Curriculum for UG Degree Course in BTech. Instrumentation and Control Engineering (Academic Year: 2024-25 Onwards)											
Second Year | Semester-IV											
Sr. No.	**Course Code**	**Course Title**	**Lecture**	**Tutorial**	**Practical**	**In sem**	**End sem**	**Practical**	**Oral**	**Marks**	**Credits**
1	23PCIN401	Control Systems	3	1	0	50	50	0	0	100	4
2	23PCIN402	Microcontrollers	3	0	0	50	50	0	0	100	3
3	23PCIN403	Industrial Drives	2	0	0	25	25	0	0	50	2
4	23CEP401	Community Engagement Project	1	0	2	50	0	0	0	50	2
5	23MmIN401	Environmental Instrumentation	3	1	0	50	50	0	0	100	4
6	23EEM401	Entrepreneurship	3	1	0	50	50	0	0	100	4
7	23VSECIN401	Excel Programming	1	0	2	50	0	0	0	50	2
8	23PCIN402L	Microcontrollers Lab	0	0	2	25	0	25	0	50	1
		Total =	**16**	**3**	**6**	**350**	**225**	**25**	**0**	**600**	**22**

Instrumentation and Control Department

APPROVED BY
Secretary Academic Council
MKSSS's Cummins College of Engineering
For Women, Pune-411052

APPROVED BY
Chairman Academic Council
MKSSS's Cummins College of Engineering
For Women, Pune-411052

23PCIN401 Control Systems

Teaching Scheme
Lecture: 3 Hrs/week
Tutorial: 1 Hr/week

Examination Scheme
In semester: 50 Marks
End semester: 50 Marks
Credits: 4

Prerequisite: Basics of Linear Algebra and Laplace Transform

Course Objectives:

1. Understand the basic components of control systems and types of control systems.
2. Learn and develop the relationship between system input and output.
3. Learn to develop systems mathematical models.
4. Understand the basic mathematical tools for analysis of control systems.

Course Outcomes:

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

1. Compare different types of Control Systems.
2. Identify various Time & Frequency Domain parameters of a given system.
3. Analyze stability of the control system.
4. Design Mathematical Model of Control System that meets design specifications.

Unit I: Introduction to Control System

Introduction and brief classification of Control System, Representation of Electrical, Mechanical, Electromechanical, Thermal and Pneumatics Control System with Differential Equations, Concept of Transfer Function

Unit II: Transfer Function, Block Diagram Algebra & Signal Flow Graph

Representation of Electrical and Mechanical Control System with Force to Voltage and Force to Current Analogy, Block Diagram Algebra, Signal Flow Graph

Unit III: Time Domain Analysis

Standard Test Signal, Dynamic Error Constants, First and Second Order System and Its Response to the Standard Test Signals, Time Domain Specifications, Static Error Constants – kv, kp, ka and ess.

Unit IV: Stability Analysis

Concept of Stability in S – Domain, Concept of Relative Stability and Absolute Stability, Classification of Stability, Stability Analysis by Routh Hurwitz Criteria.

Unit V: Frequency Domain Analysis

Introduction to Bode Plot, Nyquist Plot, Nyquist Stability Criterion, Gain and Phase Margins, Robustness.

Unit IV: Compensation Techniques

Introduction to Compensation, Compensation via Root Locus, Compensator Configurations, Commonly used Compensators, Effect of Adding Poles and Zeros to Root Locus.

Text Books:

1. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International (P) Limited, Publishers, 5th Edition, 2009.
2. B. C. Kuo, "Automatic Control Systems", John Wiley and Sons, 8th Edition, 2003.
3. K. Ogata, "Modern Control Engineering", 4th Edition, Pearson Education.
4. D. Roy Choudhury, "Control System Engineering", PHI.

