepts related to disasters, including hazard, vulnerability, resilience, and risk.

CO2: Understand disaster risk reduction (DRR) strategies, including structural and non-structural measures.

CO3: Analyze factors affecting vulnerabilities and their differential impacts on different communities.

CO4: Assess India's hazard and vulnerability profile.

CO5: Assess the vulnerabilities of buildings and infrastructure to earthquakes and other hazards.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1				2	2					2	2	1	1
CO2	2	2	1			2	2	1				2	2		
CO3	1	2	2		1	2	2						2		
CO4	1	1	2	1	1	2	2					1	2		
CO5	1			1		2	2						1	1	2

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)

T1.	Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-938038642
T2.	Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-12590073
T3.	Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
T4.	Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCE BOOK(S)	
R1.	Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005.
R2.	Government of India, National Disaster Management Policy, 2009.

OPEN ELECTIVE OFFERED BY EEE DEPARTMENT

Course Code: 24EEO001	**Course Title: Sustainable and Environmental Friendly HV Insulation system**	
Course Category: OEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To know about the products related with sustainable application.
• To learn about Green Gaseous insulators and its hazardous effects.
• To learn about Green liquid insulators and its hazardous effects.
• To learn about Green solid insulators and its hazardous effects.
• To understand the standards and testing of green insulation systems.

UNIT I	**SUSTAINABLE AND ENVIRONMENTAL ENERGY AND PRODUCTS**	**9**
Carbon print, global warming potential, environment requirement for any product and system.		
UNIT II	**ALTERNATE GREEN GASEOUS INSULATORS**	**9**
SF6 gas and its hazardous environmental effects, alternate gases, gaseous mixtures and othersources and its properties.		
UNIT III	**ALTERNATE GREEN LIQUID INSULATORS**	**9**
Hazardous effects of existing liquid dielectric materials (such as organic oil), alternate sources ofenvironmental friendly liquid such as ester oil, vegetable oils dielectric and its properties.		
UNIT IV	**ALTERNATE GREEN SOLID INSULATORS**	**9**
Hazardous effects of existing solid dielectric materials, alternate sources of environmental friendlysolid dielectric and its properties.		
UNIT V	**EVOLVING STANDARDS FOR GREEN INSULATION SYSTEMS**	**9**
Requirements, evolving standards of management, testing, usage and disposal of alternateinsulation systems, Major applications and standards.		
		Total : 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand sustainable and environmental energy and products.
CO2: Understand the alternate green gaseous insulators.
CO3: Understand the alternate green liquid insulators.
CO4: Understand the alternate green solid insulators.
CO5: Understand the standards and testing of Green insulation systems.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1			1	1	1	1						1		
CO2	2					2	2						2		
CO3	2					2	2						2		
CO4	2					2	2						2		
CO5	2				2	2	2						2		

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	R. Arora and H.C.W Mosch, "High Voltage Insulation Engineering", 2nd Edition, New Age International Publishers, 2021.
T2.	Chandra Swaroop Meena, Ashwani Kumar and Varun Pratap Singh, "Sustainable Technologies for Energy Efficient Building", 2nd Edition, CRC Press, 2021.
T3.	U.Mohan Rao and Ramanujam Sarathi, "Alternative Liquid Dielectrics for High Voltage Transformer Insulation Systems: Performance Analysis and Applications", 2nd Edition, Wiley- IEEE press, 2021.

REFERENCE BOOK(S)	
R1.	M.H. Fulekar, Bhawana Pathak and R.K. Kale, "Environment and Sustainable Development", Springer, 2020.
R2.	P. Muthukumar and Dilip Kumar Sakar, "Innovations in Sustainable Energy and Technology", Springer, 2020.

Course Code: 24EEO002	Course Title: Smart Grids	
Course Category: OEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To acquire knowledge about the evolution of Smart and Interconnected energy systems.
• To gain knowledge about the various challenges and benefits of smart grid and the national andinternational initiatives taken.
• To acquire knowledge on the concepts related with transmission in smart grid technologies.
• To get an insight into smart grid technologies applied to distribution systems.
• To gain knowledge about various computing technologies for Smart Operation of the Grid.

UNIT I	SMART GRID	9
Evolution of Energy Systems, Concept, Definitions and Need, Difference between Conventional & Smart Grid, Drivers, structures, functions, opportunities, challenges and benefits of Smart Grid, Basics of Micro grid, National and International Initiatives in Smart Grid.		
UNIT II	**SMART METERING**	**9**
Introduction to Advanced Metering infrastructure (AMI) - drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Real time management and control, Phasor Measurement Unit (PMU).		
UNIT III	**SMART GRID TECHNOLOGIES (Transmission)**	**9**
Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, Wide area Monitoring, Protection and control.		
UNIT IV	**SMART GRID TECHNOLOGIES (Distribution)**	**9**
DMS, Volt/VAr control, Fault Detection, Isolation and service restoration, Outage management, High- Efficiency Distribution Transformers, Phase Shifting Transformers, Electric Vehicles.		
UNIT V	**HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS**	**9**
Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Computing technologies for Smart		

Grid applications (Web Service to CLOUD Computing), Role of big data and IoT, Cyber Security for Smart Grid.
Total : 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the importance and objectives of Power System Grid.
CO2: Understand the concept of a smart grid.
CO3: Identify and discuss smart metering devices and associated technologies on Transmission Sector.
CO4: Deliver an overview of Micro grid and Electric Vehicle Technology on Distribution Sector.
CO5: Interpret the various computing technologies to understand the role of Cloud computing and IoT for effective and efficient operation of Smart Grid.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2			1		1	1		1			1	2		
CO2	2		2	1		1	1		2			1	2		
CO3	2	2	2	2		2	1		1			2	2	2	
CO4	2	1	2	2		2	1		2			2	2	2	
CO5	2	1	2	2		2	1		2			2	2		

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	Stuart Borlase, "Smart Grids Advanced Technologies and Solutions", 2nd Edition, CRC, 2018.
T2.	Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu and Akihiko Yokoyama, "Smart Grid:Technology and Applications", John Wiley, 2012.
T3.	James Momoh, "Smart Grid Fundamentals of Design and Analysis", IEEE press, 2012.

REFERENCE BOOK(S)	
R1.	Ahmed F. Zobaa and Trevor J. Bihl, "Big data analytics in future power systems", 1st Edition, CRC press, 2018.
R2.	Stuart Borlase, "Smart Grid: Infrastructure, Technology and Solutions", CRC Press, 2012.
R3.	Janaka B. Ekanayake , "Smart Grid: Technology and Applications", 1st Edition, Wiley Publications, 2021.

Course Code: 24EEO003	Course Title: Hybrid Energy Technology	
Course Category: OEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To acquire knowledge about different types of hybrid energy systems.
• To know about the various electrical Generators used for the Wind Energy Conversion Systems.
• To design the power converters used in SPV Systems.
• To gain knowledge about the various power converters used in hybrid energy systems.
• To get knowledge about the performance of the various hybrid Renewable energy systems.

UNIT I	HYBRID ENERGY SYSTEMS	9
Hybrid Energy Systems - Need for Hybrid Energy Systems - Solar - Wind - Fuel Cell - Diesel, Wind - Biomass - Diesel, Micro - Hydel - PV, Ocean and geyser energy - Classification of Hybrid Energy systems - Importance of Hybrid Energy systems - Advantages and Disadvantages - Environmental aspects of renewable energy - Impacts of renewable energy generation on the environment - Present Indian and international energy scenario of conventional and RE sources - Ocean energy, Hydel Energy - Wind Energy, Biomass energy, Hydrogen energy - Solar Photovoltaic (PV) and Fuel cells: Operating principles and characteristics.		
UNIT II	**ELECTRICAL MACHINES FOR WIND ENERGY CONVERSION SYSTEMS**	**9**
Review of reference theory fundamentals - Construction, Principle of operation and analysis: Squirrel Cage Induction Generator (SCIG), Doubly Fed Induction Generator (DFIG) - Permanent Magnet Synchronous Generator (PMSG).		
UNIT III	**POWER CONVERTERS AND ANALYSIS OF SOLAR PV SYSTEMS**	**9**
Power Converters for SPV Systems - Line commutated converters (inversion-mode) - Boost and buck- boost converters - selection of inverter, battery sizing, array sizing - Analysis of SPV Systems - Block diagram of the solar PV systems - Types of Solar PV systems: Stand-alone PV systems.		
UNIT IV	**ANALYSIS OF POWER CONVERTERS FOR HYBRID**	**9**

