MINOR DEGREES OFFERED UNDER SVEC-19 REGULATIONS

Offering Dept.	Title of the Minor	Students of Eligible Branches
CSE	Artificial Intelligence and Machine Learning	All branches except CSE, IT and CSSE
IT	Internet of Things	All branches except IT
CSSE	Cyber Security	All branches except CSE, IT and CSSE
ECE	VLSI and Embedded Systems	All branches except ECE
EEE	Power Systems and Drives	All branches except EEE
EIE	Instrumentation and Control Engineering	All branches except EIE
ME	Robotics	All branches except ME
CE	Sustainable Engineering	All branches except CE

Academic Regulations for Minor Degree:

The concept of Minor degree is introduced in the curriculum of all B.Tech. programs offering a Major degree. The main objective of Minor degree in a discipline is to provide additional learning opportunities for academically motivated students and it is an optional feature of the B.Tech. Program. To earn a Minor degree in a discipline, a student has to earn 18 extra credits (By studying FIVE theory & THREE laboratory courses or SIX Theory Courses) from the core courses of the minor discipline.

a. Students having a CGPA of 8.0 or above up to II B.Tech I-Semester without any backlogs shall be permitted to register for a Minor degree by paying the requisite fee.

b. In the subsequent semesters, the student has to pass all the courses registered for Major and Minor Degrees in the first attempt i.e., regular examinations without any backlog to keep the Minor Degree registration active or else it shall be cancelled.

c. If a student becomes ineligible for continuing the Minor Degree, the earned credits under Minor Degree cannot be transferred to Major

Degree; they will remain extra. These additional courses will be mentioned in the transcript. However, they are eligible to receive B.Tech. Degree after satisfying its requirements.

d. The evaluation pattern of the courses shall be similar to the evaluation of regular program courses.

e. Minimum strength required for offering Minor Degree in a discipline is 40 students.

f. A student registered for Minor degree shall pass in all subjects that constitute the requirement for the Minor degree program. No class/division (i.e., second class, first class and distinction, etc.) shall be awarded for Minor degree program.

g. The Minor degree shall be mentioned in the degree certificate as Bachelor of Technology in XXX with Minor in YYY. For example, Bachelor of Technology in Computer Science & Engineering with Minor in Title of the Minor Pursued. This shall also be mentioned in the transcripts, along with the list of courses taken for Minor degree program. However, the performance of the student in the Minor courses will not be considered for the calculation of SGPA and CGPA for the award of Major Degree.

h. Separate course/class work and time table shall be arranged for the various Minor degree programs. Attendance regulations for these Minor discipline programs shall be as per regular courses.

i. Students aspiring for Minor degree must register from III B.Tech I-Semester onwards and must opt for a Minor in a discipline other than the discipline he is registered in.

j. A Student shall register for Minor with the following combinations:

Offering Theory and Laboratory Courses: SEVEN credits in a semester starting from III B.Tech I-Semester to III B.Tech II-Semester (TWO theory & ONE laboratory courses) and FOUR credits in IV B.Tech I-Semester (ONE theory & ONE laboratory courses).

Offering Theory Courses only: SIX credits in a semester starting from III B.Tech I-Semester to IV B.Tech I-Semester (TWO theory courses).

NOTE: Interested meritorious students shall be permitted to register either for a Minor degree in a discipline (or) Honors Degree in a discipline only, but not both.

MINOR DEGREE IN

INSTRUMENTATION AND CONTROL ENGINEERING

Offering Department: ELECTRONICS AND INSTUMENTATION ENGINEERING

Students of Eligible Branches: CSE, CSSE, IT, ECE, EEE, ME and CE

COURSE STRUCTURE

Year &Semester	Course code	Course title	Contact Periods per week			C	Scheme of Examination Max. Marks		
			L	T	P		Int. Marks	Ext. Marks	Total Marks
III B.Tech. I-Sem (2 Theory+ 1 Lab)	19BM51001	Electrical and Electronic Measurements	3	-	-	3	40	60	100
	19BM51002	Industrial Instrumentation	3	-	-	3	40	60	100
	19BM51003	Computer Control of Process	3	-	-	3	40	60	100
	19BM51031	Industrial Instrumentation lab	-	-	2	1	50	50	100
III B.Tech. II-Sem (2 Theory+ 1 Lab)	19BM61001	Aircraft Instrumentation	3	-	-	3	40	60	100
	19BM61002	Process Control Instrumentation	3	-	-	3	40	60	100
	19BM61003	Smart Sensors	3	-	-	3	40	60	100
	19BM61031	Process Control Lab	-	-	2	1	50	50	100
IV B.Tech. I-Sem (1 Theory+ 1 Lab)	19BM71001	Biomedical Instrumentation	3	-	-	3	40	60	100
	19BM71002	Programmable Logic Controllers	3	-	-	3	40	60	100
	19BM71031	Biomedical Instrumentation Lab	-	-	2	1	50	50	100

Note: If any student has chosen a course from the above list in their regular curriculum then, he/she is not eligible to opt the same course/s for the Minor degree. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course.

III B. Tech. – I Semester

(19BM51001)**ELECTRICAL AND ELECTRONIC MEASUREMENTS**

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	3	-	-	3

PRE-REQUISITES: -

COURSE DESCRIPTION: Science of measurement; construction and principle of operation of ammeters, voltmeters, ohmmeters; potentiometers; power meter; power factor meter; energy meter; design of AC and DC bridges; frequency and time measurements.

COURSE OUTCOMES: After successful completion of this course, the students will be able to:

CO1. Select suitable measuring instrument for measurement of voltage, current, resistance, power and energy by applying the fundamental concepts of measuring instruments.

CO2. Calibrate the DC and AC potentiometers and apply the concepts for calibration of ammeter& voltmeter and measurement of resistance & inductance.

CO3. Design AC and DC bridges for measurement of resistance, capacitance and Inductance.

CO4. Demonstrate the digital measuring instrument used for measurement of frequency and time period.