Reference Books:

1. N. K. Sinha, "Control Systems", New Age International (P) Limited Publishers, 4th Edition, 2013
2. M. N. Bandyopadhyaya, "Control Engineering, Theory & Practice", PHI.
3. Norman Nise, "Control System Engineering", 3rd Edition, John Wiely and Sons.
4. Graham C Goodwin, Stefan F. Graebe, Mario E. Salgado, "Control System Design", PHI.
5. Ajit K. Mandal, "Introduction to Control Engineering", New Age International.
6. R. T. Stefani, B. Shahian, C. J. Savant and G. H. Hostetter, "Design of Feedback Control Systems", Oxford University Press.
7. Samarjit Ghosh, "Control Systems Theory and Applications", Pearson Education.

Tutorials:

Minimum 8 assignments based on the course contents

23PCIN402 Microcontrollers

Teaching Scheme
Lecture: 3 Hrs/week

Examination Scheme
In semester: 50 Marks
End semester: 50 Marks
Credits: 3

Prerequisites: Concepts of Digital Electronics, Basics of C programming

Course Objectives:
1. To introduce the architecture and features of microcontrollers
2. To provide an understanding of hardware and software design and integration for Microcontroller based systems
3. To develop a small application system with AVR microcontroller.

Course Outcomes:
The students will be able to
1. Comprehend the architecture and features of microcontroller
2. Select appropriate features of AVR microcontroller for given application
3. Configure on-chip peripherals for given application
4. Design microcontroller-based system of various applications

Unit I: Introduction to 8 bit microcontrollers
Microprocessors and Microcontroller architecture, Overview, Family and Features of AVR microcontrollers, Role of microcontrollers in Industrial systems like condition monitoring or equivalent. Concepts of Memory (RAM and ROM), Buses, AVR Pin diagram, AVR Memory Organization, Program Counter and Program ROM space

Unit II: Architecture and Programming -I
Microcontroller Application Development Tools: Simulator, Emulator, ISP, Cross assembler,. AVR architecture, Programming techniques for AVR, data types, writing loops and subroutines in C, Time Delays, logic operations, data conversion and memory allocation in C. AVR Port Structure, Alternate Port Functions, I/O configurations, I/O Port programming and Bit manipulations in C, System Clock and Clock Options, Reset Sources

Unit III: Architecture and Programming -II

Introduction to interfacing display and keyboard, WatchDog Timer and Stack Memory concepts and use,. AVR Fuse bits, External and Internal Interrupts, Programming, Configuring and Priority

Unit IV: Integrated Timers and Counters

8 bit Timer/ Counter 0 with PWM, Modes, Prescaling and Programming in C, 16 bit Timer/ Counter 1, Modes, Prescaling and Programming in C, Input Capture and Wave generation using timers

Unit V: ADC and Serial interfaces

ADC Features, Operation, Programming and Configuring, Introduction to serial interfaces: SPI, I2C and USART, Introduction to RS232C, RS485

Unit VI: Small system development

Power Management in AVR microcontrollers, Peripheral interfacing, Introduction to Features and capabilities of Arduino Systems, Case study for System design and development

Text Books:

1. 'The AVR microcontroller and Embedded Systems Using Assembly and C', Mazidi, Naimi, Naimi, Prentice Hall, 2011
2. 'Arduino, the complete beginners guide', Bryon Francis
3. 'Embedded Systems, Architecture Programming and Applications', Raj Kamal, McGraw Hill
4. ‘Programming And Customizing The AVR Microcontroller’, Dhananjay Gadre, Tata McGraw Hill Publishing Company Limited

Reference Books:

1. Datasheet of AVR ATMega8535
2. Microchip AVR Microcontroller Primer Programming and Interfacing’, Steven Barett, Daniel Pack, Third Edition, Morgan & Claypool Publishers
3. AVR Programming: Learning to Write Software for Hardware, Elliot Williams, Maker Media Inc.

23PCIN403 Industrial Drives

Teaching Scheme
Lecture : 2 Hrs/week

Examination Scheme
In semester : 25 Marks
End semester : 25 Marks
Credits : 2

Prerequisite: -

Course Objectives:
1. To understand and analyze different power electronic devices.
2. To study different special purpose integrated circuits.
3. To use different control methodologies based on different applications.
4. To use the knowledge to understand and solve practical problems.