	ENERGY SYSTEMS	
Introduction to Power Converters - Stand-alone Converters - AC - DC - AC converters: uncontrolled rectifiers, PWM Inverters - Bi-Directional Converters - Grid-Interactive Inverters - Matrix converter - Merits and Limitations.		
UNIT V	**CASE STUDIES FOR HYBRID RENEWABLE ENERGY SYSTEMS**	**9**
Hybrid Systems - Range and type of Hybrid systems – Performance Analysis – Cost Analysis - Case studies of Diesel - PV, Wind - PV - Fuel - cell, Micro - hydel - PV, Biomass-Diesel - Fuel - cell systems.		
		Total : 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Analyze the impacts of hybrid energy technologies on the environment and demonstrate them to harness electrical power.
CO2: Select a suitable Electrical machine for Wind Energy Conversion Systems and simulatewind energy conversion system.
CO3: Design the power converters such as AC-DC, DC-DC, and AC-AC converters for SPV systems.
CO4: Analyze the power converters such as AC-DC, DC-DC, and AC-AC converters for Hybrid energy systems.
CO5: Interpret the hybrid renewable energy systems.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		2	1		1	1		1			1	2	1	
CO2	2	1	2	1		1	1		1			1	2	2	
CO3	2	2	2	1		1	1		1				2	2	
CO4	2	2	1	2		1	1		1				2	2	
CO5	2	2	2	2		1	1		1			1	1	1	

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	Bahman Zohuri, "Hybrid Energy Systems", Springer, 1st Edition, 2018.
T2.	S.M. Muyeen, "Wind Energy Conversion Systems", 1st Edition, Springer, 2012.

T3.	Md. Rabiul Islam, Md. Rakibuzzaman Shah and Mohd Hasan Ali, "Emerging Power Converters for Renewable Energy and Electric Vehicles", 1st Edition, CRC Press, 2021.

REFERENCE BOOK(S)	
R1.	Ernst Joshua, "Wind Energy Technology", 3rd Edition, PHI, India, 2018.
R2.	Rashid.M. H, "Power electronics Hand book", 4th Edition, Academic press, 2018.
R3.	Rai. G.D, "Non-conventional energy sources", 6th Edition, Khanna publishers, 2017.

Course Code: 24EEO004	Course Title: Introduction to PLC Programming	
Course Category: PEC	Credits: 3	
L:T:P(Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks: 100

COURSE OBJECTIVES
• To understand basic PLC terminologies, PLC architecture and operation.
• To configure and integrate sensors, switches, and solid-state relays in PLC-based control systems.
• To develop PLC logic for simple applications using ladder logic.
• To understand the hardware and software behind PLC and SCADA.
• To gain exposure to the applications of PLC programming.

UNIT I	INTRODUCTION TO PLC	9
Introduction to PLC: Microprocessor, I/O Ports, Isolation, Filters, Drivers, Microcontrollers/DSP, PLC/DDC - PLC Construction: What is a PLC, PLC Memories, PLC I/O, PLC Special I/O, PLC Types.		
UNIT II	**PLC INSTRUCTIONS**	**9**
PLC Basic Instructions: PLC Ladder Language - Function block Programming- Ladder/Function Block functions - PLC Basic Instructions, Basic Examples (Start/Stop Rung, Entry/Reset Rung) - Configuration of Sensors, Switches, Solid State Relays - Interlock examples - Timers, Counters, Examples.		
UNIT III	**PLC PROGRAMMING**	**9**
Different types of PLC program, Basic Ladder logic, logic functions, PLC module addressing, registers basics, basic relay instructions, Latching Relays, arithmetic functions, comparison functions, data handling, data move functions, timer-counter instructions, input-output instructions, sequencer instructions.		
UNIT IV	**COMMUNICATION OF PLC AND SCADA**	**9**
Communication Protocol - Modbus, HART, Profibus. SCADA: - Hardware and software, Remote terminal units, Master Station and Communication architectures.		
UNIT V	**CASE STUDIES**	**9**
Stepper Motor Control - Elevator Control - CNC Machine Control - conveyor control - Interlocking Problems.		

	Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Identify the basic requirements of PLC input/output devices and architecture.
CO2: Apply the Instruction Set used for ladder Logic and Function Block Programming.
CO3: Design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Block.
CO4: Analyze SCADA hardware, software, remote terminal units, master stations, and communication architectures.
CO5: Understand the applications of PLC programming.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1					1		1					
CO2	3	3	2					1		1	2				2
CO3	3	3	3	3	1			1		1					
CO4	3	3		3	3			1		1			3	3	
CO5	3	3	3	2	1			1		1			3	3	3

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	Frank Petruzzula, "Programmable Logic Controllers", 6th Edition, Tata Mc-Graw Hill, 2023.
T2.	John W. Webb and Ronald A. Reis, "Programmable Logic Controllers Principles and Applications", 3rd Edition, PHI publication, 2011.
T3.	Madhuchhanda Mitra and Samarjit Sen Gupta, "Programmable Logic Controllers and Industrial Automation: An Introduction", 2nd Edition, Penram International Publishing () Pvt. Ltd, 2017.

REFERENCE BOOK(S)	
R1.	Madhuchand Mitra and Samerjit Sengupta, "Programmable Logic Controllers Industrial Automation an Introduction", 2nd Edition, Penram International Publishing Pvt. Ltd, 2005.
R2.	J. R. Hackworth and F. D. Hackworth, "Programmable Logic Controllers Principlesand Applications", Pearson publication, 2004.

Course Code: 24EEO005	Course Title: Flexible AC Transmission Systems	
Course Category: OEC	Credits: 3	
L:T:P(Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks: 100

COURSE OBJECTIVES
• To know about the Power control in Electrical Transmission lines.
• To impart knowledge about static VAR Compensator and its applications.
• To gain knowledge on Thyristor Controlled Series Capacitor and its applications.
• To understand the performance of power systems with FACTS controllers.
• To acquire knowledge about advanced FACTS controllers.

UNIT I	REAL AND REACTIVE POWER COMPENSATION	9
Real and reactive power control in electrical power transmission lines - loads & system compensation - Uncompensated transmission line - shunt and series compensation.		
UNIT II	**STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS**	**9**
Voltage control by SVC - Advantages of slope in dynamic characteristics - Influence of SVC on system voltage - Design of SVC voltage regulator - TCR - FC - TCR - Modeling of SVC for power flow and fast transient stability- Applications: Enhancement of transient stability - Steady state power transfer - Enhancement of power system damping.		
UNIT III	**THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS**	**9**
Operation of the TCSC - Different modes of operation - Modelling of TCSC, Variability reactance model - Modelling for Power Flow and stability studies. Applications: Improvement of the system stability limit - Enhancement of system damping.		
UNIT IV	**VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS**	**9**
Static Synchronous Compensator (STATCOM) - Principle of operation - VI Characteristics. Applications: Steady state power transfer - enhancement of transient stability - prevention of voltage instability. SSSC - operation of SSSC and the control of power flow - modelling of SSSC in load flow and transient stability studies - Dynamic voltage restorer (DVR).		
UNIT V	**ADVANCED FACTS CONTROLLERS**	**9**
Interline DVR(IDVR) - Unified Power flow controller (UPFC) - Interline power flow controller (IPFC) - Unified Power quality conditioner (UPQC).		

	Total : 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Explain Power control in Electrical Transmission lines.
CO2: Analyze and develop Static VAR Compensator (SVC) for Steady state power transfer.
CO3: Analyze and develop Thyristor Controlled Series Capacitor (TCSC) for system stability.
CO4: Analyze the performance of steady state and dynamics of facts controllers.
CO5: Explain about advanced FACTS controllers.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2					2				2		
CO2	2	1	2	1					2				2		1
CO3	2	2		2					2				2		
CO4	2	2	1	1					2				2		
CO5	2	1	2	2					2				2		1

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	R.Mohan Mathur and Rajiv K.Varma, "Thyristor-Based Facts Controllers for Electrical Transmission Systems", IEEE press and JohnWiley &Sons, Inc, 2002.
T2.	Narain G. Hingorani, "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors, 2011.

