TECHNO INDIA UNIVERSITY

WEST BENGAL

M.Tech in Electronics & Communication Engineering

Syllabus

2024-25

THIRD SEMESTER

Program: M. Tech. in ECE	**Year, Semester:** 2nd Yr., 1st Sem.
Course Title: Remote Sensing	**Subject Code:**TIU-PEC-E201
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

1. To understand the physics of remote sensing, including the electromagnetic spectrum, atmospheric effects such as scattering and absorption, and the interaction of energy with surface features like vegetation, soil, and water.
2.To explore data acquisition platforms, including various types of aircraft, manned and unmanned spacecraft, and satellites (e.g., LANDSAT, SPOT, IRS, INSAT, IKONOS, QUICKBIRD), and their characteristics.
3.To gain knowledge of photographic products, opto-mechanical and electro-optical sensors, multispectral and thermal scanners, and geometric characteristics of scanner imagery.

COURSE OUTCOME:

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

CO-1:	Understand various network types, design issues, protocols, and architectures, including real-time application protocols and services like integrated services and RSVP.	K2
CO-2:	Explore the architecture and protocols of VoIP systems, focusing on voice media transport, signaling protocols, and PSTN gateways.	K2
CO-3:	Examine VPN architectures, tunneling, security mechanisms, and MPLS operations, including routing, traffic engineering, and MPLS-based VPNs.	K4
CO-4:	Analyze traffic modeling techniques such as Poisson and non-Poisson models and evaluate network performance using these models.	K4
CO-5:	Apply principles of cryptography, authentication, and security mechanisms across multiple network layers to prevent attacks and ensure integrity.	K3
CO-6:	Understand the infrastructure for network management, focusing on the internet standard management framework (SMI, MIB, SNMP) and network security administration.	K2

COURSE CONTENT:

MODULE 1:	**Physics of Remote Sensing**	**14 Hours**
Understanding the electromagnetic spectrum, atmospheric effects (scattering, absorption), spectral reflectance of surface features, and remote sensing using multi-concept techniques.		
MODULE 2:	**Remote Sensing Platforms and Data Acquisition**	**14 Hours**
Overview of different platforms, including manned/unmanned aircraft, satellites (LANDSAT, SPOT, IRS, INSAT), and sensor systems for data acquisition.		
MODULE 3:	**Thermal and Hyperspectral Remote Sensing**	**12 Hours**
Principles of spectroscopy, imaging, thermal sensors, data processing techniques, and applications of thermal and hyperspectral remote sensing.		
TOTAL LECTURES		**40 Hours****

Books:

1. Lillesand T.M., and Kiefer, R.W. Remote Sensing and Image interpretation, John Wiley & Sons-2000, 6th Edition
2. John R. Jensen, Introductory Digital Image Processing: A Remote Sensing Perspective, 2nd Edition, 1995
. 3. John A.Richards, Springer –Verlag, Remote Sensing Digital Image Analysis,1999.
4. Paul Curran P.J. Principles of Remote Sensing, ELBS; 1995.
5. Charles Elachi and Jakob J. van Zyl , Introduction To The Physics and Techniques of Remote Sensing , Wiley Series in Remote Sensing and Image Processing, 2006.
6. Sabins, F.F.Jr, Remote Sensing Principles and Image interpretation, W. H. Freeman& Co, 1978 7. Woodhouse, I. Introduction to Microwave Remote Sensing, Speckled Press, 2015.

Program: B. Tech. in ECE	**Year, Semester:** 2nd Yr., 3rd Sem.
Course Title: Sensors and Conditioning circuits	**Subject Code:**TIU-OE-UECE-T32xxx
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

1. Understand the principles of State Space.
2. Analyze the concept of Time Domain & Frequency Domain.

COURSE OUTCOME:

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

CO-1:	Learn about elements of measurement system, transfer function, frequency response of different order system	K4
CO-2:	Understand the working principles, application of various sensors	K4
CO-3:	Understand the working principles, application of various actuators	K4
CO-4:	Learn about the materials and technologies used in fabrication of sensors and transducers	K4
CO-5:	Understand the principles and importance of sensor data conditioning circuits for accurate data acquisition and noise reduction	K4
CO-6	Develop problem-solving skills for real-world applications involving sensors and conditioning circuits	K4

COURSE CONTENT:

