APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

(A State Government University)

B. Tech, 2024

Minor Degree in

Applied Electronics and Instrumentation Engineering

Offered By : Applied Electronics and Instrumentation Engineering

CURRICULUM

Minor (Title)											
Sl. No:	Semester	Course Code	Course Title (Course Name)	Credit Structure			SS	Total Marks		Credits	Hrs./ Week
				L	T	P		CIA	ESE		
1	3	MNAET309	Transducers and Instrumentation* /MOOC#	3	1	0	5	40	60	4	4
2	4	MNAET409	Industrial Instrumentation*/ MOOC#	3	1	0	5	40	60	4	4
3	5	MNAET509	Control System Theory /MOOC	3	1	0	5	40	60	4	4
4	6	MNAET609	Process Dynamics and Industry 4.0 /MOOC	3	0	0	4.5	40	60	3	3
Total							**20/ 21**			**15**	**15**

*****_Students must register for theory courses listed in the 3rd and 4th semesters of the Minor curriculum._ **#**_Students who fail a theory course listed in the Minor curriculum are permitted to register for an alternate MOOC course specified in the Minor curriculum._

&_The courses offered in the third and fourth semesters can be structured as either theory-based courses **or** a combination of theory and lab-based courses._

SYLLABUS

SEMESTER 3

SEMESTER 3

TRANSDUCERS AND INSTRUMENTATION

Course Code	MNAET309	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Nil	Course Type	Theory

Course Objectives:

1. To familiarize the basics of Instrumentation system and its quality parameters.
2. To understand and apply the concepts of various transducers and other measuring instruments.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basics of Measurement - Generalized block diagram of Instrumentation system, Standards, Calibration of meters (basics only), Static and Dynamic characteristics of transducers, Errors in measurements and its basic analysis, Loading effects (concepts only).	11
2	**Passive transducers (Principle of operation, characteristics, measuring circuits and applications only)** Resistance transducers - Potentiometer, Strain gauge (gauge factor derivation) - Strain gauge Load Cell, Thermistor. Inductive Transducers - LVDT. Temperature sensors - Thermocouples, RTD, thermistor. piezo electric transducers - Hall Effect transducers, photo electric transducers, LDR.	11
3	**DC and AC Bridges** Sources and detectors - Balance Equation, Wheatstone Bridge, Kelvin's Double bridge, Maxwell's inductance bridge and Maxwell's inductance capacitance bridge, Schering bridge, Wien's bridge.	11

4	Cathode ray oscilloscopes - principles, measurement and limitations. Digital storage oscilloscopes – principles. Measurements using DSO. Recording instruments (basics only) - Strip chart recorder, X-Y Plotter. Waveform analyzing instruments (basics only) - Spectrum analyzer, Distortion meter, Qmeter, Power factor meter.	**11**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Illustrate the basic concepts and performance characteristics involved in a measurement system.	**K2**
CO2	Explain the principle and working of various transducers, measuring physical parameters	**K2**
CO3	Investigate the role of DC and AC bridges in a measurement system	**K2**
CO4	Explain different recorders, display systems and analysers in measurement.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**										**2**
CO2	**3**	**2**	**2**									**2**
CO3	**3**	**2**										
CO4	**3**	**2**										**2**

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Electronic Instrumentation	H Kalsi	Mcgraw Hill, 2019	4th edition
2	A Course In Electrical And Electronic Measurements And Instrumentation	A K Sawhney	Dhanpatroy and Co.	2015, 3rd Edition
3	Electronic Instrumentation & Measurements	David A Bell	Oxford 2017	3rd Edition

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Sensors and Transducers	Patranibus D	PHI	2nd edition 2003
2	Electrical Measurements and Measuring systems 1	Golding E W and Widdis F C	Wheeler &co	1993

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	(https://archive.nptel.ac.in/courses/108/108/108108147
2	https://archive.nptel.ac.in/courses/108/108/108108147
3	https://archive.nptel.ac.in/courses/108/108/108108147
4	https://archive.nptel.ac.in/courses/108/108/108108147

MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B. TECH MINOR DEGREE EXAMINATION, MONTH AND YEAR

Course Code: MNAET309

Course Name: Transducers and Instrumentation

Max. Marks: 60 | Duration: 2 Hours 30 Minutes

PART A

		Answer all questions. Each question carries 3 marks	CO	Marks
1		Discuss the difference between accuracy and precision.	1	(3)
2		Discuss the difference between primary and secondary standards	1	(3)
3		Give the applications of Hall-effect transducers.	2	(3)
4		Enumerate the various types of thermocouples.	2	(3)
5		Describe the applications of Wien Bridge	3	(3)
6		Develop bridge balance equation of Wheatstone's bridge.	3	(3)
7		What is the purpose of triggering circuit in CRO ?	4	(3)
8		Compare Strip chart recorder and X-Y recorder	4	(3)

PART B

Answer any one full question from each module. Each question carries 9 marks

Module 1				
9	a)	With a neat diagram explain instrumentation system with examples.	1	(6)
	b)	Explain resolution.	1	(3)
10	a)	Explain the errors in measurements	1	(5)
	b)	Write short notes on static characteristics of a transducer.	1	(4)
Module 2				
11		Provide a detailed description of the construction and operation of an LVDT.	2	(9)
12	a)	Derive the expression for Gauge Factor of strain Gauge	2	(6)
	b)	Describe the piezoelectric effect and give the materials showing piezoelectric effect.	2	(3)
Module 3				
13		Derive the balancing equation for Kelvin's bridge	3	(9)
14	a)	Discuss the bridge used for measurement of capacitance	3	(6)

	b)	Develop the balancing equation for AC bridges	3	(3)
Module 4				
15	a)	Explain the working of a Spectrum Analyzer with the help of a block Diagram	4	(6)
	b)	Give the working of Q factor meter	4	(3)
16		Illustrate the working of a sampling oscilloscope with block diagram	4	(9)
*****				

SEMESTER 4

SEMESTER 4

INDUSTRIAL INSTRUMENTATION

Course Code	MNAET409	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	MNAET309	Course Type	Theory

Course Objectives:

1. To equip the students with the basic knowledge of various instruments that measures physical quantities.
2. To make students to choose appropriate instruments for various measurements.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Pressure Measurement - Units and Standards, Manometers, Elastic type pressure gauges- Bourdon tube – Bellows – Diaphragms. Electrical methods - Elastic elements with LVDT- strain gauges – potentiometric pressure transducers- Capacitive type pressure gauge–Piezo electric pressure sensor, Optical pressure Transducer. Measurement of vacuum - Ionization gauge, Pirani Gauge, Thermal conductivity vacuum gauges.	11
2	**Flow Measurement** Fundamentals- Bernoulli's principle, Flow characteristics, classification, Variable head flow meters - Orifice meter, Venturi meter, Pitot Tube. Variable area flowmeter- Rotameter. Positive Displacement Flow meters - Nutating disc flow meter, Lobed impeller flow meter	11
3	**Measurement of acceleration, torque, pH, Humidity and Sound** Seismic accelerometers, piezoelectric accelerometers, piezo resistive accelerometer, capacitive MEMS accelerometer, Strain gauge	11

	torquemeters, -Magnetostrictive torque transducer, pH meter, Hygrometers, Microphones. Measurement of radiation- Giger Muller Counter, Scintillation counter	
4	Level Measurement - Float Type level indicator, Displacer Type Torque tube assembly, rotating paddle switches. Electrical Methods - Resistive-Inductive and Capacitive level gauging. Measurement of density – Definitions, Radiation Type, Ultrasonic type, Thermal conductivity Density gauges.	11

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Relate the general concepts various types of pressure measuring instruments.	**K2**
CO2	Illustrate the fundamentals, working, types and application of various flow measurement devices.	**K2**
CO3	Outline the basic concepts for measurement of acceleration, torque, pH, Humidity, Sound and radiation	**K2**
CO4	Select suitable instruments for measurement of level and density	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**										
CO2	**3**	**2**										
CO3	**2**	**2**										**2**
CO4	**2**	**2**										

Text books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Principles of Industrial Instrumentation	Patranabis D	Tata McGraw Hill	2ndEdition,1997.
2	Application and Design: Applications and Design	Doebelin E.O	Tata McGraw Hill, New York	Tata McGraw Hill, New
3	Process Measurement and Analysis	Liptak B.G	Chilton Book Company, Radnor, Pennsylvania,	4th Edition, 2003.
4	Course in Mechanical Measurements and Instrumentation &Control	AK Sawhney & Puneet	Dhanpat Raj & Co	January 2020