DETAILED SYLLABUS:

UNIT-I: AMMETERS AND VOLTMETERS (11 Periods)

Classification of analog instruments, Principle of operation of analog instruments, operating forces of electromechanical indicating instruments: deflecting, control and damping; Permanent Magnet Moving Coil (PMMC): Construction, working principle, Expression of torque equation, Errors in PMMC Instruments, Advantage and Disadvantages of PMMC Instruments; Moving Iron Instruments: Classification of Moving Iron Instruments, Construction, working principle and Expression of torque equation; Ammeter: Ammeter shunt, Effect of Temperature Change in Ammeter, Multi-range Ammeters; Voltmeter: Voltmeter Multipliers, Effect of Temperature Change in Voltmeters, Multi-range Voltmeter Analog voltmeter, AC voltmeter using rectifiers, true RMS Voltmeter

UNIT-II: OHMMETERS AND POTENTIOMETERS (09 Periods)

Ohmmeters: Series type ohmmeter, shunt type ohmmeter, Multimeter.

DC Potentiometers: Basic potentiometer circuit, standardization, Compton's Potentiometers, Multiple-range potentiometer, applications: Calibration of Voltmeter, Calibration of Ammeter, Measurement of Resistance.

AC Potentiometers: Standardization, Types of A.C Potentiometers: Polar types, Coordinate types, applications: Voltmeter Calibration, Ammeter Calibration, Measurement of Self reactance of a coil.

UNIT-III: POWER & ENERGY METERS (08 Periods)

Power in D.C Circuits, Power in A.C Circuits, Electrodynamometer wattmeter: Construction, working principle, Torque equation, Errors in Electrodynamometer wattmeter, Three Phase Wattmeter. Electrodynamometer Power Factor Meter: Single Phase, Three Phase. Energy Meter: Single Phase Induction Type Energy Meter: Construction, Working Principle, Errors in Single Phase energy meter; Polyphase energy meters: Two element energy meter

UNIT-IV: BRIDGES (08 Periods)

Measurement of Resistance: Medium Resistance Measurement: Wheatstone bridge, Kelvin Bridge; Low Resistance Measurement: Kelvin double bridge; High Resistance Measurement: Direct deflection methods.

Measurement of Inductance: Maxwell Bridge, Hay's Bridge and Anderson Bridge.

Measurement of capacitance: De Sauty's Bridge and Schering bridge, Q-meter.

UNIT-V:FREQUENCY AND TIME MEASUREMENTS (09 Periods)

Digital Frequency Meter - Basic Circuit, Time Base Selector, Start and Stop gate; Circuit for Measurement of Frequency; Simplified Composite Circuit for a Digital Frequency Meter; High Frequency Measurement, Frequency synthesizer; Period Measurement; Ratio and Multiple Ratio Measurements; Time Interval Measurements; Universal Counter Timer.

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXT BOOK:

1. A.K.Sawhney, *A Course in Electrical and Electronics Measurements and Instrumentation*, Dhanpat Rai and Sons, New Delhi, 19th Revised edition, 2013.
2. H S Kalsi, *Electronic Instrumentation and Measurements*, McGraw-Hill, 4th edition, 2019.

REFERENCE BOOKS:

1. E.W. Golding & F.C. Widdis, *Electrical Measurements and Measuring Instruments*, 5th edition, Wheeler Publishing.
2. Doeblin, E.O., Measurement Systems: Applications and Design, McGraw-Hill, 4th edition 2003.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/108/105/108105153/
2. https://swayam.gov.in/nd1_noc19_ee44/preview

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	-	-	-	-	-	-	-	-	-	3	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	2	2	3	-	1	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
Average	*2.4*	*2.5*	*3*	-	*1*	-	-	-	-	-	-	-	*3*	-	-
Level of correlation of the course	**3**	**3**	**3**	**-**	**1**	-	-	-	-	-	-	-	**3**	-	-

Correlation Level: 3-High 2-Medium 1-Low

III B. Tech. – I Semester

(19BM51002)INDUSTRIAL INSTRUMENTATION

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	3	-	-	3

PRE-REQUISITES: -

COURSE DESCRIPTION: Measurement of humidity, Viscosity, Density, Pressure, Level and Flow parameters; Signal Conditioning & Safety Instruments.

COURSE OUTCOMES: After successful completion of this course, the students will be able to:

CO1. Analyze and identify the appropriate transducer to measure density, viscosity, humidity and pressure based on applications.

CO2. Analyze and identify the appropriate transducer to measure level and flow based on applications.

CO3. Design signal conditioning circuit for amplifiers, range extension and conversion of V to I & I to V.

CO4. Demonstrate the safety instruments, requirements for safety and standards.

DETAILED SYLLABUS:

UNIT - I: DENSITY, VISCOSITY & HUMIDITY MEASUREMENT (11 Periods)

Density: Introduction, Pressure head type, Displace type, Float type, Buoyancy effect densitometer method, Hot-wire gas bridge type, Vibration type, Radioactive method. Viscosity: Introduction, Friction tube viscometer, Saybolt's viscometer, Rotameter viscometer, Searle's rotating cylinder, Cone and Plate viscometer. Consistency meter – Rotating vane type and oscillating type. Humidity: Psychrometer, hygrometer & Types, Dew point device. Analysis and selection of Density, Viscosity and Humidity sensors.

UNIT - II: PRESSURE MEASUREMENT (08 Periods)

Dead weight gauges, Manometer and its Types, Elastic transducers – Bourdon tube, Diaphragm, Bellows, Electrical Types, Resistive, Inductive and Capacitive, Force balance & Vibrating Cylinder, High pressure measurement – Very high pressure transducer (Bulk modulus Gage), Low Pressure (Vacuum) measurement – McLeod Gage, Knudsen Gage, Momentum transfer gage, Thermal conductivity gage, Ionization gage, Sound level meter, Microphone. Analysis and selection of pressure sensors.

UNIT – III: LEVEL MEASUREMENT (07 Periods)

Introduction, Gauge Glass technique, Float Types – Float–and– tape method, Float–and–shaft method, Magnetic float types. Displacer types, Hydrostatic types – Air-Purge type, Bubbler type. Thermal effect types, Electrical types – Resistance switch type, Inductive and Capacitance type. Ultrasonic Methods, bellow element type level transmitters, Fibre - optic type, Analysis and selection of level sensors.