REFERENCE BOOK(S)	
R1.	K.R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Limited, Publishers, New Delhi, 2008.
R2.	V.K.Sood, "HVDC and FACTS controllers-Applications of Static Converters in Power System", Kluwer Academic Publishers, April 2004.

OPEN ELECTIVE OFFERED BY CSE DEPARTMENT

Course Code: 24CSO001	**Course Title: Generative AI**	
Course Category: PEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks: 100**

COURSE OBJECTIVES
• To Understand the capabilities, evolution, benefits, challenges, and applications of Generative AI.
• To Learn techniques for writing effective prompts and explore different prompt engineering approaches.
• To Study the fundamentals of generative models, including RNNs, LSTMs, GANs, VAEs, transformers, and diffusion models.
• To Explore Generative AI platforms, pre-trained models, and applications for text, image, and code generation.
• To Analyze the ethical, social, and economic implications, along with the limitations and future of Generative AI.

UNIT I	**INTRODUCTION TO GENERATIVE AI**	**9**
Capabilities - History and Evolution -Benefits- Challenges - Applications of Generative AI – Tools for Text, Image Code, Audio and Video generation– Economic Potential of Generative AI - Use cases.		
UNIT II	**PROMPT ENGINEERING TECHNIQUES AND APPROACHES**	**9**
Prompt Creation -Writing effective prompts -Techniques for using text prompts: Zero shot and few-shot prompt techniques – Prompt engineering approaches: Interview pattern, Chain-of Thought, Tree-of Thought - Benefits of using text prompts - Challenges in generating meaningful and coherent prompts.		
UNIT III	**MODELS FOR GENERATIVE AI**	**9**
Basics of Sequential data processing – Building blocks of Generative AI - Discriminative modelling – Generative modelling –Recurrent Neural Networks – Long Short-Term Memory (LSTM) Networks - Generative Adversarial Networks (GANs) - Variational Auto encoders (VAEs) – Transformer–based Models - Diffusion models Applications.		
UNIT IV	**PLATFORMS FOR GENERATIVE AI**	**9**
Introduction to Platforms – Features of platforms – Capabilities -Applications - Pre-trained Models - Challenges – Generation of Text to Text – Generation of Text to Image – Text to		

Code Generation – Explainable AI – Benefits – Use cases.		
UNIT V	**ETHICAL ISSUES AND LIMITATIONS OF GENERATIVE AI**	**9**
Limitations of Generative AI – Issues and concerns – Considerations for Responsible Generative AI – Economic Implications – Social Implications – Future and professional Growth of Generative AI.		
Total: 45 Hours		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the capabilities, evolution, benefits, challenges, and applications of Generative AI.
CO2: Apply effective prompt engineering techniques for improving AI-generated outputs.
CO3: Analyze various generative models, including RNNs, LSTMs, GANs, VAEs, transformers, and diffusion models.
CO4: Explore Generative AI platforms, pre-trained models, and multimodal AI generation techniques.
CO5: Evaluate ethical, social, and economic implications along with the future potential of Generative AI.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3			2									2	1
CO2			2		2			2					1		1
CO3		2		2	2									2	
CO4					3		3		2				1		1
CO5						2		1		1		1			1

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	David Foster, “Deep Learning: Teaching Machines to Paint, Write”, 2nd edition. O’Reilly Media, Inc 2023.
T2.	Joseph Babcock, Raghav Bali, “Generative AI with Python and TensorFlow 2: Create Images, Text, and Music with VAEs, GANs, LSTMs, Transformer Models”, Packt Publishing,2021

REFERENCE BOOK(S)	
R1.	Ian Good fellow, Joshua Bengio, Aaron Courville, “Deep Learning”, MIT Press,2016.

R2.	Ben Auffarth "Generative AI with LangChain: Build Large Language Model (LLM) Apps with Python, ChatGPT, and Other LLMs",2023
R3.	Rajeev Kapur, "AI Made Simple: A Beginner's Guide to Generative Intelligence",2023

Course Code: 24CSO002	**Course Title: Game Programming**	
Course Category: PEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks: 100**

COURSE OBJECTIVES
• To understand the concepts of Game design and development.
• To learn the processes, mechanics and issues in Game Design.
• To be exposed to the Core architectures of Game Programming.
• To know about Game programming platforms, frame works and engines.
• To learn to develop games.

UNIT I	**3D GRAPHICS FOR GAME PROGRAMMING**	**9**
3D Transformations, Quaternions, 3D Modeling and Rendering, Ray Tracing, Shader Models, Lighting, Color, Texturing, Camera and Projections, Culling and Clipping, Character Animation,Physics-based Simulation, Scene Graphs.		
UNIT II	**GAME ENGINE DESIGN**	**9**
Game engine architecture, Engine support systems, Resources and File systems, Game loop and real-time simulation, Human Interface devices, Collision and rigid body dynamics, Game profiling.		
UNIT III	**GAME PROGRAMMING**	**9**
Application layer, Game logic, Game views, managing memory, controlling the main loop, loading and caching game data, User Interface management, Game event management.		
UNIT IV	**GAMING PLATFORMS AND FRAMEWORKS**	**9**
2D and 3D Game development using Flash, DirectX, Java, Python, Game engines - Unity. DX Studio,		
UNIT V	**GAME DEVELOPMENT**	**9**

Developing 2D and 3D interactive games using DirectX or Python – Isometric and Tile Based Games, Puzzle games, Single Player games, Multi Player games.
Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Discuss the concepts of Game design and development.
CO2: Design the processes, and use mechanics for game development.
CO3: Explain the Core architectures of Game Programming.
CO4: Use Game programming platforms, frame works and engines.
CO5: Create interactive Games.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3			2									2	1
CO2			2		2			2					1		2
CO3		2		2	2									2	1
CO4					3		3		2				1		
CO5						2		1		1		1			1

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Mike Mc Shaffrfy and David Graham, "Game Coding Complete", Fourth Edition, Cengage Learning, PTR, 2012.
T2.	David H. Eberly, "3D Game Engine Design, Second Edition: A Practical Approach to Real-Time Computer Graphics" 2 nd Editions, Morgan Kaufmann, 2006.

REFERENCE BOOK(S)	
R1.	Ernest Adams and Andrew Rollings, "Fundamentals of Game Design", 2 nd Edition Prentice Hall / New Riders, 2009.
R2.	Eric Lengyel, "Mathematics for 3D Game Programming and Computer Graphics", 3 rd Edition, Course Technology PTR, 2011.
R3.	David H. Eberly, "3D Game Engine Design, Second Edition: A Practical Approach to Real-Time Computer Graphics" 2 nd Editions, Morgan Kaufmann, 2006.

Course Code: 24CSO003	Course Title: Neural Networks and Deep Learning	
Course Category: PEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks: 100

COURSE OBJECTIVES
• To understand the fundamental concepts of artificial neural networks and their applications.
• To explore different deep learning architectures and their significance in real-world problems.
• To study optimization techniques for training deep neural networks effectively.
• To analyze various deep learning frameworks and tools used for implementation.
• To apply deep learning techniques to solve problems in areas such as image processing, NLP, and speech recognition.