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Process / Industrial Instruments &Controls Handbook	Douglas M. Considine	McGraw Hill	5th Edition, 1999.
2	Applied Instrumentation in Process Industries – A survey	Andrew W.G	Butterworth Heinemann	2nd Edition,1995.
3	Flow measurement	Spitzer D. W	ISA press, New York	1998

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1-4	**Industrial Instrumentation, IIT Kharagpur by Prof. Alok Barua**

MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FORTH SEMESTER B. TECH MINOR DEGREE EXAMINATION, MONTH AND YEAR

Course Code: MNAET409

Course Name: Industrial Instrumentation

Max. Marks: 60 | Duration: 2 hours 30 minutes

PART A

		Answer all questions. Each question carries 3 marks	CO	Marks
1		Differentiate between Vacuum pressure and gauge pressure?	1	(3)
2		List the advantages and disadvantages of ionization gauges.	1	(3)
3		Explain the limitations of Orifice plate.	2	(3)
4		Differentiate between Laminar & Turbulent flow	2	(3)
5		Discuss the working of Hygrometers	3	(3)
6		Explain magnetostriction effect	3	(3)
7		Distinguish between displacer and float type level gauges	4	(3)
8		Define density. Give its unit.	4	(3)

PART B

Answer any one full question from each module. Each question carries 9 marks

Module 1				
9	a)	Illustrate how vacuum pressure can be measured using Pirani Gauge.	1	(5)
	b)	Explain how measurement is done using potentiometric pressure gauges	1	(4)
10	a)	With a neat diagram explain the working of Bourdon tube	1	(6)
	b)	Illustrate the applications of diaphragms.	1	(3)
Module 2				
11	a)	Explain the working of Rotameter and show mathematically how the scale reading is linear with flow.	2	(7)
	b)	State continuity equations	2	(2)
12	a)	Explain with neat diagram the working of venturi meter	2	(7)
	b)	Give the advantages and disadvantages of venturi meter	2	(2)
Module 3				
13	a)	With a neat diagram explain the working of microphones.	3	(4)
	b)	Write short notes on any 2 types of accelerometers	3	(5)

14	a)	Illustrate the working of Giger Muller counter	3	(5)
	b)	Explain the working of any pH meter	3	(4)
Module 4				
15	a)	Explain in detail about any two types of densitometers	4	(5)
	b)	Discuss the paddle switches	4	(4)
16	a)	Explain the construction and working of Torque and Displacer type level measuring device	4	(5)
	b)	How level is measured using capacitive transducers.	4	(4)
*****				

SEMESTER 5

SEMESTER 5

CONTROL SYSTEM THEORY

Course Code	MNAET509	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Nil	Course Type	Theory

Course Objectives:

1. To study the elements of control system, modelling and perform stability analysis of systems.
2. To understand the frequency domain analysis

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**System modelling -** Introduction to control systems, Classification of control systems. Mathematical modelling of mechanical system. Open loop and closed loop control systems, Transfer function, Poles and Zeros, Block diagram reduction techniques.	11
2	Signal flow graph, Mason's gain formula. **Time domain analysis -** Standard test signals, Response of first and second order systems to impulse and step inputs. **Time domain specifications -** Delay time, rise time, peak time, maximum percentage overshoot and settling time.	11
3	**Steady state response -** Steady state error- Static & Dynamic error coefficients. **Concept of stability:** Routh-Hurwitz method for stability analysis.	11
4	**Frequency domain analysis -** Frequency response, Frequency domain specifications, Stability in the frequency domain, Nyquist stability criterion. Stability analysis using Bode plots, relative stability, Gain margin and phase margin.	11

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Analyze the systems using transfer function approach	**K3**
CO2	Conduct time domain analysis and steady state analysis of systems	**K3**
CO3	Conduct stability analysis of systems using time domain methods	**K3**
CO4	Analyze control system stability in frequency domain	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3			2							3
CO2	3	3			2							3
CO3	3	3	2		2							3
CO4	3	3	2		2							3

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Modern Control Engineering	Katsuhiko Ogata	Pearson Education	5/e, 2009
2	Control Systems: Principles and design	M. Gopal	McGraw Hill Education India Education	4/e, 2012
3	Automatic Control systems	Benjamin C. Kuo, Farid Golnaraghi	Wiley	9/e, 2014