UNIT – IV: FLOW MEASUREMENT (10 Periods)

Introduction, Head types – Orifice, Venturi, Flow Nozzle, Dahl Tube, Pitot tube, Area Flow meter - Rotameter & types, Mass flow meters – Turbine Mass flow meter, Coriolis flow meter, Gyroscopic flow meter, Liquid bridge mass flow meter, Calorimetric flow meter. Positive Displacement type flow meters - Nutating Disc, Rotary Vane, Lobed Impeller, Reciprocating Piston type, Fluted Rotor.Electrical type flow meter – Turbo magnetic flow meter, Electromagnetic flow meter, Ultrasonic flow meter, Hotwire anemometer type, Vertex Shedding type.Analysis and selection of Flow sensors.

UNIT-V: SIGNAL CONDITIONING & SAFETY INSTRUMENTS (09 Periods)

Wheatstone bridge: Compensation & Sensitivity. Design of I to V, V to I converters, Range conversion of current, voltage, Design application of Instrumentation amplifier, Signal conditioning for Self-generating sensors: Chopper and low drift amplifiers Composite amplifier, charge amplifier and electrometer amplifier.

Proximity Sensors, Limit switches, Electrical & Intrinsic Safety: NEMA types, Fuses & Circuit breakers. Explosion hazards & intrinsic safety – Protection methods, Purging, pressurization, ventilation.

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXT BOOKS:

1. D. Patranabis, *Principles of Industrial Instrumentation*, TMH, 3rd Edition, 2010.
2. A. K. Sawhney, *A Course in Electrical and Electronics Measurements and Instrumentation*, Dhanpat Rai and Sons, 19th edition, 2011.

REFERENCE BOOKS:

1. Bela G Liptak, *Instrument Engineers' Handbook: Process Measurement and Analysis*, CRC Press - Butterworth Heinemann, 4th Edition, 2003.
2. Ramon PallásAreny, John G. Webster, *Sensors and Signal Conditioning*, John Wiley and Sons, 2nd Edition, 2000.
3. Ernest Doebelin, Dhanesh Manik, *Measurement Systems*, McGraw-Hill International, 6th Edition, 2011.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/108105064/
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/108105064/lec1.pdf
3. https://www.ibiblio.org/kuphaldt/socratic/sinst/book/liii.pdf

CO-PO and PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	3	-	-	-	-	-	-	-	3	-	-
CO2	2	-	-	-	3	-	-	-	-	-	-	-	3	-	-
CO3	2	-	-	-	3	-	-	-	-	-	-	-	3	-	-
CO4	2	-	-	-	3	-	-	-	-	-	-	-	3	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO6	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
Average	2.75	3	3	-	3	-	-	-	-	-	-	-	3	-	-
Level of correlation of the course	3	3	3	-	3	-	-	-	-	-	-	-	3	-	-

Level of Correlation: 3 - High 2 - Medium 1 - Low

III B. Tech. – I Semester

(19BM51003) COMPUTER CONTROL OF PROCESS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	3	-	-	3

PRE-REQUISITES: -

COURSE DESCRIPTION: Analysis of discrete state variable system identification techniques, direct discrete design techniques, advanced control strategies used in industries, Adaptive Control.

COURSE OUTCOMES: After successful completion of this course the student will be able to

CO1. Demonstrate knowledge on discrete data systems, Z –Transform and modified Z - Transform of Sampled Data system.

CO2. Design of controllersbasedondiscretetimemodels areused in Industries.

CO3. Analyze various control strategies and identify mathematical model for various systems.

CO4. Asses the information to provide effective solution for real time problems using adaptive control methods.

DETAILED SYLLABUS:

UNIT-I: DISCRETE STATE-VARIABLE TECHNIQUE (11 Periods)

State equation of discrete data system with sample and hold, State transition equation, Methods Of computing the state transition matrix, Decomposition of discrete data transfer functions, State Diagrams of discrete data systems, System with zero-order hold, Controllability and observability of linear time invariant discrete data system, Stability tests of discrete-data system.

UNIT-II: SYSTEMIDENTIFICATION (08 Periods)

SystemTheory,Mathematicalmodels,Modelproperties,Structuralmodelrepresentation,Systemidentificationprocedure. Modified Z – Transform, First order system with timedelay.

UNIT-III: DESIGNOF CONTROLLERS (09 Periods)

Computer control loop, Convertingcontinuoustimecontrollertodiscretetimedomain, Designofcontrollersbasedondiscretetimemodelbeatand Dahlin'salgorithms.DesignofFeedForwardController:BlockDiagram.

UNIT-IV: ADVANCED PROCESS CONTROLSTRATEGIES (09 Periods)

Cascade Control- Dynamic response, Types, Implementation, Predictive Control– ModelbasedandMultivariableSystem,StatisticalProcessControl.
AlgorithmsforProcesseswithDeadTime–SmithPredictor,Analytical Predictor.

UNIT-V: ADAPTIVECONTROL **(08 Periods)**

Self-Tuning Regulators, Adaptive Control Adjustment, Indirect Adaptive Control, Direct Adaptive Control, Model Reference Adaptive Control, Relationship between MRAC and STR, Inertial Control with examples.

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXT BOOKS:

1. S.K.Singh, *Computer Aided Process Control*, PHI,2009.
2. Gopal, M., Digital Control and State Variable Methods, Tata McGraw Hill, 2003.

REFERENCE BOOKS:

1. M. Chidambaram, *Computer Control of Processes*, Narosa Publications, 2nd Edition,2003.
2. Karel J. Keesman, *System Identification: An Introduction*, Springer,2011.
3. Pradeep B.Deshpande and Raymond H Ash, *Elements of Computer Process Control with Advanced Applications*, 2nd Edition, Instrument Society ofAmerica,1981.
4. Krishna Kant, *Computer-based Industrial Control*, 2nd Edition, PHI, Delhi, 2010.