UNIT I	INTRODUCTION TO NEURAL NETWORKS	9
Biological vs. Artificial Neural Networks - Perceptron and Multilayer Perceptron (MLP) - Activation Functions (Sigmoid, ReLU, Tanh, Softmax) - Gradient Descent and Backpropagation Algorithm		
UNIT II	**DEEP LEARNING ARCHITECTURES**	**9**
Introduction to Deep Neural Networks (DNN) - Convolutional Neural Networks (CNN) - Architecture and Applications - Recurrent Neural Networks (RNN) - LSTMs and GRUs - Autoencoders and Generative Adversarial Networks (GANs)		
UNIT III	**OPTIMIZATION TECHNIQUES IN DEEP LEARNING**	**9**
Loss Functions and Cost Functions - Regularization Techniques (Dropout, L1/L2 Regularization) - Batch Normalization and Data Augmentation - Adam, RMSprop, and other Optimization Methods		
UNIT IV	**TOOLS AND FRAMEWORKS FOR DEEP LEARNING**	**9**
Overview of Deep Learning Frameworks (TensorFlow, PyTorch, Keras) - Model Training, Validation, and Hyperparameter Tuning - Transfer Learning and Pretrained Models (ResNet, VGG, BERT) - Deployment of Deep Learning Models		
UNIT V	**APPLICATIONS OF DEEP LEARNING**	**9**
Image Processing and Object Detection (YOLO, Faster R-CNN) - Natural Language Processing (NLP) and Speech Recognition - Reinforcement Learning and AI in Robotics - Case Studies in Healthcare, Finance, and Autonomous Systems		

	Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Explain the architecture and functioning of different types of neural networks.
CO2: Design and implement deep learning models using different architectures.
CO3: Optimize deep learning models using various training strategies.
CO4: Utilize deep learning frameworks such as TensorFlow and PyTorch for problem-solving.
CO5: Apply deep learning techniques to domains such as computer vision and natural language processing.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1												
CO2	3	3	2	2											
CO3	3	3	3	2	2										
CO4	3	3	3	3	2	2									
CO5	3	3	3	3	3	2	1								

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Ian Goodfellow, Yoshua Bengio, Aaron Courville, *Deep Learning*, MIT Press, 2016.
T2.	Simon Haykin, *Neural Networks and Learning Machines*, Pearson, 2018.
T3.	François Chollet, *Deep Learning with Python*, Manning Publications, 2021.

REFERENCE BOOK(S)	
R1.	Aurelien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, O'Reilly, 2022.
R2.	Charu C. Aggarwal, *Neural Networks and Deep Learning: A Textbook*, Springer, 2018.
R3.	Satish Kumar, *Neural Networks: A Classroom Approach*, McGraw-Hill, 2017.

Course Code: 24CSO004	Course Title: Introduction to Augmented Reality (AR) / Virtual Reality (VR)	
Course Category: PEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks: 100

COURSE OBJECTIVES
• To know the basic concepts of virtual reality.
• To understand visual computation in computer graphics.
• To understand the interaction between the system and the computer.
• To know the application of VR in Digital Entertainment.
• To know the basic concepts of augmented reality.

UNIT I	INTRODUCTION OF VIRTUAL REALITY	9
Fundamental Concept and Components of Virtual Reality - Primary Features and Present Development on Virtual Reality - Multiple Models of Input and Output Interface in Virtual Reality: Input - Tracker - Sensor - Digital Glove - Movement Capture - Video-based Input - 3D Menus & 3DScanner – Output - Visual /Auditory / Haptic Devices.		
UNIT II	**VISUAL COMPUTATION IN VIRTUAL REALITY**	**9**
Fundamentals of Computer Graphics - Software and Hardware Technology on Stereoscopic Display - Advanced Techniques in CG: Management of Large-Scale Environments & Real Time Rendering.		
UNIT III	**INTERACTIVE TECHNIQUES IN VIRTUAL REALITY**	**9**
Body Track - Hand Gesture - 3D Manus - Object Grasp. Development Tools and Frameworks in Virtual Reality: Frameworks of Software Development Tools in VR.		
UNIT IV	**APPLICATION OF VR IN DIGITAL ENTERTAINMENT**	**9**
VR Technology in Film & TV Production - VR Technology in Physical Exercises and Games - Demonstration of Digital Entertainment by VR.		
UNIT V	**AUGMENTED AND MIXED REALITY**	**9**
Taxonomy - technology and features of augmented reality - difference between AR and VR - Challenges with AR - AR systems and functionality - Augmented reality methods - visualization techniques for augmented reality - wireless displays in educational augmented reality applications - mobile projection interfaces - marker-less tracking for augmented reality		

- enhancing interactivity in AR environments - evaluating AR systems.
Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Explain the architecture and functioning of different types of neural networks.
CO2: Design and implement deep learning models using different architectures.
CO3: Optimize deep learning models using various training strategies.
CO4: Utilize deep learning frameworks such as TensorFlow and PyTorch for problem-solving.
CO5: Apply deep learning techniques to domains such as computer vision and natural language processing.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1										1		1
CO2	3	3	2	2									1		2
CO3	3	3	3	2	2								1		1
CO4	3	3	3	3	2	2							2		1
CO5	3	3	3	3	3	2	1						1		1

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Burdea, G. C., P. Coffet., "Virtual Reality Technology", Second Edition, Wiley-IEEE Press, 2003/2006.
T2.	Alan B. Craig, "Understanding Augmented Reality, Concepts and Applications", Morgan Kaufmann, 2013.

REFERENCE BOOK(S)	
R1.	Alan Craig, William Sherman, Jeffrey Will, "Developing Virtual Reality Applications, Foundations of Effective Design", Morgan Kaufmann, 2009.
R2.	Jason Jerald, "The VR Book: Human-Centered Design for Virtual Reality", ACM Books,2015
R3.	Paul Mealy, "Virtual & Augmented Reality For Dummies", For dummies, 2018

Course Code:24CSO005	Course Title: High Speed Networks	
Course Category: OEC	Credits: 3	
L:T:P(Hours/Week): 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• Understand High-Speed Network Technologies
• Analyze Congestion and Traffic Management
• Explore TCP and ATM Congestion Control Mechanisms
• Study Integrated and Differentiated Services
• Learn About QoS-Supporting Protocols

UNIT I	HIGH SPEED NETWORKS	9
Frame Relay Networks – Asynchronous transfer mode – ATM Protocol Architecture,ATM logical Connection – ATM Cell – ATM Service Categories – AAL. High Speed LAN's: Fast Ethernet – Gigabit Ethernet– Fibre Channel – Wireless LAN's, WiFi and WiMax Networks applications, requirements – Architecture of 802.11.		
UNIT II	**CONGESTION AND TRAFFIC MANAGEMENT**	**9**
Queuing Analysis – Queuing Models – Single Server Queues – Effects of Congestion – Congestion Control – Traffic Management – Congestion Control in Packet Switching Networks – Frame Relay Congestion Control.		
UNIT III	**TCP AND ATM CONGESTION CONTROL**	**9**
TCP Flow control – TCP Congestion Control – Retransmission – Timer Management – Exponential RTO backoff – KARN's Algorithm – Window management – Performance of TCP over ATM. Traffic and Congestion control in ATM – Requirements – Attributes – Traffic Management Frame work, Traffic Control – ABR traffic Management – ABR rate control, RM cell formats – ABR Capacity allocations – GFR traffic management.		
UNIT IV	**INTEGRATED AND DIFFERENTIATED SERVICES**	**9**
Integrated Services Architecture – Approach, Components, Services- Queuing Discipline – FQ – PS – BRFQ – GPS – WFQ – Random Early Detection – Differentiated Services.		
UNIT V	**PROTOCOLS FOR QOS SUPPORT**	**9**
RSVP – Goals & Characteristics, Data Flow, RSVP operations – Protocol Mechanisms– Multiprotocol Label Switching – Operations, Label Stacking – Protocol details – RTP –		

Protocol Architecture – Data Transfer Protocol– RTCP.
Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: compare and analyse the fundamental principles of various high speed communication networks and their protocol architectures
CO2: Analyse the methods adopted for performance modeling of traffic flow and estimation
CO3: Examine the congestion control issues and traffic management in TCP/IP and ATM networks
CO4: Compare, analyse and implement the various routing protocols in simulation software tools examine the various services.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2		1				1	1		1	1		1
CO2	1	2	1		1				2	1		1	1		1
CO3	1	2	2		1				2	1		1	1		2
CO4	1	2	1		1				1	2		1	1		2
CO5	1	2	2		1				1	2		1	1		1

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	William Stallings, "High speed networks and internet", Second Edition, PearsonEducation, 2002.

REFERENCE BOOK(S)	
R1.	Warland, Pravin Varaiya, "High performance communication networks", 2 nd Edition , Jean Harcourt Asia Pvt. Ltd., , 2001.
R2.	Irvan Pepelnjk, Jim Guichard, Jeff Apcar, "MPLS and VPN architecture",Cisco Press, Volume 1 and 2, 2003.
R3.	Abhijit S. Pandya, Ercan Sea, "ATM Technology for Broad Band Telecommunication Networks", CRC Press, New York, 2004.

EMPLOYABILITY ENHANCEMENT COURSES

Course Code: 24CDC101	**Course Title: Career Development Skills I**	
Course Category: EEC	**Credits: 1**	
L:T:P (Hours/Week) 1:0:0	**Total Contact Hours: 15**	**Max Marks: 100**

COURSE OBJECTIVES
• Learn about the career planning and goal setting to meet the corporate world.
• Develop motivational skills and personality development.
• Develop the methodologies for team building.

