
DR. A.P.J. ABDUL KALAM TECHNICAL
UNIVERSITY, UTTAR PRADESH, LUCKNOW



EVALUATION SCHEME & SYLLABUS

FOR

B. TECH. FOURTH YEAR

**ELECTRONICS AND INSTRUMENTATION ENGINEERING
INSTRUMENTATION AND CONTROL ENGINEERING
APPLIED ELECTRONICS AND INSTRUMENTATION ENGINEERING
INSTRUMENTATION ENGINEERING**

AS PER

AICTE MODEL CURRICULUM

[Effective from the Session: 2025-26]

B.Tech. VII Semester

S. No.	Course Code	Course Title	Learning Mode	Periods			Evaluation Scheme				End Semester		Total	Credits
				L	T	P	CT	TA	Total	PS	TE	PE		
1	BIC 701	AI in Bio-Medical Instrumentation	Offline	3	0	0	20	10	30	-	70	-	100	3
2	B*C071-74	Departmental Elective-IV	Offline	3	0	0	20	10	30	-	70	-	100	3
3	BOEM**	Open Elective-II (M)	Offline/ MOOCs	3	0	0	20	10	30	-	70	-	100	3
4	BIC 751	AI in Bio-Medical Instrumentation Lab	Offline	0	0	2	-	-	-	50	-	50	100	1
5	BIC752	Mini Project or Internship Assessment*		0	0	4	-	-	-	100	-	-	100	2
6	BIC753	Project-I		0	0	10	-	-	-	150	-	-	150	5
7	BIC754	Start-up and Entrepreneurial Activity Assessment#		0	0	4	-	-	-	100	-	-	100	2
		Total		9	0	20							750	19
		*The Mini Project or internship (5 - 6 weeks) conducted during summer break after VI semester and will be assessed during VII semester. #The Startup and Entrepreneurial Activity Assessment will be done in 7th semester under which a student will have to undergo a startup/entrepreneurship activity of at least 60 hours till 6th semester												

Course Code

Course Title

Department Elective-I

BIC071	Applied Fuzzy Electronic Systems
BIC072	Computerised Process Control
BIC073	Micro & Smart Systems
BEC074	Drone Systems: Design, Control & Navigation

B.Tech. VIII Semester

Sr. No.	Subject Code	Subject	Learning Mode	Periods			Evaluation Scheme				End Semester		Total	Credits
				L	T	P	CT	TA	Total	PS	TE	PE		
1	BOEM**	Open Elective-III	MOOCs	3	0	0	20	10	30	-	70	-	100	3
2	BOEM**	Open Elective-IV	MOOCs	3	0	0	20	10	30	-	70	-	100	3
3	BIC 851	Project-II		0	0	18	-	-	-	100	-	350	450	10
		Total		6	0	18							650	16

The Internal Assessment of MOOCs will be done by the respective institute and the External Assessment (End Semester Examination) will be done by the University.