ADDITIONAL LEARNING RESOURCES:

1. http://nptel.ac.in/courses/112103174/4
2. http://nptel.ac.in/courses/112103174/3
3. www.freevideolectures.com /Course/3126/Process-Control-and-Instrumentation
4. www.nptel.ac.in/courses/103105064/

CO-PO and PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	**3**
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	3
CO3	3	-	3	-	-	-	-	-	-	-	-	-	-	-	3
CO4	3	-	3	3	-	-	-	-	-	-	-	-	-	-	3
Average	3	3	3	3	-	-	-	-	-	-	-	-	-	-	3
Level of correlation of the course	**3**	**3**	**3**	**3**	-	-	-	-	-	-	-	-	**-**	-	**3**

Level of Correlation: 3 - High 2 - Medium 1 - Low

III B. Tech. – I Semester

(19BM51031)**INDUSTRIAL INSTRUMENTATION LAB**

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
50	50	100	-	-	2	1

PRE-REQUISITES: - A Course on Industrial Instrumentation.

COURSE DESCRIPTION: LabVIEW basics; Circuit design and simulation in Multisim; Measurement of Torque, Temperature, Viscosity, Humidity, Pressure, Level and Flow.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Apply the LabVIEW functions in programming.
CO2. Simulate electrical circuits using Multisim.
CO3. Analyze the characteristics of measuring instruments by applying the fundamental concepts.
CO4. Develop PC based data logger systems by interfacing hardware devices like myRIO, ELVIS and required sensors for measurement.
CO5. Design and solve problems in the measurement of parameters for required specifications.
CO6. Work independently and in teams to solve problems with effective communication.

LIST OF EXPERIMENTS:

(Minimum ELEVEN experiments are to be conducted)

1. LabVIEW Basics : Practice of Virtual Instrumentation Course content

Numeric, Boolean, Strings, For, While, Case Structures, Arrays, Clusters, Sequence: Flat, Stacked, Formula Node, SubVI's, Local/Global Variables.

2. Data Acquisition and analysis using Graphs, Charts, myRio/ELVIS and LabVIEW.
3. Data Logging and analysis of simulated or acquired signals using File I/O.
4. Design and verification of converters using op-amps in Multisim.

a) I to V
b) V to I

5. Design and verification of resistance measurement, conversion in Multsim using

a) Op-Amp
b) Wheatstone bridge for improving sensitivity, compensation and linearity.

6. Measurement of Pressure.
7. Measurement of Humidity.
8. Measurement of Flow.
9. Measurement of Torque.
10. Measurement of Viscosity.
11. Design and verification of level measurement.
12. Design and verification of Speed measurement.
13. Design and verification of temperature measurement using LabVIEW & ELVIS.

REFERENCE BOOKS/LABORATORY MANUALS:

1. Travis Jeffrey, Jim Kring, *LabVIEW for Everyone*, Pearson Education, 2009.
2. Johnson Jennings, *LabVIEW Graphical Programming*, McGraw Hill, 4th Edition, 2014.
3. D. Roy Chowdhury, *Linear Integrated Circuits*, New Age International Pvt. Ltd., 4th Edition, 2010.
4. D. Patranabis, *Principles of Industrial Instrumentation*, TMH, 3rd Edition, 2010.
5. Ramon PallásAreny, John G. Webster, *Sensors and Signal Conditioning*, John Wileyand Sons, 2nd Edition, 2000.
6. A. K. Sawhney, *A Course in Electrical and Electronics Measurements and Instrumentation*, Dhanpat Rai and Sons, 19th edition, 2011.

SOFTWARE/Tools used:

1. NI Labview 2018
2. NI Circuit Design Suite – Multisim 2019
3. NI myRIO
4. NI ELVIS

ADDITIONAL LEARNING RESOURCES:

1. https://www.ni.com/pdf/manuals/320999e.pdf
2. https://ieeexplore.ieee.org/document/8960023/
   A Different way of Level measurement for PBL in Education of Students using NI-LabVIEW, Multisim and MyRIO
3. http://www.ni.com/pdf/manuals/376047c.pdf
4. https://www.clemson.edu/cecas/departments/ece/document_resource/undergrad/lab_manuals/NI_ELIVS_II_Orientation_Manual.pdf
5. http://www.ni.com/pdf/manuals/374629c.pdf
6. http://www.ni.com/pdf/manuals/373363f.pdf

CO-PO and PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	2	2	2	2	1	1	3	3	3
CO2	3	3	2	2	2	2	1	1	1	1	1	1	3	3	3
CO3	3	3	3	2	2	2	2	1	1	1	1	1	3	3	3
CO4	3	3	3	3	2	2	2	2	1	1	1	1	3	3	3
CO5	3	3	3	3	3	2	2	2	2	1	1	1	3	3	3
CO6	3	3	3	3	3	3	2	2	2	1	1	1	3	3	3
CO7	3	3	3	3	3	3	3	2	2	2	1	1	3	3	3
CO8	3	3	3	3	3	3	3	3	2	2	1	1	3	3	3
CO9	3	3	3	3	3	3	3	3	3	2	1	1	3	3	3
Average	3	3	3	3	3	3	2	2	2	1	1	1	3	3	3
Level of correlation of the course	3	3	3	3	3	2	2	2	2	1	1	1	3	3	3

Level of Correlation: 3 - High 2 - Medium 1 - Low

III B. Tech. – II Semester

(19BM61001)**AIRCRAFT INSTRUMENTATION**

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	3	-	-	3

PRE-REQUISITES: -

COURSE DESCRIPTION: Aircraft Instruments; Air Data Instruments; Gyroscopic Instruments; Engine Instruments and Flight Control and Navigational Aids, EFIS, Electronic warfare and Aircraft safety.

COURSE OUTCOMES: After successful completion of this course, the students will be able to:

CO1: Demonstrate knowledge on aircraft system.

CO2: Select suitable instrument for specific parameter measurement in an aircraft.

CO3: Design control schemes for Auto pilot and Auto-throttle system in an aircraft.

CO4: Select navigation aids for appropriate communication in an aircraft.

CO5: Demonstrate knowledge on aircraft safety systems and electronic warfare.