UNIT I	**CAREER PLANNING AND GOAL SETTING**	3
Career planning: Self-Assessment – Skills Development – Networking – Professional Development – Flexibility and Adaptability – Work-Life Balance – Seeking Feedback – Stay Updated **Goal Settings:** - Set SMART > Specificity – Measurability – Achievability – Relevance – Time-bound – Breakdown into Steps – Review and Adjust – Accountability – Celebrate Achievements		
UNIT II	**MOTIVATION**	**3**
Motivation I – Purpose **–** Learning mind-set – Stay Organized – Embrace Responsibility – Stay appositive – Reflect and Adapt – Peer Recognition and Support – Inspirational Guest Speakers of Role Models **Personality Effectiveness -** Self **–**Awareness **–** Emotional Intelligence – Adaptability – Conflict Resolution – Leadership Skills – Time Management – Continuous Learning – Positive Attitude **i) Building Personality –** Self-Reflection and Awareness – Assertiveness and Confidence – Relationship Building – Personal Branding **ii) Discipline –** Consistency and Persistence – Self-Control and Delayed Gratification – Accountability – Resilience – Interpersonal Skills and Collaboration – Presentation skills – Learning from Mistakes		
UNIT III	**PERSONALITY DEVELOPMENT**	**3**
i) Grooming – Dress Code Etiquette – Personal Appearance – Body Language and Posture **ii) Hygiene –** Practices & clothing care **iii) Cleanliness –** Workspace maintenance – Environmental Awareness & Digital hygiene Overall preparation – Role of confidence & Cultural Sensitivity		

UNIT IV	PRESENTATION AND PUBLIC SPEAKING SKILLS	3

Presentation Speaking Skills – Know the audience – Clear objective – Content structure – Postures and Gestures – Voice projection – Eye contact – appropriate language – Speech Clarity – Visual aids interaction

Public Speaking skills – Research – audience pulse – Pace and Pause – Expertise – Authenticity – Adaptability to unexpected situations

SWOT Analysis – Enhanced Self-awareness **–** Benchmarking with Strength, Weakness, Challenges and Opportunities – Risk management – Versatility – Decision making

UNIT V	TEAM BUILDING	3

Team building – Openness **–** Cooperation **–** Building trust – Respect – Diversity and Inclusion – Cohesion – Prioritisation – Learning team culture – Celebrate success

Activity Sessions- i) Debate – Critical thinking – Confidence building – Persuasive techniques – Ethical reasoning – Empathy

ii) Picture connector – Imagination and Innovation – Analysis **–** Societal awareness **–** Expression **–** Cognitive development – Playful exploration

Total : 15 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Learn about the career planning and goal setting to meet the corporate world.
CO2: Develop motivational skills and personality development.
CO3: Develop the methodologies for team building

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1								3			
CO2								2	2	3		2			
CO3	1	1	1					1	2	2					

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Dr.R.S.Aggarwal, "A Modern Approach to Verbal and Non-verbal Reasoning", S Chand Publishing, 2023.
T2.	Arun Sharma and Meenakshi Upadhyay, "Verbal Ability and Reading comprehension", Tata McGraw Hill Education, 2014.

T3.	Sanjay Kumar and Pushp Lata, “Communication skills”, Oxford Higher Education, 2011.

REFERENCE BOOK(S)	
R1.	Arun Sharma, “Logical Reasoning for CAT”, Tata McGraw Hill Education, 2024.
R2.	Peeyush Bhardwaj, “The Hand on Guide to Analytical and Logical Reasoning”, Arihant Publication, 2023.
R3.	Nira Konar, “Communication Skills for Professionals”, PHI learning Pvt. Ltd, 2011.

Course Code: 24CDC102	Course Title: Career Development Skills II	
Course Category: EEC	Credits: 1	
L:T:P (Hours/Week) 1:0:0	Total Contact Hours: 15	Max Marks: 100

COURSE OBJECTIVES
• Develop interpersonal skills.
• Develop Listening and Speaking skills.
• Make interferences and predictions about spoken discourse that enhance RW skills.

UNIT I	MOTIVATION AND INTERPERSONAL SKILLS	3

Motivation II – Offer personalised guidance and support – Engage active learning methods – Create a supportive environment personally – Highlight success stories – Celebrate progress – Follow ups.

Interpersonal Skills – Verbal, Non-verbal and Listening skills – Analysing problems – Contributing ideas – Positive relationships – Mutual respect – Negotiation.

UNIT II	LISTENING AND CONVERSATION SKILLS	3

Listening skills – Focus and attention – Non-verbal cues – Paraphrasing – Understanding emotions – Reflecting feelings – Allowing pause – Avoiding interruption – Respond appropriately – Clarifying and Confirming – Maintaining open-mindedness

Conversation skills – Opening lines – Ice-breakers – Sharing and expressing ideas – Clarity and relevance – Smooth translations – Articulate thoughts - Avoid judgement – Polite language – Express appreciation – Open to feedback

UNIT III	TYPES OF SKILLS	3

Reading skills – Speed and Accuracy – Understanding main ideas – Skimming and Scanning – Word recognition – Expanding vocabulary – Analysing text – Making connections – Evaluate and Synthesise – Academic / Professional/ Personal reading

Writing skills – Clear communication – Logical organization – Grammar and Mechanics – Avoiding redundancy – Choosing strong words – Tone and Style – Concluding structure – Editing and Revision – Originality – Academic/ Professional/ Personal writing

Attitudes – Positive Attitudes - Preparedness – Adaptability – Professionalism – Resilience – Listening skills – Teamwork and Collaboration – Curiosity and Learning orientation – Gratitude and Humility

Manners & Behaviour – Politeness and Courtesy – Confidence without arrogance – Respect for personal space and boundaries – Flexibility and Conflict Resolution skills

UNIT IV	TIME AND STRESS MANAGEMENT	3

i)Self-awareness – Understanding Strengths and Weaknesses – Personal values – Emotional intelligence – Self-Reflection and Learning Style

ii)Self-confidence – building a Positive Self – Image – Overcoming fear of failure – Assertiveness

Time management – Setting Priorities – Planning and Scheduling – Time Estimation and Budgeting – Minimizing Procrastination – Effective decision making

Stress management – Stressors Identification - Relaxation techniques – Mindfulness-Physical Activity – Positive thinking - Healthy lifestyle – Sound sleep – Hobbies and leisure activities – Humour and laughter – Say 'no' to unwanted

Emotional intelligence – Self-regulation – empathy – Societal bearing – Understanding causes and consequences of emotions

UNIT V	HIGHER EDUCATION AND ENTREPRENEURSHIP	3

i) Introduction to Higher Education – Specialization – Research opportunities – Career advancement – Employability –

ii) Competitive exams – Merit recognition – Validation of academic abilities – Global recognition (GRE, GMAT, SAT) – Competitive edge – Global career opportunities – Excel, Grow and Achieve professionally

Introduction to Entrepreneurship – Independence and autonomy – Opportunity to pursue passion – Innovation and creativity – Creating jobs – Sharing and Mutual growth via collaborations and partnerships.

Total : 15 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Develop strong interpersonal skills.
CO2: Develop strong listening and speaking skills.
CO3: Make predictions about spoken discourse that enhance RW skills

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1								3			
CO2								2	2	3		2			
CO3	1	1	1			1		1	2	2		1			

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Dr.R.S.Aggarwal, "A Modern Approach to Verbal and Non-verbal Reasoning", S Chand Publishing, 2023.
T2.	Arun Sharma and Meenakshi Upadhyay, "Verbal Ability and Reading comprehension", Tata McGraw Hill Education, 2014.
T3.	Sanjay Kumar and Pushp Lata, "Communication skills", Oxford Higher Education, 2011.

REFERENCE BOOK(S)	
R1.	Arun Sharma, "Logical Reasoning for CAT", Tata McGraw Hill Education, 2024.
R2.	Peeyush Bhardwaj, "The Hand on Guide to Analytical and Logical Reasoning", Arihant Publication, 2023.
R3.	Nira Konar, "Communication Skills for Professionals", PHI learning Pvt. Ltd, 2011.