B.Tech 4rd Year VII Semester Syllabus

BIC701	AI in Bio-Medical Instrumentation	3L:0T:0P	3 Credits
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Unit	Topics	Lectures
I	Introduction To Artificial Intelligence: Definition – Future of Artificial Intelligence – Characteristic of Intelligent Agents – Typical Intelligent Agents –Problem Solving Approach to Typical AI problems. Problem solving by Searching: Uninformed and informed strategies and implementation; Path planning; Constraint Satisfaction Problems (CSP). Knowledge Representation: Logical Agents– Propositional and first order Predicate logic– inference– Knowledge representation and Automated Planning– Uncertain Knowledge and Reasoning: Quantifying uncertainty– probabilistic reasoning;	8
II	Introduction of Bio-Medical Instrumentation System: Man- Instrumentation system Components, Problems encountered in measuring a living system. Basics of Anatomy and Physiology of the body. Bioelectric potentials: Resting and action potentials, propagation of action potential, The Physiological potentials – ECG, EEG, EMG, ERG, EOG and Evoked responses. Electrodes and Transducers: Electrode theory, Biopotential Electrodes- Surface electrodes, Needle electrodes, Microelectrodes, Biomedical Transducer.	8
III	Cardiovascular Measurements: Electrocardiography – ECG amplifiers, Electrodes and Leads, ECG –Single channel, Three channel, Vector Cardiographs, ECG System for Stresses testing, Holter recording, Blood pressure measurement, Heart sound measurement. Pacemakers and Defibrillators. Patient Care & Monitoring: Elements of intensive care monitoring, displays, diagnosis, Calibration & Reparability of patient monitoring equipment. Processing of physiological signals (ECG, EEG) using AI algorithms.	8
IV	Respiratory system Measurements: Physiology of Respiratory system. Measurement of breathing mechanism – Spirometer. AI powered Respiratory Therapy equipments: Inhalators, Ventilators & Respirators, Humidifiers, and Nebulizers & Aspirators. Nervous System Measurements using AI algorithms: Physiology of nervous system, Neuronal communication, Neuronal firing measurements.	8
V	Ophthalmology Instruments: Electroretinogram, Electro-oculogram, Ophthalmoscope, Tonometer for eye pressure measurement. Diagnostic Techniques using AI algorithms: Ultrasonic diagnosis, Eco-cardiography, Eco-encephalography, Ophthalmic scans, X-ray & Radio-isotope diagnosis and therapy, CAT-Scan, Emission computerized tomography, MRI	8

Text Book:

1. S. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach, Prentice Hall.
2. R. S. Khandpur, “Handbook of Biomedical Instrumentation”, 3rd Ed., Mc Graw Hill Education.
3. Cromwell, “Biomedical Instrumentation and Measurements” PHI
4. Chatterjee & Miller, “Biomedical Instrumentation Systems,” Cengage.
5. S. K. Venkata Ram, “Bio-Medical Electronics &Instrumentation (Revised)”, Galgotia.

Reference Books:

1. M. Tim Jones, “Artificial Intelligence: A Systems Approach (Computer Science)”, Jones and Bartlett Publishers; 1st Edition, 2008.
2. J. G. Webster (editor), “Medical Instrumentation Application & Design”, 3rd Ed WILEY, India
3. J. G. Webster, “Bio- Instrumentation”, Wiley
4. S. Ananthi, “A Text Book of Medical Instruments”, New Age International
5. Carr & Brown, “Introduction to Biomedical Equipment Technology”, Pearson

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Understand the fundamental concepts and terminology of Artificial Intelligence, enabling them to discuss and comprehend AI-related topics.
2. Describe the Man-Instrumentation system Components, Problems encountered in measuring living system.
3. Design Electrocardiography – ECG amplifiers, Electrodes and Leads, ECG –Single channel, Three channel, Vector Cardiographs, ECG System for Stresses testing, Holter recording, Blood pressure measurement.
4. Realization of Physiology of Respiratory system. Measurement of breathing mechanism Spirometer. Respiratory Therapy equipments.
5. Recognize the basics of Electroretinogram, Electro-oculogram, Ophthalmoscope, Tonometer for eye pressure measurement. Diagnostic techniques.

BIC751	AI in Bio-Medical Instrumentation Lab	0L:0T:2P	1 Credit
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SUGGESTIVE LIST OF EXPERIMENTS:

- ECG Signal Classification Using Machine Learning**
Objective: Record ECG signals and classify them as normal or abnormal using ECG sensor, DAQ module, MATLAB/Python.
- EEG-Based Brain State Detection**
Objective: Identify mental states like relaxed, focused, or drowsy using EEG headset (e.g., Emotiv, NeuroSky), PC with Python.
- Glucose Level Prediction from Physiological Parameters**
Objective: Predict glucose levels using non-invasive data (e.g., pulse, BP) using Pulse sensor & BP monitor.
- Heart Rate Monitoring & Arrhythmia Detection**
Objective: Detect arrhythmia from heart rate variability (HRV) using Pulse sensor or ECG module.
- Biomedical Image Segmentation (e.g., X-ray or MRI)**
Objective: Segment key organs or anomalies using AI. [Tool: Open-source datasets (e.g., NIH Chest X-ray), Python with Keras/TensorFlow]
- Oximeter Signal Analysis and SpO₂ Estimation**
Objective: Analyze photoplethysmogram (PPG) signals for oxygen saturation using Pulse oximeter module.
- AI-Based Gait Analysis Using Wearable Sensors**
Objective: Detect abnormal walking patterns for early disease detection using IMU sensors, Smartphone sensors.
- To study Auditory system check-up using Audiometer.
- To Measure Skin Conductance and Skin Potential using Galvanic Skin Response Module,
- Conduct Electromyogram test using EMG biofeedback Trainer.