DETAILED SYLLABUS:

UNIT-I: INTRODUCTION TO AIRCRAFT (10 Periods)

Control Surfaces, Forces, Moments and Angle of Attack, Modern Aircraft System, Aircraft Instruments and their Layout, Aircraft Display Types: Quantitative Displays, Display Color and Markings, Glass Cockpits of Modern Aircraft: Attitude Director Indicator, Electronic Attitude Director Indicator, Horizontal Situation Indicator, EFIS, Command bars, HSI, ADP.

UNIT-II: COCKPIT INSTRUMENTS (10 Periods)

Introduction to Air Data Instruments, Air Data Computer, Combined Pitot and Static Probe, Position Error, ASI, ALTI, VSI, Introduction to Gyro, Vibrating Gyros, Ring Laser Gyroscope, Fibre Optic Gyros, Directional Gyro, Gyro Horizon.

UNIT-III: ENGINE INSTRUMENTS (10 Periods)

Introduction, Engine Speed Measurement: Electrical TachoGenerator/Indicator, Non-Contact type TachoProbe, Torque Measurement, Electronic Torque Meter, Pressure Measurement, Engine vibration Measurement and Monitoring, Fuel Flow Rate Indicator, Engine Fuel Quantity Indicator

UNIT-IV: FLIGHT CONTROL AND NAVIGATIONAL AIDS (08 Periods)

Introduction to AFCS, Auto pilot, Auto-throttle, IFCS, Fundamentals of Radio Navigation Aids, VOR, DME, Instrument Landing system, GPS.

UNIT-V: ELECTRONIC WARFARE AND AIRCRAFT SAFETY (07 Periods)

Introduction to Electronic warfare, Electronic support, EP, EA, Jamming and Spoofing, DEW, Air data warning systems, Stall warning systems, GPWS, TCAS

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXT BOOK:

1. S.Nagabhushana, L.K.Sudha, *Aircraft Instrumentation andSystems*, I K International Publishing House Pvt. Ltd,2010

REFERENCE BOOK:

1. Pallett, E.H.J, *AircraftInstruments and Integrated Systems*,Pearson higher Education, 1992.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/101/104/101104069/
2. https://nptel.ac.in/courses/112/103/112103281/
3. http://www.nptelvideos.in/2012/11/space-flight-mechanics.html

CO-PO and PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	3	-	-	-	-	-	-	-	3	-	-
CO3	2	-	3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	2	-	-	-	3	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
Average	*2.6*	*3*	*3*	-	*3*	*3*	-	-	-	-	-	-	*3*	-	-
Level of correlation of the course	**3**	**3**	**3**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**

Level of Correlation: 3 - High 2 - Medium 1 - Low

III B. Tech. – II Semester

(19BM61002)**PROCESS CONTROL INSTRUMENTATION**

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	3	-	-	3

PRE-REQUISITES: -

COURSE DESCRIPTION: Mathematical modeling of processes, Different types of controllers, characteristics of controllers, design of controllers, Tuning of controllers, characteristics of control valves, multi loop controllers.

COURSE OUTCOMES: After successful completion of this course, the students will be able to:

CO1. Develop mathematical model of various process by applying fundamental laws.

CO2. Design controller by applying fundamental concepts of control schemes and tuning methods.

CO3. Demonstrate knowledge on various final control elements used in process Industries

CO4. Apply the Multi loop control concepts of real time industrial and domestic applications.

DETAILED SYLLABUS:

UNIT - I: PROCESS CHARACTERISTICS (10 Periods)

Elements of process control, Process variables, Degree of freedom, Characteristics of electric system, liquid system, gas system and thermal system, Elements of process dynamics, Mathematical model of liquid process, gas process and thermal processes, Servo operation, Regulatory operation, Self-regulation.

UNIT - II: CONTROL SCHEMES AND CONTROLLERS (10 Periods)

Discontinuous controller modes: Two position, Multi-position, Floating control modes; Continuous controller modes: Proportional, Integral, Derivative; Composite controller modes: PI, PD, PID; Electronic controllers: Design of discontinuous, continuous and composite controller modes. Pneumatic controllers (displacement type).

UNIT – III: CONTROLLER TUNING (08 Periods)

One-Quarter decay ratio criteria, Time integral performance criteria, Process loop tuning: open-loop transient response method, Ziegler-Nichol's method, Cohen- Coon method, Direct synthesis method, Frequency responsemethod.

UNIT - IV: FINAL CONTROL ELEMENTS (09 Periods)

Pneumatic actuators: Spring actuator, Hydraulic actuators: Piston actuator, Electrical actuators: Solenoid, Electro-pneumatic actuators, Control valves: Types of control valves and its characteristics, Sliding-stem control valves, Rotating-shaft control valves, Selection of control valves, Control-valve sizing, Pneumatic valve positioner.

UNIT - V: MULTI LOOP CONTROL SCHEMES (08 Periods)

Cascade control, Ratio control, Feed forward control, Over-ride, Split range, Case study on distillation column: Principle control scheme- constant top product, constant bottom product and reflex rate, constant reflex rate and steam rate.

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXT BOOKS:

1. Donald P. Eckman, Automatic Process Control, Wiley Eastern Ltd., 1993.
2. Curtis D. Johnson, *Process Control Instrumentation Technology*, Pearson Education, New Delhi, 7th Edition, 2002.
3. G. Stephanopoulis, *Chemical Process Control,* PrenticeHall, 1990.

REFERENCE BOOKS:

1. Patranabis, *Principles of Process Control*, TMH.,1981.
2. Peter Harriot, *Process Control*,TMH.
3. K. Krishnaswamy, *Process Control*, New Age International, 2nd Edition, 2009.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in
2. https://www.amtekcompany.com › Amatrol
3. https://wiki.metakgp.org › H31011:Instrumentation and Process Control

CO-PO and PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	-	-	-	-	-	-	-	-	-	-	-	3
CO2	2	2	3	-	-	-	-	-	-	-	-	-	-	-	3
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO4	3	-	-	-	3	-	-	-	-	-	-	-	-	-	3
Average	2.5	2	3	-	3	-	-	-	-	-	-	-	-	-	3
Level of correlation of the course	**3**	**2**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**

Level of Correlation: 3 - High 2 - Medium 1 - Low

III B. Tech. – II Semester

(19BM61003) **SMART SENSORS**

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	3	-	-	3

PRE-REQUISITES: -

COURSE DESCRIPTION: Smart sensors for physical variables, Different smart materials and technologies, getting sensor information to MCU, Communication protocols and different standards for smart sensors.

