Autonomous Program Structure
Second Year B. Tech. Fourth Semester
(Instrumentation and Control)
Academic Year: 2021-2022 Onwards

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Marks	Credit
		Lecture	Tutorial	Practical	In Semester	End Semester	Oral	Practical		
20IN401	Fundamentals of Computer Networks	3	0	0	50	50	0	0	100	3
20IN402	Control Systems	3	0	0	50	50	0	0	100	3
20IN403	Micro controller Techniques	3	1	0	50	50	0	0	100	4
20IN404	Power Electronic and Drives	3	1	0	50	50	0	0	100	4
20IN405	Unit Operations	3	1	0	50	50	0	0	100	4
20IN402L	Control Systems Lab	0	0	2	25	0	0	25	50	1
20IN403L	Micro controller Techniques Lab	0	0	2	25	0	0	25	50	1
20AC401	Audit Course	0	0	2	0	0	0	0	0	No Credit
	Total	**15**	**3**	**6**	**300**	**250**	**0**	**50**	**600**	**20**
	Grand Total	**24**			**600**				**600**	**20**

20IN401 Fundamentals of Computer Networks

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

Prerequisites: -

Course Objectives:
1. To define computer networks and describe their purpose
2. To understand the types and components of networks
3. To understand the functions of each layer in a network

Course Outcomes: the students will be able to
1. Identify components and methods in networks.
2. Compare the functions of layers in a network.
3. Identify models and issues in networks.
4. Compare protocols and standards.

Unit 1: Introduction to Computer Networks (08)
Type of Networks LAN, WAN, MAN, Ad-hoc Networks. Networking Topologies: Bus, Mesh, Star, Ring and Hierarchical. Types of Connection- Point to Point, Point to Multi Point, Network Standards. Network components: Switches, Routers, Hubs, Gateways, Repeaters, Modems, Cables, NIC and access points.

Unit 2: Network Models and Physical Layer (08)
ISO-OSI 7-layer model, Functions of each layer, TCP/IP model.
Protocol Data Units, encapsulation and decapsulation
Digital modulation and multiplexing methods: FDM, TDM, PCM, FSK, GFSK, Spread Spectrum Technique
Transmission Media: Twisted pair cable, coaxial cable, Fiber Optic cable

Unit 3: Data Link Layer (08)
Data Link Layer Design Issues, Error Detection and Error Correction, Medium Access Control Sub layer, Ethernet MULTIPLE ACCESS PROTOCOLS, ALOHA, Carrier Sense Multiple Access Protocols, Collision-Free Protocols, Limited-Contention Protocols, Wireless LAN Protocols

Unit 4: Ethernet Basics (06)
Ethernet Basics, Collision Domain, Broadcast Domain, CSMA/CD, Half- and Full-Duplex Ethernet, Ethernet at the Data Link Layer, Ethernet Addressing, Ethernet Frames, Channel Bonding, Ethernet at the Physical Layer.

Unit 5: Network Layer (06)
IP Addressing, Communication from Host to Host, Network Layer Protocol, Packaging the Transport Layer PDU, IPv4 and IPv6 Packet Header, Comparison of IPv4 and IPv6, Subnetting, Static Routing, Dynamic Routing, Routing Protocols
Introduction to NFV (Network Function Visualization)

Unit 6: Protocols and QoS framework in Networks (06)

UDP, HTTP, FTP, SMTP and equivalent
Internet QoS: Introduction, Architecture, Traffic Policing, Traffic Shaping, Traffic Scheduling, Integrated and Differentiated Service Architecture
Network Security

Books:

1. Mark A. Dye, Rick McDonald, Antoon W. Rufi, "Network Fundamentals", Cisco Press, 2008
2. Behrouz A. Forouzan, "Data Communications and Networking", 4th Edition, Tata McGraw- Hill, Publications, 2017.
3. William Stallings "Data and computer communication", Pearson, 10th Edition, 2015
4. Kurose, Ross "Computer Networking a Top Down Approach Featuring the Internet",6th edition (March 5, 2012), Pearson , ISBN-10: 0132856204.
5. Andrew S. Tenenbaum, "Computer Networks", 5th Edition, PHI, ISBN 81-23- 2175-8

20IN402 Control Systems

Teaching Scheme:
Lectures: 3 Hrs/Week

Examination Scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

Prerequisites: Basics of Linear Algebra and Laplace Transform

Course Objectives:
1. Understand the basic components of control system 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: the students will be able to
1. Analyze & predict systems behavior based on time and Frequency Domain Analysis.
2. Design Control System that meets design specifications.
3. Develop a Mathematical Model of the Control System.
4. Compare the Classic Control System with the Modern Control System.

Unit 1: Introduction to Control System (07)
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 2: Transfer Function, Block Diagram Algebra & Signal Flow Graph (08)
Representation of Electrical and Mechanical Control System with Force to Voltage and Force to Current Analogy, Block Diagram Algebra, Signal Flow Graph

Unit 3: Time Domain Analysis (07)
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 4: Stability Analysis (07)
Concept of Stability in S – Domain, Concept of Relative Stability and Absolute Stability, Classification of Stability, Stability Analysis by Routh Hurwitz Criteria.