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Automatic Control Systems (with MATLAB programs)	S. Hassan Saeed	KATSON Educational series	2013
2	Control System Engineering	Norman S Nise	Wiley	5/e, 2009
3	Modern Control Systems	Richard C Dorf and Robert H. Bishop	Pearson Education	13/e, 2016
4	Control System Engineering	I. J. Nagrath and Madan Gopal	New Age International	7/e, 2021

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/107106081
2	https://nptel.ac.in/courses/107106081
3	https://nptel.ac.in/courses/107106081
4	https://nptel.ac.in/courses/107106081

MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

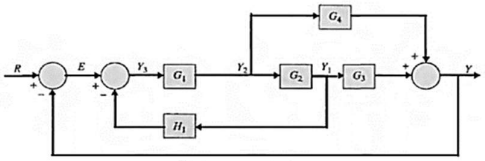
FIFTH SEMESTER B. TECH MINOR DEGREE EXAMINATION, MONTH AND YEAR

Course Code: MNAET509

Course Name: CONTROL SYSTEM THEORY

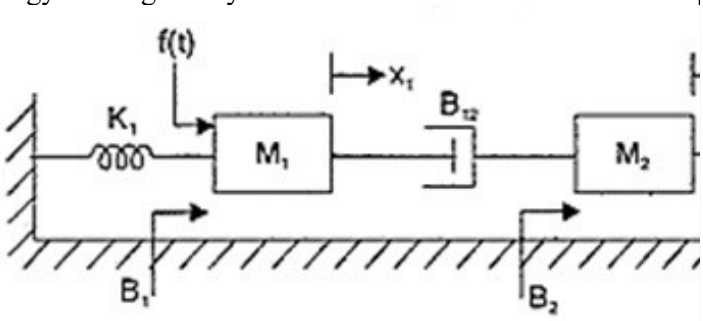
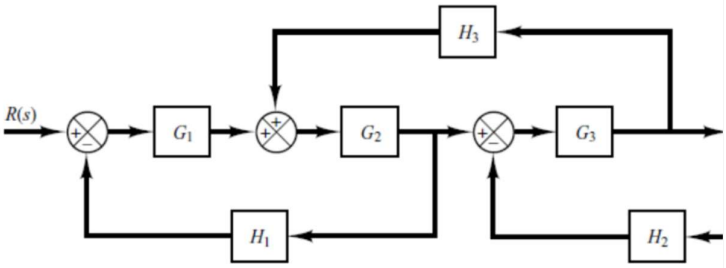
Max. Marks: 60		Duration: 2 hours 30 minutes

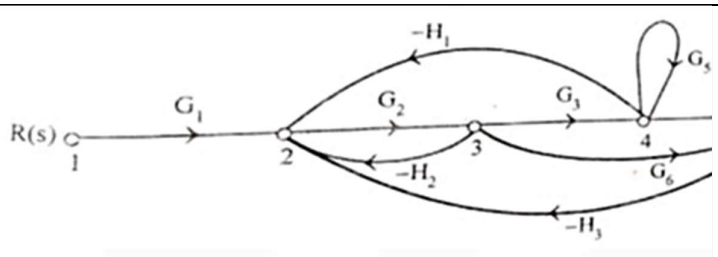
PART A

		Answer all questions. Each question carries 3 marks	CO	Marks
1		Compare open loop and closed loop control systems. Give examples	CO1	(3)
2		Find the $\boldsymbol{Y(s)/R(s)}$ transfer function of the system shown in Figure 	CO1	(3)
3		Derive the expression for peak time of a second order system.	CO2	(3)
4		Compare the features of transient and steady state part of a system response. Give an example for a second order control system with natural frequency of 2 rad/s and damping ratio of 0.5	CO2	(3)
5		For a unity feedback control system, the open loop transfer function , $\boldsymbol{G(s) = \frac{10(s+2)}{s^2(s+1)}}$. Find the (a) position, (b) velocity and (c) acceleration error constants.	CO2	(3)
6		State the angle and magnitude criteria that roots of the characteristic equation must be satisfied.	CO3	(3)
7		State and explain Nyquist Stability criteria.	CO4	(3)
8		Define Gain Margin and Phase Margin. How stability is analysed using GM and PM?	CO4	(3)