COURSE OUTCOMES: After successful completion of this course, the students will be able to:

CO1. Apply suitable smart sensor for measurement of physical parameters.

CO2. Demonstrate knowledge on smart materials and its fabrication techniques.

CO3. Design signal conditioning circuits for various smart sensors.

CO4. Select appropriate protocol for real time applications.

CO5. Demonstrate knowledge on IEEE standards for smart sensors.

DETAILED SYLLABUS:

UNIT-I: SMART SENSORS FOR ELECTRICAL AND NON-ELECTRICAL, PHYSICAL AND CHEMICAL VARIABLES: TENDENCIES AND PERSPECTIVES (08 Periods)

Introduction, Temperature IC and Smart Sensors, Pressure IC and Smart Sensors and Accelerometers, Rotation Speed Sensors, Intelligent Opto Sensors, Humidity Frequency Output Sensors, Chemical and Gas Smart Sensors.

UNIT-II: MATERIALS AND TECHNOLOGIES (09 Periods)

Materials: Silicon as a Sensing Material, Plastics, Metals, Ceramics, Structural Glasses, Optical Glasses, Nano-materials, Surface Processing: Spin-Casting, Vacuum Deposition, Sputtering, Chemical Vapor Deposition, Electroplating, MEMS Technologies: Photolithography, Silicon Micromachining, Micromachining of Bridges and Cantilevers, Wafer Bonding.

UNIT-III: GETTING SENSOR INFORMATION INTO THE MCU (10 Periods)

Introduction, Amplification and Signal Conditioning: Instrumentation Amplifiers, SLEEP MODE Operational Amplifier, Rail-to-Rail Operational Simplifiers, Switched-Capacitor Amplifier, 4- to 20-mA Signal Transmitter, Inherent Power-Supply Rejection, Separate Versus Integrated Signal Conditioning: Integrated Passive Elements, Integrated Active Elements, Digital Conversion: A/D Converters, Performance of A/D Converters, Implications of A/D Accuracy and Errors.

UNIT-IV: COMMUNICATIONS FOR SMART SENSORS (09 Periods)

Introduction, Sources (Organizations) and Standards, Automotive Protocols: CAN Protocol, LIN Protocol, Media Oriented Systems Transport, FlexRay, Industrial Networks, Protocols in Silicon: MCU with Integrated CAN, LIN Implementation, Ethernet Controller, Transitioning Between Protocols, Application Example.

UNIT-V: STANDARDS FOR SMART SENSING (09 Periods)

Introduction, Setting the Standards for Smart Sensors and Systems, IEEE 1451.1, IEEE 1451.2, IEEE 1451.3, IEEE 1451.4, IEEE 1451.5, IEEE 1451.6, IEEE 1451.7, Application Example.

TotalPeriods: 45

Topics for Self-study are provided in the Lesson Plan

TEXT BOOKS:

1. Nikolay Kirianaki, Sergey Yurish, Nestor Shpak, Vadim Deynega , "*Data Acquisition and Signal Processing for Smart Sensors*", John Wiley & Sons Ltd, 1st edition, 2002.
2. Jacob Fraden , "*Handbook of Modern Sensors: Physics, Designs, And Applications*", Springer, 5thedition, 2016.
3. Randy Frank, "*Understanding Smart Sensors*", Artech House, 3rd Edition, 2013.

REFERENCE BOOKS:

1. Sergio Franco*, "Design with Operational Amplifiers and Analog Integrated Circuits",* McGraw-Hill Education, 4th edition, 2015.
2. G.K. Ananthasuresh K.J. Vinoy S. Gopala krishnan K.N. Bhat V.K. Aatre, "*Micro and Smart Systems: Technology and Modeling*", John Wiley & Sons, Inc., 1st edition, 2012.

ADDITIONAL LEARNING RESOURCES:

1. **Smart sensors:**
   https://www.electrochem.org/dl/interface/wtr/wtr10/wtr10_p029-034.pdf
   https://www.ee.iitb.ac.in/~esgroup/es_mtech02_sem/es02_sem_rep_dubey.pdf
2. **MEMS Technologies: Photolithography**
   https://nanoscale.unl.edu/pdf/Photolithography_Participant_Guide.pdf
3. **Standards for smart sensors- ieee-1451:**
   https://www.electronicdesign.com/technologies/components/article/21787128/smart-sensors-ieee-1451.

CO-PO and PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	3	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	2	3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	3	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
Average	*3*	*2*	*3*	-	*3*	-	-	-	-	-	-	-	*3*	-	-
Level of correlation of the course	**3**	**2**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**

Level of Correlation: 3 - High 2 - Medium 1 - Low

III B. Tech. – II Semester

(19BM61031)**PROCESS CONTROL LAB**

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
50	50	100	-	-	2	1

PRE-REQUISITES: A Course on Process Control Instrumentation.

COURSE DESCRIPTION: Tuning methods, Characteristics of control valve, Response of controllers for different processes like flow, level, pressure etc., Design of controllers.

COURSE OUTCOMES: After completion of this course, the student will be able to

CO1. Demonstrate knowledge on process equipments.

CO2. Develop the transfer function of the process and analyze the performance of the process in terms of time domain specifications.

CO3. Design electronic PID controller and tune its controller parameters using various tuning methods.

CO4. Analyze the response of flow, level and pressure process.

CO5. Work independently and in teams to solve problems with effective communication.