Course Outcomes:
The students would be able to
1. Define the characteristics of different power devices.
2. Compare various power circuits and motors
3. Select suitable power circuits and motors for various applications.
4. Design suitable controlling circuits for different applications.

Unit I: Introduction to Power Devices
SCR, TRIAC, DIAC, Power MOSFET, UJT, SCR gate triggering and commutation circuits

Unit II: Converters
Single Phase and Three Phase controlled rectifiers, (Half wave, full wave and bridge Configuration) with resistive and inductive load with freewheeling diode.
Choppers: Principle, Working, Classification, Chopper controlling strategies, Uninterruptible Power Supply (UPS)

Unit III: Electric Machines
DC Motors, Stepper motors, 3 phase Induction motors - Principle, Construction, Working, Types, Characteristics, Applications, Induction Motors

Unit IV: Protection and Control Devices

Starters for motors, circuit breakers, fuses, over voltage and over current protection circuits for power devices, cooling mechanism for power devices, Solid state relays, Variable frequency drive (VFD)

Text Books:

1. M.D. Singh, K. B. Khanchandani, 'Power Electronics', 2nd edition, 2017 McGraw Hill Company
2. B. L. Theraja and A. K. Theraja, S. Chand &Sons, "A textbook of Electrical Technology", Volume-II, AC & DC Machines

Reference Books:

1. P. C. Sen,' Power Electronics', TMH, 2nd ed, 2017
2. Mohamad Rashid,' Power Electronics', PHI, 2nd edition, 2004
3. G.K.Dubey, Power semiconductor controlled drives, Prentice Hall- 1989
4. Bhag S. Guru, Huseyin P. Hiziroglu,"Electric Machinery and Transformers", Third Edition, 2000
Oxford University Press
5. Krishnan, Electrical Motor Drives, PHI-2003

23CEP401 Community Engagement Project

Teaching Scheme
Lecture: 1 Hr/week
Practical: 2 Hrs/week

Examination Scheme
In semester: 50 Marks
Credits: 2

Course Outcomes:

After completion of the course, students will be able to

CO1: To define problem statement for identified community

CO2: To select method for data collection

CO3: To analyze the collected data

CO4: To conclude / summarize overall learning from the project and communicate it to the stakeholders

In this course, students will identify a significant challenge/problem faced by a certain community, apply a systematic approach to investigate the problem, conduct field visits to collect relevant data, analyse the collected data, summarise their findings and compile a detailed report about their study. This report may be presented to the stakeholders.

Pedagogy:

- In-class activity: Group discussions, interaction with faculty mentor
- Out-of-the-class activity: Field visits, interaction with community, data collection

23MmIN401 Environmental Instrumentation

Teaching Scheme
Lecture: 3 Hrs/week
Tutorial: 1 Hr/week

Examination Scheme
In semester: 50 Marks
End semester: 50 Marks
Credits: 4

Prerequisite: -

Course Objectives:

1. To learn the necessity of Instrumentation in Environmental Engineering.
2. To describe various components in Environmental Instrumentation.
3. To understand different types of Pollutions and various control strategies.

Course Outcomes:

The student will be able to

1. Identify the necessity of instrumentation related to the environmental issues.
2. Suggest instrumentation required in various environmental systems.
3. Select various sensors and instruments for measurement of environmental parameters
4. Analyze the given application related to environmental engineering

Unit I: Sensors, Detectors, Analysers for Environmental Instrumentation

Necessity of instrumentation & control for environment, sensor requirement for environment, Instrumentation methodologies: Detectors & Analyser, Laws and Standards used in environmental instrumentation

Unit II: ICT- Automatic Weather Station

Instruments in Weather stations like Barometer, Rain gauge, Ceilometer etc. Global environmental analysis, Remote Sensing Technology in Environmental Engineering, Rover Environmental Monitoring Station (REMS).