Course Code: 24CDC201	Course Title: Career Development Skills III	
Course Category: EEC	Credits: 1	
L:T:P (Hours/Week) 1:0:0	Total Contact Hours: 15	Max Marks: 100

COURSE OBJECTIVES
• To enhance numerical, analytical, and logical reasoning skills.
• To develop professional workplace etiquette and effective email communication skills.

UNIT I	QUANTITATIVE APTITUDE AND REASONING	12
Quantitative Aptitude – Number System – HCF and LCM – Average – AP&GP – Logarithm. Data Interpretation and Logical Reasoning Skills – Tabulations – Logical Sequence – Puzzle Test. Verbal and Non-Verbal Reasoning – Logical Sequence of Words – Truth Verification – Analogy – Figure Matrix. Verbal Ability – Grammar Concepts – Antonyms and Synonyms – Reading Comprehension.		
UNIT II	**BUSINESS ETIQUETTE**	**3**
Workplace Etiquette – Punctuality and Time Management – Professional Attire and Grooming – Respectful Communication – Workspace Cleanliness and Organization – Ethical Behaviour and Integrity. E-Mail Etiquette – Importance of Professional Email Communication – Crafting an Effective Subject Line – Maintaining a Polite and Respectful Tone – Respond with Proper Salutations and Closings – Responding Promptly to Emails – Avoid Excessive Formatting or Emojis – Proper Use of Reply All and Forward Functions – Handling Sensitive or Confidential Information. Activities – Role Play, Presentation, Case Study, Mock Team Meeting, Discussion, Responding to Email.		
		Total: 15 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Develop strong analytical, reasoning, and verbal skills across quantitative aptitude, data interpretation, logical reasoning, and verbal ability.
CO2: Apply professional workplace etiquette and exhibit proficiency in crafting clear, respectful, and effective email communication.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1								3			
CO2								2	2	3		2			

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Dr.R.S.Aggarwal, "A Modern Approach to Verbal and Non-verbal Reasoning", S Chand Publishing, 2023.
T2.	Arun Sharma and Meenakshi Upadhyay, "Verbal Ability and Reading comprehension", Tata McGraw Hill Education, 2014.
T3.	Sanjay Kumar and Pushp Lata, "Communication skills", Oxford Higher Education, 2011.

REFERENCE BOOK(S)	
R1.	Arun Sharma, "Logical Reasoning for CAT", Tata McGraw Hill Education, 2024.
R2.	Peeyush Bhardwaj, "The Hand on Guide to Analytical and Logical Reasoning", Arihant Publication, 2023.
R3.	Nira Konar, "Communication Skills for Professionals", PHI learning Pvt. Ltd, 2011.

Course Code: 24CDC202	Course Title: Career Development Skills IV	
Course Category: EEC	Credits: 1	
L:T:P (Hours/Week) 1:0:0	Total Contact Hours: 15	Max Marks: 100

COURSE OBJECTIVES
• To strengthen numerical, analytical, and logical reasoning abilities.
• To improve business communication abilities.

UNIT I	QUANTITATIVE APTITUDE AND REASONING	12
Quantitative Aptitude – Percentage – Profit and Loss – Ratio and Proportion – Pipes and Cistern – Time and Work. Data Interpretation and Logical Reasoning Skills – Bar Graphs – Coding and Decoding – Venn Diagram. Verbal and Non-Verbal Reasoning – Critical Reasoning – Types of Reasoning – Cube and Dice – Pattern Completion. Verbal Ability – Grammar Concepts – Enhancing Vocabulary – One Word Substitution.		
UNIT II	**BUSINESS COMMUNICATION SKILLS**	**3**
Business Communication – Effective Listening Skills – Summarizing and Paraphrasing – Presentation, Planning and Delivery. Sales and Negotiations – Understanding Customers' Needs, Building Rapport and Trust – Negotiation Techniques and Closing the Deal – Continuous Improvement and Professional Development. Customer Service – Importance and Key Elements of Effective Customer Service – Empowering Frontline Employees and Leveraging Technology – Measuring and Improving Customer Satisfaction. Activities – Paraphrasing, Self-Introduction, Presentation, Role Play, Group Discussion.		
Total: 15 Hours		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Solve problems using numerical, analytical, and logical reasoning skills.
CO2: Utilize communication techniques for effective business interactions for improving professional efficiency.

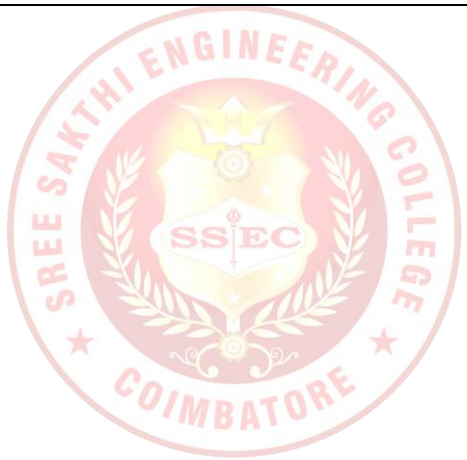
COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1								3			
CO2								2	2	3		2			

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Dr.R.S.Aggarwal, “A Modern Approach to Verbal and Non-verbal Reasoning”, S Chand Publishing, 2023.
T2.	Arun Sharma and Meenakshi Upadhyay, “Verbal Ability and Reading comprehension”, Tata McGraw Hill Education, 2014.
T3.	Sanjay Kumar and Pushp Lata, “Communication skills”, Oxford Higher Education, 2011.

REFERENCE BOOK(S)	
R1.	Arun Sharma, “Logical Reasoning for CAT”, Tata McGraw Hill Education, 2024.
R2.	Peeyush Bhardwaj, “The Hand on Guide to Analytical and Logical Reasoning”, Arihant Publication, 2023.
R3.	Nira Konar, “Communication Skills for Professionals”, PHI learning Pvt. Ltd, 2011.



lklab exercises.

Course Code: 24CDC301	Course Title: Career Development Skills V	
Course Category: EEC	Credits: 1	
L:T:P (Hours/Week) 1:0:0	Total Contact Hours: 15	Max Marks: 100

COURSE OBJECTIVES
• To extend logical reasoning, analytical, and numerical skills.
• To learn how to create effective resumes and job applications.

UNIT I	QUANTITATIVE APTITUDE AND REASONING	12
Quantitative Aptitude – Time and Distance – Boats and Streams – Mixture – Simple Interest – Compound Interest. Data Interpretation and Logical Reasoning Skills – Pie Chart – Blood Relation – Direction Sense. Verbal and Non-Verbal Reasoning – Verbal Analogy –Syllogism – Series – Counting of Figures. Verbal Ability – Word Roots, Affixes and Foreign Words – Idioms and Phrases – Spotting Common Errors.		
UNIT II	**EMPLOYABILITY SKILLS**	**3**
Resume Building – Basic Facts – Resume Types – Sections of Resume – Resume Format – Ordinary Resume "Do's and Don'ts" – Electronic Resume Formats – Using Resume Keywords – Online Resume Banks. Job Application Basic Formats – Personal Information – Work History – Education – Skills and Qualifications – Achievements and Awards – References – Examples. Activities – Developing Corporate Resume, Drafting Job Application, Rendering Presentation, Discussion.		
		Total: 15 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Use the logical reasoning, analytical thinking, and numerical skills to find answers for complex problems.
CO2:Apply appropriate formats, sections and keywords to effectively present their qualifications while preparing resume and job application.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1								3			
CO2								2	2	3		2			

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Dr.R.S.Aggarwal, "A Modern Approach to Verbal and Non-verbal Reasoning", S Chand Publishing, 2023.
T2.	Arun Sharma and Meenakshi Upadhyay, "Verbal Ability and Reading comprehension", Tata McGraw Hill Education, 2014.
T3.	Sanjay Kumar and Pushp Lata, "Communication skills", Oxford Higher Education, 2011.

REFERENCE BOOK(S)	
R1.	Arun Sharma, "Logical Reasoning for CAT", Tata McGraw Hill Education, 2024.
R2.	Peeyush Bhardwaj, "The Hand on Guide to Analytical and Logical Reasoning", Arihant Publication, 2023.
R3.	Nira Konar, "Communication Skills for Professionals", PHI learning Pvt. Ltd, 2011.