LIST OF EXPERIMENTS:

(Minimum 10 experiments to be conducted)

1. Analyze the behavior of Flow process with and without controller.
2. Obtain the performance for liquid level process with and without controller.
3. Response of Pressure Process using controller.
4. Obtain the transfer function model for Interacting Systems.
5. Obtain the transfer function model for Non-Interacting Systems.
6. Analyze the servo and regulatory response for pressure control process.
7. Obtain the characteristics of electro-pneumatic converter.
8. Obtain the controller parameters using Process reaction curve method.
9. Obtain the controller parameters using continuous oscillation method.
10. Study the response of ratio controller.
11. Study the closed loop performance of cascade controller.
12. Obtain the valve flow-lift characteristics of Linear, On-OFF and equal percentage control valve.
13. Realization of control actions- Electronic PID controller.

REFERENCE BOOKS/LABORATORY MANUALS:

1. DonaldP.Eckman,*AutomaticProcessControl*,WileyEasternLtd., 1993.
2. Curtis D. Johnson, *Process Control Instrumentation Technology*, Pearson Education, New Delhi, 7th Edition, 2002.

ADDITIONAL LEARNING RESOURCES:

1. http://www.vlab.co.in/lab_ready_for_use.php
2. https://www.pidlab.com/en/
3. http://www.eiecouncil.com/process-control-lab.html

CO-PO and PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2	3	2	3	-	-	-	-	-	-	-	-	-	-	-	3
CO3	3	2	3	-	-	-	-	-	-	-	-	-	-	-	3
CO4	2	3	-	-	-	-	-	-	-	-	-	-	-	-	3
CO5	-	-	-	-	-	-	-	-	2	2	-	-	-	-	3
Average	2.75	2.33	3	-	-	-	-	-	2	2	-	-	-	-	3
Level of correlation of the course	3	3	3	-	-	-	-	-	2	2	-	-	-	-	3

Level of Correlation: 3 - High 2 - Medium 1 - Low

IV B. Tech. – I Semester

(19BM71001)**BIOMEDICAL INSTRUMENTATION**

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	3	-	-	3

PRE-REQUISITES: -

COURSE DESCRIPTION: Human Anatomy & Physiology; Bio-signals; Cardiovascular and Neuro-muscular Instrumentation; Therapeutic Equipment; Advanced Imaging techniques.

COURSE OUTCOMES: After successful completion of this course, the students will be able to

CO1. Demonstrate knowledge on Bioelectric Potentials and various electrodes for measuring Potentials.
CO2. Analyze ECG signals and measure various cardiovascular parameters.
CO3. Analyze EEG and EMG signals and measure various parameters in neuro muscular and respiratory systems.
CO4. Demonstrate the working of various theraptic instruments.
CO5. Demonstrate the working of imaging instruments used for diagnosis by following ethical values.

UNIT–I: BIO ELECTRIC POTENTIALS AND ELECTRODES (09 Periods)

Block diagram of biomedical instrumentation, Problems encountered in measuring a living system, system, Structure of cell, Resting and Action Potentials, Propagation of Action Potentials, sources of Bioelectric Potentials, Electrode theory, Bio potential electrodes, Bio chemical transducers.

UNIT–II: CARDIOVASCULAR INSTRUMENTATION (09 Periods)

Physiology of cardiovascular system, electrical conduction system of the heart, interpretation of ECG waveform, standard 12-lead configurations, Einthoven triangle, specifications of ECG Machine; Blood pressure, blood flow and heart sound measurements; Relation between electrical and mechanical activities of the heart.

UNIT–III: NEURO-MUSCULAR AND RESPIRATORY INSTRUMENTATION (09 Periods)

Physiology of nervous system, electrode placement for EEG and EMG recording, Specification of EEG and EMG machines, Interpretation of EEG and EMG.

Respiratory Instrumentation: Mechanism of respiration, Spirometry, Pnemuotachograph Ventilators.

UNIT – IV: THERAPEUTIC EQUIPMENT (09 Periods)

Pacemakers: Need for Cardiac pacemakers, pacing modes, Ventricular asynchronous Pacemaker (Fixed rate Pacemaker), Ventricular inhibited Pacemaker (demand Pacemaker), Atrial Synchronous pacemaker, Comparision between internal & external Pacemakers; Defibrillators: AC Defibrillator, DC Defibrillator, Synchronised DC Defibrillator; Diathermy: Shortwave and microwave, Dialysis: Hemo Dialysis, Peritonal Dialysis.

UNIT – V: MEDICAL IMAGING SYSTEM (09 Periods)

Ultrasonic Imaging: Doppler principle, Modes of Display: A-Mode, B-Mode and Echocardiography. Computed Tomography: Block diagram of CT scanner, Applications of Computed Tomography.MRI Imaging System, Cine angiogram, Endoscope.

TotalPeriods: 45

Topics for self-study are provided in the lesson plan

TEXTBOOKS:

1. Leslie Cromwell, Fred. J. Weibell and Erich. A. Pfeiffer, "*Biomedical Instrumentation and Measurements"*, 2nd Edition, PHI, 2003.
2. R.S. Khandpur, "*Hand Book of Biomedical Instrumentation*", Tata McGraw Hill, 2nd Edition, 2002.

REFERENCE BOOKS:

1. John G.Webster, "*Medical Instrumentation Application and Design*", 3rd Edition, Wiley India Pvt. Ltd.,2004
2. M. Arumugam, "*Biomedical Instrumentation*", Anuradha Publications, 1992.

ADDITIONAL LEARNING RESOURCES:

1. https://www.nibib.nih.gov›science-education›students-resource
2. https://www.who.int›medical_devices›support
3. https://nptel.ac.in

CO-PO and PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	2	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	2	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	3	-	-	-	-	3	-	-
Average	3	3	-	-	-	-	-	3	-	-	-	-	3	2	-
Level of correlation of the course	3	3	-	-	-	-	-	3	-	-	-	-	3	2	-

Level of Correlation: 3 - High 2 - Medium 1 - Low

IV B. Tech. – I Semester

(19BM71002)**PROGRAMMABLE LOGIC CONTROLLERS**

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	3	-	-	3

PRE-REQUISITES: -

COURSE DESCRIPTION Introduction to PLC, PLC ladder diagrams, programming PLC, timers, counters and sequences used in PLC, data handling functions, bit Patterns, advanced PLC functions.