BIC071	Applied Fuzzy Electronic Systems	3L:0T:0P	3 Credits
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Unit	Topics	Lectures
I	History of Fuzzy Logic: Fuzzy Sets, Possibility Distributions, Fuzzy Rules, Fuzzy Sets, Operations of Fuzzy Sets, Properties of Fuzzy Sets, Geometric Interpretations of Fuzzy Sets, Possibility Theory, Fuzzy Relations and their Compositions, Fuzzy Graphs, Fuzzy Numbers, Functions with Fuzzy, Arguments, Arithmetic Operations of Fuzzy Numbers.	8
II	Fuzzy Rules: Fuzzy Mapping Rule, Fuzzy Implication Rule, Fuzzy Rule Based Models for Function Approximations, Theoretical Foundation of Fuzzy Mapping Rules, Types of Fuzzy Rule Based Models: Mamdani Model, TSK Model, Standard Additive Model, Fuzzy Implications and Approximate Reasoning; Propositional Logic, First Order Predicate Calculus, Fuzzy Implications Approximate Reasoning, Criteria and Family of Fuzzy Implications, Possibility vs. Probability, Probability of Fuzzy Event, Probabilistic Interpretations of Fuzzy Sets, Fuzzy Measure.	8
III	Uncertainty in information; Classical Sets, Fuzzy Sets and their properties; Cardinality of Classical Relations and their properties, The α -Level Set, Cardinality of Fuzzy Relations and their properties; Composition; Tolerance and Equivalence relationship; Membership Functions; Fuzzification and Defuzzification process; Fuzzy to Crisp Conversions; Lambda cuts; Extension Principle, Crisp functions and its mapping, Fuzzy functions and its mapping; Fuzzy Numbers; Internal Analysis in Arithmetic.	8
IV	Approximate method of Extension, Vertex Method, DSW Algorithm, and Restricted DSW Algorithm and their comparison, Classical Predicate Logic; Fuzzy Logic; Approximate Reasoning; Fuzzy Tautologies, Contradictions, Equivalence, and Logical Proof; Fuzzy Rule Based Systems, Models of Fuzzy AND, OR, and Inverter; Fuzzy Algebra; Truth Tables; Fuzzy Functions; Concept of Fuzzy Logic Circuits; Fuzzy Flip- Flop; Fuzzy Logic Circuits in Current Mode, Furry Numbers.	8
V	Fuzzy Logic in Control Engineering: Fundamental Issues in Control Engineering, Control Design Process, Semiformal Aspects of Design Process, Mamdani Architecture of Fuzzy Control, The Sugeno-Takagi Architecture. Fuzzy Logic in Hierarchical Control Architecture, Historical Overview and Reflections on Mamdani's Approach, Analysis of Fuzzy Control System via Lyapunov's Direct Method, Linguistic Approach to the analysis of Fuzzy Control System, Parameter Plane Theory of Stability, Takagi-Sugeno-Kang Model Of Stability Analysis.	8

Text Books:

1. John Yen, Reza Langari, "Fuzzy Logic: Intellegent Control and Information", Pearson Publication.
2. Ahmad M. Ibrahim, "Introduction to Applied Fuzzy Electronics", Prentice Hall Publication.
3. Ahmad M. Ibrahim, "Fuzzy Logic for Embedded Systems Applications", Newnes Publications.
4. Witold Pedrycz, Fernando Gomide, "Fuzzy Systems Engineering: Toward Human Centric Computing", John Wiley Publications.