MODULE 1:	Elements of a general measurement system	**10 Hours**
Static Characteristics: systematic characteristics, statistical characteristics, calibration; Dynamic characteristics of measurement systems: transfer functions of typical sensing elements, step and frequency response of first and second order elements, and dynamic error in measurement systems		
MODULE 2:	Sensing elements	**12 Hours**
Resistive sensing elements: potentiometers, Resistance Temperature Detector (RTD), thermistors, strain gages. Capacitive sensing elements: variable separation, area and dielectric; Inductive sensing elements: variable reluctance and LVDT displacement sensors. Thermo-electric sensing elements: laws, thermocouple characteristics, installation problems, cold junction compensation. IC temperature sensor Elastic sensing elements: Bourdon tube, bellows, and diaphragms for pressure sensing, force and torque measurement, Advanced Sensor Technologies: MEMS (Micro-Electro-Mechanical Systems) sensors, Nanotechnology in sensors, Smart sensors, Wireless sensor network.		
MODULE 3:	Actuators	**8 Hours**
DC motors, Stepper motors, Servo motors - working principles and applications, Hydraulic Actuators: Principles of hydraulic power, Hydraulic cylinders and motors, Hydraulic control systems, Pneumatic Actuators : Principles of pneumatic power, Pneumatic cylinders and motors, Pneumatic control systems, Piezoelectric Actuators: Piezoelectric effect and materials, Design and operation of piezoelectric actuators, Shape Memory Alloys (SMA) and Magnetostrictive Actuators, Principles of shape memory alloys, Design and applications of SMA actuators, Advanced Actuator Technologies : Micro-electro-mechanical Systems (MEMS)actuators, Nanotechnology in actuators, Smart actuators and integrated systems, Actuators in robotics and automation		
MODULE 4:	Signal Conditioning Elements	**12 Hours**

Deflection bridges: design of resistive and reactive bridges, push-pull configuration for improvement of linearity and sensitivity, Amplifiers: Operational amplifiers-ideal and non-ideal performances, inverting, non-inverting and differential amplifiers, instrumentation amplifier, filters. A.C. carrier systems, phase sensitive demodulators and its applications in instrumentation. ADC types: Successive approximation, delta-sigma, flash, Design considerations for ADC circuits, and Digital-to-Analog Converters (DACs). Noise Reduction Techniques: Sources of noise in sensor data, Shielding and grounding methods, Signal averaging and filtering, Adaptive filtering		
MODULE 5:	Linearization Techniques	**8 Hours**
Non-linearity in sensor data, Linearization methods: hardware and software approaches, Lookup tables and polynomial approximation, Temperature Compensation Techniques : Temperature effects on sensors, Methods for temperature compensation, Implementation of temperature compensation circuits, Data Fusion and Integration : Basics of data fusion, Methods for integrating data from multiple sensors, Applications of data fusion in sensor networks Basics of data acquisition systems, Interfacing sensors with microcontrollers and digital systems, Software tools for data acquisition and analysis.		
MODULE 6:	Sensor applications in automotive systems	**10 Hours**
environmental monitoring systems, Industrial automation, medical instrumentation, smart home technologies, Internet of Things (IoT) applications		
TOTAL LECTURES		**60 Hours**

Books:

1. Principles of Measurement Systems, J.P. Bentley, Pearson Education.
2. Introduction to Measurement and Instrumentation, A.K. Ghosh , PHI Learning.
3. Transducers and Instrumentation, D.V.S. Murthy, PHI Learning.
4. “Introduction to Sensors”, by John Vetelino and Aravind Reghu
5. “Actuators: Basics and Applications” by Hartmut Janocha
6. “Sensors and Signal Conditioning”, by Ramón Pallás-Areny and John G. Webster
7. “Measurement Systems: Application and Design”, by Ernest O. Doebelin and Dhanesh N. Manik
8. “Introduction to Instrumentation and Measurements”. by Robert B. Northrop
9. “Operational Amplifiers and Linear Integrated Circuits” by Robert F. Coughlin and Frederick F. Driscoll
10. “Analog and Digital Signal Processing”, by Ashok Ambarda
11. “Fundamentals of Industrial Instrumentation and Process Control”, by William Dunn

Program: M. Tech. in ECE	**Year, Semester:** 2nd Yr., 1st Sem.
Course Title: Composite Materials	**Subject Code:**TIU-PME-E203
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

1. Understand composite materials, their classification, and functional requirements.
2. Analyze properties and applications of different fibers and reinforcement types.