PART B

Answer any one full question from each module. Each question carries 9 marks

Module 1				
9		Find the transfer function $\frac{X_2(S)}{F(s)}$ and draw the Force-Voltage analogy of the given system 	CO1	(9)
10	a)	A system is described by the following i). It has two zeros at s=-2 & s=1 ii). Type of the system is 2 iii). It contains poles at s=-1 & s=$\pm 2j$ Determine the transfer function of the system.	CO1	(3)
	b)	Determine the overall transfer function $\frac{C(s)}{R(s)}$ of the block diagram shown 	CO1	(6)
Module 2				
11	a)	A unity feedback control system with forward gain $G(s) = \frac{1}{(2s+4)}$ is driven by a unit ramp input signal. Obtain the response of the system.	CO2	(6)
	b)	The damping ratio of a system is 0.75 and the natural frequency of oscillation is 12 rad/sec. Determine the peak overshoot and peak time.	CO2	(3)
12	a)	Draw the signal flow graph for the following set of algebraic equations: $x1 = ax0 + bx1 + cx2$ $x2 = dx1 + ex3$	CO1	(3)
	b)	Find the overall gain $\frac{C(s)}{R(s)}$ for the signal flow graph using Mason's gain equation.	CO1	(6)

				
Module 3				
13	a)	The characteristic equation of a system is $\boldsymbol{s^7 + 9s^6 + 24s^5 + 24s^4 + 24s^3 + 24s^2 + 23s + 15 = 0}$ Determine the location of roots on S- plane and hence comment on the stability of the system using Ruth Hurwitz criterion	CO3	(9)
14	a)	For a system with characteristic equation, $\boldsymbol{F(s) = s^4 + 22s^3 + 10s^2 + s + K = 0}$. Obtain the marginal value of $\boldsymbol{K}$ and the frequency of oscillations for that value of $\boldsymbol{K}$.	CO3	(4)
	b)	Define velocity error coefficient. Given $G(s)H(s) = \frac{k}{s(s+20)}$ determine the value of k ,for which steady state error to a unit ramp will be 0.02	CO3	(5)
Module 4				
15		Using Nyquist stability criterion, determine whether the closed loop system having the following open loop transfer function is stable? $\boldsymbol{G(s) = \frac{180}{(s+1)(s+2)(s+5)}}$	CO4	(9)
16		Plot the Bode diagram for the following transfer function and find the gain margin and the phase margin. $\boldsymbol{G(s) = \frac{10}{s(1+0.4s)(1+0.1s)}}$	CO4	(9)
*****				

SEMESTER 6

SEMESTER 6

PROCESS DYNAMICS AND INDUSTRY 4.0

Course Code	MNAET609	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Nil	Course Type	Theory

Course Objectives:

1. Understand the fundamental principles of process control and automation.
2. Design, implementation and optimize control strategies for various types of processes.
3. Discuss advanced control techniques and their application in industrial settings.
4. Discuss emerging technologies such as Industry 4.0 and their impact on smart manufacturing.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Process Characteristics** Elements of Process dynamics, Process Variables (types and selection criteria), Process degree of freedom. Characteristics of physical System - Resistance, Capacitive and Combination of both. Types of processes (basics only) - Dead time, Single /multi capacity, self-Regulating /non-self-regulating, Interacting /non interacting, Linear/non-linear, and Selection of control action for them.	9
2	**Feedback Control** Basic principles, Elements of the feedback Loop, Block Diagram, Control Performance Measures for standard inputs. Different Controllers (P, PI and PID) and tuning parameters. Tuning of feedback controllers - Open loop and closed loop tuning techniques. Advanced Control Techniques - Cascade control.	9

3	**Computer Control of Process Plants** Centralised Control System, Distributed Control Systems- Fieldbus System- Fieldbus Types, Supervisory Control and Data Acquisition (SCADA) system.	**9**
4	**Introduction to Industry 4.0 and Smart Manufacturing.** Overview and evolution of Industry 4.0, Key aspects and components of Industry 4.0. Applications of Industry 4.0. Smart factories (Basics only) – Introduction, characteristics of smart factories, benefits, smart factories versus traditional factories. Industrial sensing (Basics only) – Smart sensors, enhanced sensors (virtual sensors, self-calibration, self-testing, self-learning).	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand and apply the dynamics and characteristics of industrial processes for effective control.	**K3**
CO2	Design, analyze, and implement effective control loops and feedback control systems using different components for industrial processes.	**K3**
CO3	Understand advanced control systems and applications of computer control systems	**K2**
CO4	Illustrate the fundamentals of Industry 4.0 and smart factories	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	3	2								2
CO2	3	3	3	2								2
CO3	3	2	3	2								2
CO4	3	2	3	3								2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Process Control: Modeling, Design and Simulation, 1/e	B.Wayne Bequette	PHI	2002
2	Automatic Process Control	Donald Eckman	Wiley Eastern Limited	2009