Course Code: 24CDC302	Course Title: Career Development Skills VI	
Course Category: EEC	Credits: 1	
L:T:P (Hours/Week) 1:0:0	Total Contact Hours: 15	Max Marks: 100

COURSE OBJECTIVES
• To broaden logical reasoning, analytical and numerical skills.
• To equip students with essential leadership traits.

UNIT I	QUANTITATIVE APTITUDE AND REASONING	12
Quantitative Aptitude – Area – Calendar – Clocks – Permutation &Combination – Probability. Data Interpretation and Logical Reasoning Skills – Line Graph-Data Sufficiency – Seating Arrangement. Verbal and Non-Verbal Reasoning – Cause and Effect – Cloze Test – Mirror and Water Images – Mathematical Operator. Verbal Ability – Sentence Formation, Completion, Correction and Improvement – Change of Voice and Speech – Jumbled Sentences and Paragraph Formation.		
UNIT II	**LEADERSHIP ETIQUETTE**	**3**
Leadership – Characteristics and Styles – Developing Leadership Skills – Communication and Interpersonal Skills – Motivating and Inspiring Teams – Ethical Leadership – Decision Making – Problem Solving. Behavioural Skills (Using Star Method – Situation, Task, Action and Result) – Introduction – Defining the Context – Identifying the Objectives – Describing the Steps to be Taken – Highlighting the Outcome – Developing Behavioral Skills – STAR Method in Interviews and Benefits. Specific Technical Knowledge – Specialized Skills – Foundational Concepts and Principles – Practical Applications – Industry-Specific Regulations and Standards – Emerging Trends and Innovations – Continuous Learning and Professional Development – Troubleshooting and Problem – Solving Techniques – Collaboration and Knowledge Sharing. Activities – Role Play, Presentation, Case Study, Group Discussion.		
Total: 15 Hours		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Utilize logical reasoning, analytical thinking, and numerical skills to solve complex problems.
CO2: Demonstrate key leadership traits to effectively lead teams.

COURSE ARTICULATION MATRIX															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	1								3			
CO2								2	2	3		2			

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Dr.R.S.Aggarwal, "A Modern Approach to Verbal and Non-verbal Reasoning", S Chand Publishing, 2023.
T2.	Arun Sharma and Meenakshi Upadhyay, "Verbal Ability and Reading comprehension", Tata McGraw Hill Education, 2014.
T3.	Sanjay Kumar and Pushp Lata, "Communication skills", Oxford Higher Education, 2011.

REFERENCE BOOK(S)	
R1.	Arun Sharma, "Logical Reasoning for CAT", Tata McGraw Hill Education, 2024.
R2.	Peeyush Bhardwaj, "The Hand on Guide to Analytical and Logical Reasoning", Arihant Publication, 2023.
R3.	Nira Konar, "Communication Skills for Professionals", PHI learning Pvt. Ltd, 2011.

Course Code: 24CDC401	Course Title: Career Development Skills VII	
Course Category: EEC	Credits: 1	
L:T:P (Hours/Week) 2:0:0	Total Contact Hours: 30	Max Marks: 100

COURSE OBJECTIVES
• To build skills to prepare for interviews, focusing on professionalism, clear communication, and making a positive impression.
• To enhance students ability for effective communication and professional success.

UNIT I	INTERVIEW SKILLS	15

Preparing for the Interview – Company and Role – Common Interview Questions – Skills and Experience – Maintain Positive Mind-Set. Before the Interview – Practice Critical Interview Questions – Genuine Questions to Ask the Interviewer – Reviewing Resume – Dress code – Early Arrival – Keep Enough Copies of Resume. During the Interview – Professional Look – Greeting the Interviewer – Answering Questions Confidently. The Interviewee's Behavior – Importance – Creating Good Impression – Body Language – Eye Contact – Tone – Voice – Confidence and Composure – Enthusiasm and Engagement – Responding to Questions. Taking Questions-Types of Questions Expected – Strategies for Answering Questions – Avoiding Pitfalls While Answering-Turning Questions into Opportunities – Maintaining Emotional Control – Leaving a Positive Impression. Tackling Questions – Answering to Behavioural Questions – Responding to Technical Questions – Handling Situational and Hypothetical Questions – Handling Weaknesses and Challenges. Questioning the Interviewer – Demonstrating Interest and Engagement – Showcasing Talents, Knowledge and Research Expertise – Exploring the Company Culture and Values – Inquiring about Growth Opportunities – Addressing Concerns or Challenges – Closing the Interview on a Strong Positive Note. Farewell and Follow-Up – Expressing gratitude – Offering Resources and Support – Importance of Staying in Touch – Contact Information – Inviting Feedback and Follow-Up – Closing Wishes.

UNIT II	GROUP DISCUSSION AND MOCK INTERVIEW	15

Group Discussion – Introduction & Importance – Effective Communication in Group Discussion – Roles and Responsibilities – Strategies for Active Participation - Overcoming Challenges in Group Discussion – Evaluating the Process – Conclusion and Key Takeaways. Body Language, Voice Modulation – Importance & Techniques for Effective Voice

Modulation – Pitch Variation – Tone and Inflection – Volume Control – Pace and Pause – Practical Applications of Voice Modulation. Content and Creativity – Importance of Engaging Content – Leveraging Creativity to Stand Out – Crafting Compelling Narratives – Optimizing for Different Platforms – Measuring and Analyzing Content Performance – Staying Ahead of Trends and Innovations. Basic Mock Interview Sessions – Introduction – Purpose and Benefits – Interview Preparation – Common Interview Questions – Behavioral Interview Techniques –Technical Interview Strategies – Mock Interview Feedback and Reflection – Steps and Resources. Activities – Group Discussion, Role Play, Presentation, Mock Interview.
Total: 30 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Show professionalism, apply clear communication strategies, and effectively present themselves during interviews to make a positive impression.
CO2: Apply effective communication strategies and professional behavior to enhance their success in various workplace scenarios.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								3	2	3		2			
CO2								3	2	3		2			

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Marry Stella, “Facing Job Interviews”, Lotus Press, New Delhi, 2007.
T2.	Uco Jillert Wiersma, “Interview Charisma”, Career Knows Publishing, Norwalk, Connecticut, 2016.
T3.	Theodore Kingsley, “Interviewing Skills 3 in 1”, Indy Pub, 2023.

REFERENCE BOOK(S)	
R1.	Stephen R Covey, “Seven Habits of Highly Effective People”, G.K Hall, 1997.
R2.	Sanjay Kumar and Pushp Lata, “Communication skills”, Oxford Higher Education, 2011.
R3.	Nira Konar, “Communication Skills for Professionals”, PHI learning Pvt. Ltd, 2011.

Course Code : 24CDC221	Course Title : Mini Project I	
Course Category : EEC	Credits : 1	
L:T:P(Hours/Week) : 0:0:2	Total Contact Hours : 30	Max Marks : 100

COURSE OBJECTIVES
• To enhance students' analytical skills for better problem understanding and evaluation.
• To foster a passion for problem-solving through engaging and challenging tasks.
• To develop students' ability to apply engineering concepts in real-world scenarios effectively.

COURSE OUTCOMES
At the end of this course, students will be able to:
CO 1: Formulate a real-world problem, identify the requirements, and design solutions.
CO 2: Identify technical ideas, strategies, and methodologies.
CO 3: Utilize new tools, algorithms, and techniques to contribute to the solution.
CO 4: Test and validate the prototype for cost-effectiveness.
CO 5: Prepare a report and deliver oral demonstrations.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	1	2	-	-	2	2	2	-	-			
CO2	1	2	1	1	2	-	-	2	2	2	-	-			
CO3	1	2	1	1	2	-	-	2	2	2	2	-			
CO4	1	2	1	1	2	-	-	2	2	2	2	-			
CO5	1	2	-	-	2	-	-	2	2	2	-	-			

Course Code :24CDC222	Course Title: Mini Project II	
Course Category: EEC	Credits:1	
L:T:P(Hours/Week) : 0:0:2	Total Contact Hours:30	Max Marks:100

COURSE OBJECTIVES
• To enhance students' analytical skills for better problem understanding and evaluation.
• To foster a passion for problem-solving through engaging and challenging tasks.
• To develop students' ability to apply engineering concepts in real-world scenarios effectively.