Unit III: Water Quality Parameters and Water Treatment

Standards of raw & treated water, sources of water & their natural quality, effects of water quality, Water quality parameters & their application, conductivity analysers & their application, Water treatment

Unit IV: Air Pollution and Sound Monitoring Systems

Definitions, energy environment relationship, importance of air pollution, Air sampling methods & equipment, analytical methods for air pollution studies. Control of air pollution, Instruments used for air pollution control. Sound pollution: basics of sound pollution, its effect on the environment. Acoustic noise measurement & monitoring, control methods

Unit V: Geo-informatics

Introduction to Geo-informatics, Role of Geo-informatics in Environmental Monitoring and Control along with some case studies

Text Books:

1. Waste Water Treatment and Water Management : Water Treatment and Management,by Anamika Shrivastava, 2018.
2. Air pollution engineering by M. N. Rao & H. V. N. Rao, July 2017.
3. Noise Pollution And Its Control By Polak Kj, 2019
4. 'Environmental Engineering' by Peany Howard S, Donal R Rowe and George TachoBanoylous Teddy, 2017

Reference Books:

1. Environmental Engineering - Fundamentals, Sustainability, Design,by Mihelcic, August 2021
2. Environmental Engineering III Hardcover – Illustrated, by Lucjan Pawlowski 23 March 2010
3. Environmental Instrumentation & Analysis Handbook by Randy D. Down, October 2004
4. Environmental Engineering and Science by Gilber M Masters, Pearson Education December 2006.

Tutorials:

Minimum 8 assignments based on the course contents

23EEM401 Entrepreneurship

Teaching Scheme
Lecture: 3 Hr/Week
Tutorial: 1 Hr/week

Examination Scheme
In semester: 50 Marks
End semester: 50 Marks
Credits: 4

Prerequisite: -

Course Objectives:
Students will be able to
1. Understand the fit between individual entrepreneurial ambitions and select a problem worth solving
2. Identify customers and create value proposition
3. Identify direct and indirect competitors and prepare business model
4. Build and demonstrate an MVP (Minimum Viable product) and financial plan
5. Identify appropriate GTM Channels
6. Prepare growth plan along with possible funding options

Course Outcomes:
1. After completion of the course, the student will be able to
2. Identify entrepreneurial opportunities and develop entrepreneurial skills
3. Analyze the customer segments and create a compelling value proposition for solution
4. Develop Business Model along with Minimum Viable Product for testing
5. Create a Pitch deck with effective presentation

Unit I: Entrepreneurship foundation
Entrepreneurship and Intrapreneurship, why startup fails, Mindset, skillset, entrepreneurial styles, discover yourself, Principles of Effectuation, problem identification and opportunity discovery, problem worth solving analysis and validation, idea validation.

Unit II: Value proposition
Customer segments, market identification and sizing, primary and secondary research, customer journey mapping, market validation, brainstorming ideas, innovative solution, Problem- solution fit, compelling value proposition, sustainable differentiation, competition analysis, pricing models, competitive advantage.

Unit III: Business model canvas

Lean business model, test assumptions, identify risks, risk mitigation strategy, MVP and testing MVP, refining MVP, business plan: financial, sales, people. unit economics, identify matrix that matters, feasibility analysis.

Unit IV: Goto market strategy

Channel identification, key partnerships, marketing strategy, Pricing strategy, Effective marketing plan, digital marketing. building traction, feedback, refining MVP, Product-market fit, refining business model and strategy

Unit V: Support systems and business regulations

business entities, organization structure and functional requirements, agreements, regulations and permissions, business ethics, startup ecosystem, incubation centers and accelerators, Government initiatives, local initiatives, IPR strategy, role of technology

Unit VI: Pitch deck and growth plan

Effective pitch deck, contents of presentation, growth plan, scaling strategy, 5 years plan, creating pitch deck, Sources of funds, term sheet and contracts, equity, execution plan, team building, time management and work delegation, business partner and employee dilemma, acquisition, and mergers

Text Books:

1. “Entrepreneurship Journey from Idea to Startup” by Dr. Makarand Ramesh Velankar, Dr. Megha Sunil Borse, Dr. Anjali Milind Naik Techknowledge Publications, 2024
2. Course contents will be available on https://wadhwanifoundation.org/programs/ignite/