3	Principles and practice of Automatic Process Control, 3rd edition	Carlos A. Smith, Armando B. Corripio	John Wiley & Sons,	2005
4	Process Control Instrumentation Technology, 8th Edition	Curtis D Johnson	Pearson; 8th edition	2005
5	Process Systems Analysis and Control, 3/e	Donald H Coughnowr	Mc Graw Hill	2017
6	Industry 4.0: Concepts, Processes and Systems	Ravi Kant and Hema Gurung	CRC Press	1st Edition, 2024
7	Introduction to Industrial Internet of Things and Industry 4.0	Sudip Misra, Chandana Roy, Anadarup Mukherjee	CRC Press	1st Edition, 2021

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Handbook of Instrumentation - Process control	B.G.Liptak	Chilton Book Company, Pennsylvania	1995
2	Computer Based Industrial Control	Krishna Kant	PHI	2010
3	Fundamentals of Process Control Theory, 3rd Edition	Paul W. Murrill	ISA	1999
4	Chemical Process Control: An Introduction to Theory and Practice	George Stephanopoulos	Pearson	2015
5	Process Control- Designing processes and Control Systems for Dynamic performance, 2nd ed	Thomas E Marlin	McGraw-Hill International Editions	2000
6	Industry 4.0: The Industrial Internet of Things	Alasdair Gilchrist	Apress	2019

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/103/103/103103037/
2	https://archive.nptel.ac.in/courses/103/103/103103037/
3	https://archive.nptel.ac.in/courses/103/103/103103037/
4	https://nptel.ac.in/courses/106105195

MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH MINOR DEGREE EXAMINATION, MONTH AND YEAR

Course Code: MNAET609

Course Name: PROCESS DYNAMICS AND INDUSTRY 4.0

Max. Marks: 60 | Duration: 2 hours 30 minutes

PART A

		Answer all questions. Each question carries 3 marks	CO	Marks
1		Explain the major elements of process dynamics.	CO1	(3)
2		Define linear and non-linear processes.	CO1	(3)
3		Explain the elements of a feedback control system.	CO2	(3)
4		Differentiate open loop and closed loop tuning methods.	CO2	(3)
5		How does distributed control system differ from a centralized control system?	CO3	(3)
6		What are the key features that make SCADA suitable for remote monitoring and control?	CO3	(3)
7		What are the major challenges industries faces when transitioning from traditional to smart factories?	CO4	(3)
8		Explain any two features of enhanced sensors.	CO4	(3)

PART B

Answer any one full question from each module. Each question carries 9 marks

Module 1

9	a)	Explain the differences between self-regulating and non-self-regulating processes. Provide one industrial example of each and discuss suitable control strategies.	CO1	(6)
	b)	What are the criteria for selecting appropriate process variables in control system design?	CO1	(3)
10	a)	Explain how process characteristics influence the selection of control actions.	CO1	(6)
	b)	What is meant by the degree of freedom (DOF) in a process control system?	CO1	(3)

Module 2

11	a)	Explain the working of P, PI, and PID controllers. Compare their response characteristics and suitability for different types of processes.	CO2	(9)
12	a)	A heating system is controlled using a PID controller. Explain the procedure to tune the controller using any closed-loop tuning methods.	CO2	(6)
	b)	What is cascade control?	CO2	(3)

Module 3

13		Illustrate the architecture of a SCADA system and explain the function of its main components.	CO3	(9)
14		Compare and contrast any three types of Fieldbus standards with respect to communication protocols, topology, and typical applications.	CO3	(9)
Module 4				
15	a)	A pharmaceutical company adopted Industry 4.0 technologies like IoT and predictive analytics. Explain how these technologies improved efficiency in their production process.	CO4	(5)
	b)	How do enhanced sensors improve reliability and data accuracy in industrial systems?	CO4	(4)
16	a)	Explain the key features that distinguish Industry 4.0 from the previous industrial eras.	CO4	(5)
	b)	What are smart sensors? Give any two examples.	CO4	(4)
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