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Explain the Operations of Fuzzy Sets, Properties of Fuzzy Sets, Geometric Interpretations of Fuzzy Sets, Possibility Theory.
2. Design Fuzzy Mapping Rule, Fuzzy Implication Rule, Fuzzy Rule Based Models for Function Approximations, Theoretical Foundation of Fuzzy Mapping Rules, Types of Fuzzy Rule Based Models.
3. Realize Fuzzy Sets and their properties; Cardinality of Classical Relations and their properties.
4. Interpret the Principle of Vertex Method, DSW Algorithm, and Restricted DSW Algorithm and their comparison, Classical Predicate Logic; Fuzzy Logic.
5. Describe the fundamental Issues in Control Engineering, Control Design Process, Semiformal Aspects of Design Process, Mamdani Architecture of Fuzzy Control, The Sugeno-Takagi Architecture.

BIC072	Computerised Process Control	3L:0T:0P	3 Credits
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Unit	Topic	Lectures
I	Basics of Computer-Aided Process Control: Role of computers in process control, Elements of a computer aided Process control System, Classification of a Computer – Aided Process Control System Computer Aided Process–control Architecture: Centralized Control Systems, Distributed control Systems, Hierarchical Computer control Systems. Economics of Computer-Aided Process control. Benefits of using Computers in a Process control. Process related Interfaces: Analog Interfaces, Digital Interfaces, Pulse Interfaces, Standard Interfaces.	8
II	Industrial communication System: Communication Networking, Industrial communication Systems, Data Transfer Techniques, Computer Aided Process control software, Types of Computer control Process Software, Real Time Operating System	8
III	Process Modelling for computerized Process control: Process model, Physical model, Control Model, Process modelling. Modelling Procedure: Goals Definition, Information Preparation, Model Formulation, Solution Finding, Results Analysis, Model Validation	8
IV	Advanced Strategies For Computerized Process control: Cascade Control, Predictive control, Adaptive Control, Inferential control, Intelligent Control, Statistical control.	8
V	Examples of Computerized Process Control: Electric Oven Temperature Control, Reheat Furnace Temperature control, Thickness and Flatness control System for metal Rolling, Computer-Aided control of Electric Power Generation Plant.	8

Text Books:

1. S. K. Singh, “Computer Aided Process control”, PHI.

Reference Books:

1. C. L. Smith, “Digital computer Process Control”, Ident Educational Publishers.
2. C. D. Johnson, “Process Control Instrumentation Technology”, PHI.
3. Krishan Kant, “Computer Based Industrial Control”
4. Pradeep B. Deshpande & Raymond H. Ash, “Element of Computer Process Control with Advance Control Applications”, Instrument Society of America, 1981.
5. C. M. Houpis & G. B. Lamond, “Digital Control System Theory”, Tata McGraw Hill.

COURSE OUTCOME: At the end of this course students will demonstrate the ability to:

1. Understand the Role of computers in process control, Elements of a computer aided Process control System, Classification of a Computer.
2. Design Phase Locked Local Loop, Mixers. Time Division Multiplexed System – TDM/PAM system.
3. Realize Process model, Physical model, Control Model. Modelling Procedure.
4. Formulate of Cascade Control, Predictive control, Adaptive Control, Inferential control, Intelligent Control, Statistical control.
5. Design Electric Oven, Temperature Control, Reheat Furnace Temperature control.

BIC073	Micro & Smart Systems	3L:0T:0P	3 Credits
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Unit	Topics	Lectures
I	Miniaturization: Introduction, Need of miniaturization, Microsystems versus MEMS, Need of micro fabrication, smart materials, structures and systems, integrated Microsystems, applications of smart materials and Microsystems.	8
II	Micro sensors, actuators, systems and smart materials: Silicon capacitive accelerometer, piezo-resistive pressure sensor, conductometric gas sensor, an electrostatic combo -drive, a magnetic micro-relay, portable blood analyzer, piezoelectric inkjet print head, micro-mirror array for video projection, smart materials and systems.	8
III	Micromachining technologies: Silicon as a material for micro machining, thin film deposition, lithography, etching, silicon micromachining, specialized materials for Microsystems, advanced processes for micro fabrication.	8
IV	Modeling of solids in Microsystems: Bar, beam, energy methods for elastic bodies, heterogeneous layered beams, bimorph effect, residual stress and stress gradients, poisson effect and the anticlastic curvature of beams, torsion of beams and shear stresses, dealing with large displacements, In-plane stresses. Modeling of coupled electromechanical systems: Electrostatics, Coupled Electro-mechanics: statics, stability and pull-in phenomenon, dynamics, Squeezed film effects in electro-mechanics.	8
V	Integration of micro and smart systems: Integration of Microsystems and microelectronics, microsystems packaging, case studies of integrated Microsystems, case study of a smart-structure in vibration control. Scaling effects in Microsystems: scaling in: mechanical domain, electrostatic domain, magnetic domain, diffusion, effects in the optical domain, biochemical phenomena.	8