COURSE OUTCOMES: After successful completion of this course, the students will be able to:

CO1. Demonstrate knowledge on programmable logic controllers, various functions of PLCs.

CO2. Analyse the process of automation using PLC functions.

CO3. Develop programs for industrial applications to automate the process using PLC functions.

CO4. Solve real time problems in industries using PLCs.

DETAILED SYLLABUS:

UNIT-I:PLC BASICS AND PROGRAMMING (09 Periods)

Introduction, PLC advantages, disadvantages, PLC system, CPU,I/O modules and interfacing, power supplies, Programming equipment, Programming formats, Construction of PLC ladder diagrams, Devices connected to I/O modules. Input instructions, outputs, Operational procedures, Programming examples usingcontacts and coils, Fail-Safe Circuits, Drill press operation.

UNIT-II: LADDER DIAGRAMS, REGISTERS AND TIMER FUNCTIONS (09 Periods)

Digital logic gates, Boolean algebra PLC programming, Conversion examples. Ladder Diagrams for process control: Ladder diagrams & sequence listings, ladder diagram construction and flowchart for spray process system. Characteristics of Registers, module addressing, holding registers, Input Registers, OutputRegisters.Timer function & Industrial applications, Counter functions& industrial applications.

UNIT-III: INTERMEDIATE AND DATA HANDLING FUNCTIONS (09 Periods)

Intermediate functions: Arithmetic functions, Number comparison functions, Number conversion functions. Skip, Master control relay, Jump functions. PLC data move systems: Move function, FIFO, FAL, & Sweep functions and their applications.

UNIT-IV: PLC FUNCTIONS WORKING WITH BITS (08 Periods)

Bit Pattern, Changing a register bit status, Shift register functions and applications, Sequencer functions and applications,Controlling of two-axis & three axis Robots with PLC, Matrixfunctions.

UNIT-V: ADVANCED PLC FUNCTIONS (10 Periods)

Analog modules & systems, Analog signal processing, Multi-bit Data Processing, Analog output application examples, PID principle, position indicator with PID control, PID Modules, PID tuning, PID functions, Networking of PLCs, Alternative Programming languages.

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXT BOOK:

1. John W. Webb & Ronald A. Reiss, *Programmable Logic Controllers Principles and Applications*, 5th edition, PHI 2009.

REFERENCE BOOKS:

1. Frank D. Petruzella,*Programmable Logic Controller*, 3rd edition, Tata Mc-Graw Hill, 2010.
2. M.Chidambaram, *Computer Control of Process*, Narosa 2003.

ADDITIONAL LEARNING RESOURCES

1. https//openautomationsoftware.com/use cases /allenbradleywpfscada/
2. https//new.siemens.com/global/en/products/automation/industrysoftware/automatio nsoftware/scada.html
3. https//ab.rockwellautomation.com/Programmable Controllers

CO-PO and PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	3
CO3	3	-	3	-	-	-	-	-	-	-	-	-	-	-	3
CO4	3	-	-	-	3	-	-	-	-	-	-	-	-	-	3
Average	*3*	*3*	*3*	-	*3*	-	-	-	-	-	-	-	-	-	*3*
Level of correlation of the course	**3**	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**

Level of Correlation: 3 - High 2 - Medium 1 - Low

IV B. Tech. – I Semester

(19BM71031)BIOMEDICAL INSTRUMENTATION LAB

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
50	50	100	-	-	2	1

PRE-REQUISITES: A Course on Biomedical Instrumentation.

COURSE DESCRIPTION: Measurements of parameters: pH, Dissolved Oxygen, Conductivity blood pressure, respiration rate and heart sounds; Analysis of Bio-Signals; Compression of Bio-Signals.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Select suitable biomedical instrument for specific measurement of physiological parameters.

CO2. Design signal conditioning circuit for various biosensors.

CO3. Analyze the response of various biosignals to detect abnormalities.

CO5. Work independently and in teams to solve problems with effective communication.

LIST OF EXPERIMENTS:

Minimum of TEN experiments to be conducted

1. Calibration and measurement of pH value, Dissolved Oxygen and Thermal Conductivity of a given sample.
2. Blood pressure measurement.
3. Analysis of ECG for different lead configurations.
4. Analysis of EEG Signals.
5. Analysis of EMG Signals.
6. Design of Instrumentation Amplifier for bioelectrical Signals.
7. Measurement of Heart Sounds.
8. Real time EPR System.
9. Electrical Safety analyzer for biomedical equipments.
10. Analysis of Bio-Signals using Lab View.
11. Compression of Bio-Signals using Lab View.
12. Flame photometer for biomedical applications.
13. Study and analyze the performance of UV-VIS Spectrophotometer.

REFERENCE BOOKS/LABORATORY MANUALS:

1. Leslie Cromwell, Fred. J. Weibell and Erich. A. Pfeiffer, "*Biomedical Instrumentation and Measurements"*, 2nd Edition, PHI, 2003.
2. R.S. Khandpur, "*Hand Book of Biomedical Instrumentation*", Tata McGraw Hill, 2nd Edition, 2002.
3. John G.Webster, "*Medical Instrumentation Application and Design*", 3rd Edition, Wiley India Pvt. Ltd.,2004

ADDITIONAL LEARNING RESOURCES:

1. Lab view 2013 biomedical toolkit.
2. http://www.vlab.co.in/ba-nptel-labs-biotechnology-and-biomedical-engineering
3. https://physionet.org/

CO-PO and PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	3	-	-	-	-	-	-	-	3	-	-
CO2	3	2	3	-	-	-	-	-	-	-	-	-	2	3	-
CO3	3	3	-	-	-	-	-	-	--	-	-	-	2	3	-
CO4	-	-	-	-	-	-	-	-	2	2	-	-	3	-	-
Average	2.6	2.5	3	-	3	-	-	-	2	2	-	-	2.5	3	-
Level of correlation of the course	3	3	3	-	3	-	-	-	2	2	-	-	3	3	-

Level of Correlation: 3 - High 2 - Medium 1 - Low