3. Understand manufacturing processes for metal, ceramic, and polymer matrix composites.

COURSE OUTCOME:

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

CO-1:	**Define** and **classify** composite materials, their characteristics, advantages, and applications, and **explain** the influence of reinforcement size, shape, and distribution on composite performance.	K2
CO-2:	**Explain** the preparation, properties, and applications of various fiber reinforcements, including glass, carbon, Kevlar, and Boron fibers, and **analyze** mechanical behavior using the rule of mixtures and isostrain/isostress conditions.	K4
CO-3:	**Describe** and **compare** the manufacturing techniques of metal matrix composites, ceramic matrix composites, and carbon-carbon composites, focusing on their properties and applications.	K4
CO-4:	**Discuss** the manufacturing processes of polymer matrix composites, including preparation of molding compounds, hand layup, autoclave, filament winding, and compression molding methods, and their properties and applications.	K2
CO-5:	**Analyze** strength and failure criteria in laminar composites, such as maximum stress/strain criteria, interaction failure criteria, and hygrothermal failure, and **evaluate** laminate first-ply failure and laminate strength using caplet plots and stress concentrations.	K4
CO-6:	**Design** composite structures by applying strength design methodologies, including ply discount and truncated maximum strain criterion, and **analyze** stress concentrations in composite laminates.	K4

COURSE CONTENT:

MODULE 1:	**Introduction to Composite Materials**	**4 Hours**
Definition, classification, and characteristics of composites. Advantages, applications, and functional requirements of reinforcement and matrix. Effect of reinforcement size, shape, distribution, and volume fraction on composite performance.		
MODULE 2:	**Reinforcements**	**10 Hours**
Preparation, layup, and curing of glass, carbon, Kevlar, and boron fibers. Properties and applications of whiskers and particle reinforcements. Mechanical behavior of composites: rule of mixtures, inverse rule of mixtures, isostrain, and isostress conditions.		
MODULE 3:	**Manufacturing of Metal Matrix Composites**	**8 Hours**
Casting, solid-state diffusion, cladding, and hot isostatic pressing. Manufacturing ceramic matrix composites: liquid metal infiltration and liquid phase sintering. Carbon-carbon composites manufacturing techniques: knitting, braiding, and weaving.		
MODULE 4:	**Manufacturing of Polymer Matrix Composites**	**8 Hours**
Preparation of molding compounds and prepregs. Hand layup method, autoclave method, filament winding, compression molding, and reaction injection molding. Properties and applications of polymer matrix composites.		
MODULE 5:	**Strength and Failure Criteria**	**10 Hours**
Laminar failure criteria, strength ratio, maximum stress and strain criteria, interaction failure criteria, hygrothermal failure, laminate strength, ply discount, truncated maximum strain criteria, strength design using caplet plots, and stress concentrations.		
MODULE 6:	**Advanced Composite Performance and Applications**	**5 Hours**

Application of composite materials in various industries. Comparison of different manufacturing methods and their effect on composite performance.	
TOTAL LECTURES	**45 Hours**

Books:

1. "Composite Materials: Science and Engineering" by K. K. Chawla ISBN: 978-0387743646 Publisher: Springer
2. "Mechanics of Composite Materials" by Robert M. Jones ISBN: 978-1560327127 Publisher: Taylor & Francis
3. "Introduction to Composite Materials" by Stephen W. Tsai, Hyer C.R. ISBN: 978-0877622884 Publisher: Technomic Publishing Co.
4. "Engineering Mechanics of Composite Materials" by Isaac M. Daniel, OriIshai ISBN: 978-0195150971 Publisher: Oxford University Press
5. "Composite Materials: Design and Applications" by Daniel Gay ISBN: 978-0367374923 Publisher: CRC Press
6. "Advanced Mechanics of Composite Materials and Structural Elements" by Valery V. Vasiliev, Evgeny V. Morozov ISBN: 978-0080982311 Publisher: Elsevier
7. "Carbon-Carbon Composites" by G. Savage ISBN: 978-0412368702 Publisher: Springer

Program: M. Tech. in ECE	**Year, Semester:** 2nd Yr., 3rd Sem.
Course Title: Advanced Control Systems	**Subject Code:**TIU-PEC-E205
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

1. Understand the principles of State Space.
2. Analyze the concept of Time Domain & Frequency Domain.

COURSE OUTCOME:

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

CO-1:	Classify control systems and represent in various models	K4
CO-2:	Apply standard test signals to a system to determine their characteristics	K3
CO-3:	Make use of stability concepts to obtain the desired characteristics	K4
CO-4:	Examine the system behavior using various stability analysis techniques	K4
CO-5:	Determine the characteristics of a linear control system using various time and frequency domain tools	K2

CO-6:	Design control strategy by applying different methodologies.	K3

COURSE CONTENT:

MODULE 1:	Introduction	**10 Hours**
Concepts of control systems. Examples of control systems, classification of control systems, Block diagram algebra, Representation by Signal flow graph. Reduction using Mason's gain formula. Feedback Characteristics, Effects of feedback. Mathematical modelling of systems – Electrical, mechanical translational and rotational systems.		
MODULE 2:	Time Domain Analysis & Stability Analysis in S-Domain	**12 Hours**
Standard test signals, Time response of first and second order systems with standard input signals, Time domain specifications, steady state error and error constants. Effects of P, PI, PD and PID Controllers Concept of stability, Routh Hurwitz criterion. Construction of Root locus. Effects of adding poles and zeros to open loop transfer function on the root loci.		
MODULE 3:	Frequency Response Analysis	**8 Hours**
Correlation between time and frequency responses. Determination of frequency domain specifications, Gain margin and Phase margin		
MODULE 4:	State variable analysis	**12 Hours**
State, State variables, State variable representation, State variable form from Transfer function (Diagonal form), transfer function from State variable form, State transition matrix, properties of state transition matrix, Controllability and Observability		
TOTAL LECTURES		**42 Hours**

Books:

1. M.Gopal, "Control Systems Engineering" , 3/e , Wiley Eastern Ltd., TMH ,2008
2. Benjamin C.Kuo, "Automatic Control Systems" ,7/e , Prentice Hall of India, 1997.
3. Ogata, "Modern Control Engineering" , 2/e, Prentice Hall of India., 2011
4. R.C. Sukla, "Control Systems", 3/e, Dhanpatrai and Sons,1998 3. Control Systems Engg. , Nise– Johnwiley , 3rd Edition 2000

e- Resources & other digital material

1. https://www.udemy.com/topic/control-systems

2. https://ebooks.schandpublishing.com/detail/principles-control-system/9788121917780

3 https://library.villanova.edu/Find/Record/1437935/T

Program: M. Tech. in ECE	**Year, Semester:** 2ND Yr., 3RD Sem.
Course Title: Dissertation Phase-I	**Subject Code:**TIU-PEC- S201
Contact Hours/Week: 0–0–20 (L–T–P)	**Credit:** 10

Course Objectives:

- To develop problem-solving skills through research and practical implementation.
- To enhance technical knowledge in real-world applications.
- To improve project management, teamwork, and communication skills.
- To document and present the project findings effectively.

COURSE OUTCOME:

CO-1	Identify and define an engineering problem through literature survey and industry requirements.	K4
CO-2	Formulate project objectives, methodology, and work plan.	K4
CO-3	Design, develop, and implement innovative solutions using appropriate tools and techniques.	K4
CO-4	Analyze and evaluate project outcomes using experimental results, simulations, or prototypes.	K3
CO-5	Prepare technical documentation, research reports, and project presentations.	K3
CO-6	Demonstrate teamwork, ethical practices, and project management skills.	K4

COURSE CONTENT:

Phase 1: Project Proposal & Planning
Phase 2: System Design & Development
Phase 3: Implementation & Experimentation
Phase 4: Report Writing & Final Presentation

Program: M. Tech. in ECE	**Year, Semester:** 2ND Yr., 3RD Sem.
Course Title: Seminar	**Subject Code:** TIU-PEC-S203
Contact Hours/Week: 0–0–0 (L–T–P)	**Credit:** 2

Course Objectives:

- To develop skills in researching, analyzing, and presenting technical topics.
- To improve communication and presentation abilities.
- To enhance knowledge of emerging trends in engineering and technology.
- To encourage critical thinking and professional discussion.

COURSE OUTCOME

CO-1	Define an engineering problem.	K4
CO-2	Formulate project objectives, methodology, and work plan.	K3
CO-3	Design, develop, and implement innovative solutions using appropriate tools and techniques.	K3
CO-4	Analyze and evaluate project outcomes using experimental results, simulations, or prototypes.	K4
CO-5	Prepare technical documentation, research reports, and project presentations.	K3
CO-6	Demonstrate teamwork, ethical practices, and project management skills.	K4

COURSE CONTENT:

Phase 1: Topic Selection & Research

- Identifying recent trends in technology and research areas.
- Conducting a literature review from journals, conference papers, and patents.
- Formulating the seminar scope and objectives.
- Preparing an abstract and seeking approval from the faculty guide.

Phase 2: Report Writing & Drafting Presentation

- Structuring the seminar report (Introduction, Literature Review, Methodology, Findings, Conclusion).
- Formatting the report as per IEEE/University guidelines.
- Creating a PowerPoint presentation with visuals, graphs, and technical details.

Phase 3: Presentation & Evaluation

- Delivering the seminar presentation (10-15 minutes).
- Handling Q&A sessions and audience engagement.
- Receiving feedback and refining the report based on suggestions.