Text Books:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat and V. K. Aatre, "Micro and smart systems", Wiley India, 2010.
2. S Nihtianov, A. Luque "Smart Sensors and MEMS", Woodhead publishing limited 2014.

E - Resources: <https://nptel.ac.in/courses/112/108/112108092/>

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Interpret the need of Microsystems and Miniaturization.
2. Design the smart materials, actuators and Micro sensors.
3. Interpret the Micromachining Technologies.
4. Analyze the modeling of solids in Microsystems.
5. Evaluate the case studies of mart systems.

BEC074	Drone Systems: Design, Control & Navigation	3L:0T:0P	3 Credits
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Unit	Topics	Lectures
I	UAV Miniaturization: Design Challenges and Technological Opportunities, Aerial Network Characteristics: Dynamic Topology, Delay Constraints, Intermittent Links, Aerial Communication Techniques: Radar Identification & Limitations Beyond Radar: ADS-B, Optical & Acoustic Tracking, Aerial Voice & Data Communication.	8
II	Modern Control Theory for UAV Systems: Introduction to State-Space Modeling, State Transition Matrix and Time Response, Canonical Forms & Transformations, Significance of Eigenvalues: Real Distinct, Repeated, Complex, Application to UAV Stability & Control Systems.	8
III	UAV Aerodynamics, Propulsion & Navigation: Coordinate Systems: Earth-fixed & Body-fixed Frames, UAV Aerodynamics: Wing Configuration, Lift & Drag, Airframe Configuration & Endurance, Vibration, Noise, and Gliding Characteristics; UAV Propulsion: Propeller & Motor Modeling, Electric vs. Hybrid Propulsion Systems.	8
IV	UAV Control Systems & Autonomy: UAV Controllability & Observability Concepts, UAV Flight Control System Overview, Position Control: Euler Angles and Rotation Matrix as Outputs, Control Strategies: Autonomous vs. Semi-Autonomous Flight, Inner-loop vs. Outer-loop Control, Safety Mechanisms: Failsafe Design, Redundancy and Recovery in Autonomous Flights.	8
V	Drone Safety, Legal Framework & Future Trends: National and International Safety Guidelines: DGCA Drone Rules 2021 (India), Airspace Classification & Permissions, Pilot Training, UIN, UAS Traffic Management (UTM), NPNT Compliance & Geo-fencing Technologies, Innovations in Drone Miniaturization & Battery Technologies.	8

Text Books:

1. Reg Austin, Unmanned Aircraft Systems: UAV Design, Development and Deployment, Wiley, 2010.
2. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, 2nd Edition, 1998.
3. Brian L. Stevens, Frank L. Lewis, Aircraft Control and Simulation: Dynamics, Controls Design, and Autonomous Systems, Wiley, 3rd Edition, 2015.

Reference Books:

1. Paul G. Fahlstrom, Thomas J. Gleason, Introduction to UAV Systems, UAV Systems Inc., 4th Edition, 2012.
2. Andreas M. Savvaris, Kostas P. Valavanis, Unmanned Aircraft Systems: Theory and Practice, Springer, 2020.
3. DGCA (Directorate General of Civil Aviation, India), Drone Rules 2021 – Government of India (available online).

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Understand the constraints and opportunities in UAV miniaturization and aerial networking.
2. Understand how to represent drone systems using state-space models and use basic control theory to analyze their stability.
3. Analyze the aerodynamic behaviour and propulsion trade-offs in UAV design and navigation.
4. Recognize UAV control systems using modern control techniques for both autonomous and semi-autonomous operations.
5. Identify the rules and safety practices for drone operation in India and globally, including licensing, geofencing, and UAS traffic management.