COURSE OUTCOMES
At the end of this course, students will be able to:
CO 1: Formulate a real-world problem, identify the requirements, and design solutions.
CO 2: Identify technical ideas, strategies, and methodologies.
CO 3: Utilize new tools, algorithms, and techniques to contribute to the solution.
CO 4: Test and validate the prototype for cost-effectiveness.
CO 5: Prepare a report and deliver oral demonstrations.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	1	2	-	-	2	2	2	-	-			
CO2	1	2	1	1	2	-	-	2	2	2	-	-			
CO3	1	2	1	1	2	-	-	2	2	2	2	-			
CO4	1	2	1	1	2	-	-	2	2	2	2	-			
CO5	1	2	-	-	2	-	-	2	2	2	-	-			

Course Code :24CDC321	Course Title: Mini Project III	
Course Category: EEC	Credits:1	
L:T:P(Hours/Week) : 0:0:2	Total Contact Hours:30	Max Marks:100

COURSE OBJECTIVES
• To enhance students' analytical skills for better problem understanding and evaluation.
• To foster a passion for problem-solving through engaging and challenging tasks.
• To develop students' ability to apply engineering concepts in real-world scenarios effectively.

COURSE OUTCOMES
At the end of this course, students will be able to:
CO 1: Formulate a real-world problem, identify the requirements, and design solutions.
CO 2: Identify technical ideas, strategies, and methodologies.
CO 3: Utilize new tools, algorithms, and techniques to contribute to the solution.
CO 4: Test and validate the prototype for cost-effectiveness.
CO 5: Prepare a report and deliver oral demonstrations.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	1	2	-	-	2	2	2	-	-			
CO2	1	2	1	1	2	-	-	2	2	2	-	-			
CO3	1	2	1	1	2	-	-	2	2	2	2	-			
CO4	1	2	1	1	2	-	-	2	2	2	2	-			
CO5	1	2	-	-	2	-	-	2	2	2	-	-			

Course Code :24CDC322	Course Title: Mini Project IV	
Course Category: EEC	Credits:1	
L:T:P(Hours/Week) : 0:0:2	Total Contact Hours:30	Max Marks:100

COURSE OBJECTIVES
• To enhance students' analytical skills for better problem understanding and evaluation.
• To foster a passion for problem-solving through engaging and challenging tasks.
• To develop students' ability to apply engineering concepts in real-world scenarios effectively.

COURSE OUTCOMES
At the end of this course, students will be able to:
CO 1: Formulate a real-world problem, identify the requirements, and design solutions.
CO 2: Identify technical ideas, strategies, and methodologies.
CO 3: Utilize new tools, algorithms, and techniques to contribute to the solution.
CO 4: Test and validate the prototype for cost-effectiveness.
CO 5: Prepare a report and deliver oral demonstrations.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	1	2	-	-	2	2	2	-	-			
CO2	1	2	1	1	2	-	-	2	2	2	-	-			
CO3	1	2	1	1	2	-	-	2	2	2	2	-			
CO4	1	2	1	1	2	-	-	2	2	2	2	-			
CO5	1	2	-	-	2	-	-	2	2	2	-	-			

Course Code : 24CDC422	Course Title : Project Work Phase I	
Course Category : EEC	Credits : 2	
L:T:P(Hours/Week) : 0:0:4	Total Contact Hours :60	Max Marks :100

COURSE OBJECTIVES
• To enable students to apply learned technologies in the design, analysis, and simulation of physical systems.
• To help students integrate various systems into a cohesive and functional product.
• To develop students' ability to work effectively in teams and manage time constraints.
• To improve students' skills in presenting and documenting technical work clearly in both oral and written formats.

COURSE OUTCOMES
At the end of this course, students will be able to:
CO 1: Design, analyze, realize/simulate a physical system by using the technology they learned during the program.
CO 2: Integrate various systems into a single product.
CO 3: Work in a team with confined time duration.
CO 4: Disseminate their work both in oral and written format.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	2	2	-	-	-	3			
CO2	3	3	3	3	3	2	2	2	-	-	-	3			
CO3	-	-	-	-	-	-	-	-	3	-	-	-			
CO4	-	-	-	-	-	-	-	-	-	3	3	-			

COURSE ASSESSMENT METHODS:

Direct	Indirect
1. Interdisciplinary work 2. Innovation 3. Working model/ simulation result 4. Report with good referencing	1.Course end survey

5. End Semester Viva Voce	
Students are required to work in groups of up to 4 members to complete their main project. Special exceptions may be granted for interdisciplinary projects and computer-based simulations, with prior approval from the department committee. Management-related projects will not be permitted. Interdisciplinary projects will be given higher weightage.	

Course Code : 24CDC423	Course Title : Project Work Phase II	
Course Category : EEC	Credits : 2	
L:T:P(Hours/Week) : 0:0:4	Total Contact Hours :60	Max Marks : 100

COURSE OBJECTIVES
• To enable students to apply learned technologies in the design, analysis, and simulation of physical systems.
• To help students integrate various systems into a cohesive and functional product.
• To develop students' ability to work effectively in teams and manage time constraints.
• To improve students' skills in presenting and documenting technical work clearly in both oral and written formats.

COURSE OUTCOMES
At the end of this course, students will be able to:
CO 1: Design, analyze, realize/simulate a physical system by using the technology they learned during the program.
CO 2: Integrate various systems into a single product.
CO 3: Work in a team with confined time duration.
CO 4: Disseminate their work both in oral and written format.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	2	2	-	-	-	3			
CO2	3	3	3	3	3	2	2	2	-	-	-	3			
CO3	-	-	-	-	-	-	-	-	3	-	-	-			
CO4	-	-	-	-	-	-	-	-	-	3	3	-			
Max															

COURSE ASSESSMENT METHODS:

Direct	Indirect
1. Interdisciplinary work 2. Innovation 3. Working model/ simulation result 4. Report with good referencing 5. End Semester Viva Voce	1.Course end survey

Students are required to work in groups of up to 4 members to complete their main project. Special exceptions may be granted for interdisciplinary projects and computer-based simulations, with prior approval from the department committee. Management-related projects will not be permitted. Interdisciplinary projects will be given higher weightage.

Course Code: 24MAC221	Course Title: Summer Internship I	
Course Category: MC	Credits: 0	
L:T:P (Hours/Week):0:0:0	Total Contact Hours: 2weeks	Max Marks: 100

COURSE OBJECTIVES
• To enable students to apply theoretical knowledge to real-world engineering challenges.
• To expose students to industry-standard tools, technologies, and practices.
• To enhance professional skills such as teamwork, communication, and time management in a workplace environment

COURSE OUTCOMES
At the end of this course, students will be able to:
CO 1: Apply engineering principles to design and solve real-world problems using acquired knowledge.
CO 2: Analyze industry processes and technologies to evaluate their effectiveness in solving engineering challenges.
CO 3: Evaluate the performance of engineering systems and propose enhancements based on hands-on experience.
CO 4: Design and implement innovative solutions in collaborative projects, demonstrating leadership and teamwork.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	1	1	2	1	2	1			
CO2	3	3	2	3	2	2	2	1	2	2	2	2			
CO3	3	2	3	3	2	2	2	2	2	2	2	2			
CO4	3	2	3	2	3	2	3	1	3	3	3	2			

Course Code: 24MAC321	Course Title: Summer Internship II	
Course Category: MC	Credits: 0	
L:T:P (Hours/Week):0:0:0	Total Contact Hours: 2 Weeks	Max Marks: 100

COURSE OBJECTIVES
• To enable students to apply theoretical knowledge to real-world engineering challenges.
• To expose students to industry-standard tools, technologies, and practices.
• To enhance professional skills such as teamwork, communication, and time management in a workplace environment

COURSE OUTCOMES
At the end of this course, students will be able to:
CO 1: Apply engineering principles to design and solve real-world problems using acquired knowledge.
CO 2: Analyze industry processes and technologies to evaluate their effectiveness in solving engineering challenges.
CO 3: Evaluate the performance of engineering systems and propose enhancements based on hands-on experience.
CO 4: Design and implement innovative solutions in collaborative projects, demonstrating leadership and teamwork.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	1	1	2	1	2	1			
CO2	3	3	2	3	2	2	2	1	2	2	2	2			
CO3	3	2	3	3	2	2	2	2	2	2	2	2			
CO4	3	2	3	2	3	2	3	1	3	3	3	2			