Reference Books:

1. Harvard business review entrepreneur's handbook
2. Traction: A Startup Guide to Getting Customers by Gabriel Weinberg and Justin Mares

Tutorials:

Assignments based on the course contents

23VSECIN401 Excel Programming

Teaching Scheme
Lecture: 1 Hr/Week
Practical: 2 Hrs/week

Examination Scheme
In semester: 50 Marks
Credits: 2

Prerequisite: -

Course Outcomes:
The student will be able to
1. Identify various functions and formulas for data.
2. Apply various tests and ANOVA on the data
3. Interpret the results obtained from various tests & ANOVA
4. Analyze data using Pivot Tables and Pivot Charts

Unit I: Fundamental Arithmetic and Formulae
Unit II: Graphical Displays
Unit III: Table Construction, Workbook, and Worksheet Formatting
Unit IV: Analyze Worksheet Data, Utilize Data Tools
Unit V: Create and Manage Macros & Pivot Tables
Unit VI: Introduction to Power BI & It's Use

List of Practical Assignments:
1. Using the data given, get the sum of all the figures within the range
2. Using the data given, get the Mean, Mode Median, Skewness and Kurtosis for the data
3. Using the data given, plot the bar graph in different ways. (grouped, non-grouped, stacked etc)
4. Using the data given, plot following types of Graphical Representations (Pie Chart, Line Chart etc)
5. Enter the data given below into a worksheet.
   i). Calculate the totals for each salesperson and get the grand total.
   (ii). Format the worksheet as follows:
   - Make all the Totals bold, two decimal places, comma, center the title across columns
     and make it size 16, bold and Italic.
   - Put a double border round the whole table and a single line border inside the table.
   - Save the worksheet as Stationery Analysis

6. Carry out the calculations in the Excel Sheet by inserting the formula.
7. Apply t-test, p-value, ANOVA on the data and draw conclusions based on the values obtained.
8. Create Macro in the Excel
9. Create & Analyze Pivot Tables in Excel
10. Introduction to Power BI

Or similar type of practical assignments based on the course contents

Reference Books:

1. L. Winston Wayne, "Microsoft Excel 2019: Data Analysis and Business Model", Sixth Edition, PHI Learning PVT LTD, ISBN-10: 9389347181
2. Manisha Nigam, "Data Analysis with Excel", BPB Publication, ISBN-10: 9388176677.
3. Bill Jele & Tracy Syrstad, "Microsoft Excel VBA and Macros (Office 2021 and Microsoft 365)", Publisher – Microsoft Press, ISBN-10: 0137521529.
4. David A. Williams, "Excel Macros – The Ultimate Beginners Guide to Learn Excel Macros Step-by-Step", Publisher: David A. Williams (27 July 2020), ISBN-10: 1735338117.
5. Alberto Ferrari & Marco Russo, "Introducing Microsoft Power BI", Publisher: Microsoft Press; 1st edition (7 July 2016), ASIN: B01IPIUTTU.
6. Mike Morris, "Power BI – A complete Step-by-Step Guide for Beginners in Understanding Power BI", Publisher : Independently Published (12 September 2019), ISBN-10: 1691641227

23PCIN402L Microcontrollers Lab

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
In semester: 25 Marks
Practical: 25 Marks
Credits: 1

Course Outcomes: The students will be able to

1. Write an algorithm and microcontroller program for the given problem statement
2. Debug the developed program for the given problem statement
3. Interface various I/O devices to the microcontroller
4. Develop a microcontroller based system for the given application

List of Experiments (any 8):

1. Introduction and familiarization with programming environment of AVR
2. Arithmetic and Logical Operations in AVR
3. Bit wise operations and Port pin manipulations
4. Data Conversion Programs in C
5. Square wave generation using hardware delays with polling and interrupts
6. Event counter using timer
7. Frequency measurement using time period method
8. Analog input measurement using ADC
9. Interfacing of LCD display
10. Introduction to Arduino system Programming
11. Open ended assignment on system development

Or similar type of practical assignments based on the course contents