Unit 5: Frequency Domain Analysis (07)
Introduction to Bode Plot, Bode Plot, Nyquist Plot, Nyquist Stability Criterion, Gain and Phase Margins, Robustness.

Unit 6: Compensation Techniques (06)

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

Text Books:

1. I. 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, 3rd Edition, 1998.
2. Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Pvt. Ltd., 3rd Edition, 1998.
3. M. N. Bandyopadhyaya, "Control Engineering, Theory & Practice", PHI.
4. Norman Nise, "Control System Engineering", 3rd Edition, John Wiely and Sons.
5. R.C. Dorf & R.H. Bishop, "Modern Control System", 11th Edition, Pearson Education.
6. Graham C Goodwin, Stefan F. Graebe, Mario E. Salgado, "Control System Design", PHI.
7. Christopher T. Kilian, "Modern Control Technology Components & Systems", 3rd Edition, Cengage Learning.
8. Ajit K. Mandal, "Introduction to Control Engineering", New Age International.
9. R. T. Stefani, B. Shahian, C. J. Savant and G. H. Hostetter, "Design of Feedback Control Systems", Oxford University Press.
10. Samarjit Ghosh, "Control Systems Theory and Applications", Pearson Education.

20IN403 Microcontroller Techniques

Teaching Scheme:
Lectures: 3 Hrs/week
Tutorial: 1 Hrs/week

Examination Scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 4

Prerequisites:
1. Concepts of Digital Electronics
2. Hexadecimal number systems and their arithmetic/ logical operations
3. 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
3. Microcontroller based system development
4. To develop small application system with AVR microcontroller.

Course Outcomes: the students will be able to
1. Select appropriate features of AVR microcontroller for given application.
2. Identify detailed hardware structure and software model of the AVR for the given application.
3. Develop configuration of on-chip peripherals.
4. Design microcontroller-based system

Unit 1: Introduction to 8 bit microcontrollers (08)
Microprocessors and Microcontroller architecture, Overview, Family and Features of AVR ATMega8535, Concepts of Memory (RAM and ROM), Buses, AVR Pin diagram, AVR Memory Organization, Program Counter and Program ROM space

Unit 2: Architecture and Programming -I (08)
A. Microcontroller Application Development Tools: Simulator, Emulator, ISP, Cross assembler
B. AVR architecture, Programming techniques for ATMega8535, data types, writing loops and subroutines in C, Time Delays, logic operations, data conversion and memory allocation in C.
C. System Clock and Clock Options, Reset Sources

Unit 3: Architecture and Programming -II (08)
A. AVR Port Structure, Alternate Port Functions, I/O configurations, I/O Port programming and Bit manipulations in C
B. Introduction to interfacing display and keyboard
C. Watch Dog Timer and Stack Memory concepts and use
D. AVR Fuse bits

Unit 4: Integrated Timers and Counters (06)
A. 8 bit Timer/ Counter 0 with PWM, Modes, Prescaling and Programming in C
B. 16 bit Timer/ Counter 1, Modes, Prescaling and Programming in C
C. Input Capture and Wave generation using timers

Unit 5: Interrupts and ADC (06)

A. External and Internal Interrupts, Programming, Configuring and Priority
B. ADC Features, Operation, Programming and Configuring
C. Introduction to sensor interfacing
D. Power Management in AVR microcontrollers

Unit 6: Other integrated features **(06)**

A. Introduction to serial interfaces: SPI, I^2C and USART
B. Introduction to RS232C, RS485
C. Introduction to Features and capabilities of Arduino Systems

Text Books:

1. 'The AVR microcontroller and Embedded Systems Using Assembly and C', Mazidi, Naimi, Naimi, Prentice Hall
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.

Tutorials:

Minimum 8 assignments based on the course contents

20IN404 Power Electronics and Drives

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

Examination Scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 4

Prerequisites: Linear Integrated Circuits and Digital Electronics

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 will be able to
1. List and Define characteristics of different power devices.
2. Compare to select various power circuits and motors for suitable applications.
3. Develop controlling circuits for various design stages.
4. Design suitable controlling circuit for given applications.

Unit 1: Introduction to Power Devices (08)
SCR, TRIAC, DIAC, Power MOSFET, UJT, SCR gate triggering and commutation circuits

Unit 2: Phase Controlled rectifiers (07)
Single Phase and Three Phase controlled rectifiers, (Half wave, full wave and bridge Configuration) with resistive and inductive load with freewheeling diode.

Unit 3: Choppers and Inverters (08)
Choppers: Principle, Working, Classification, Thyristor choppers- Jones Chopper, Morgan Chopper, Chopper controlling strategies.
Inverters: Classification, Single Phase half bridge and full bridge Inverters, PWM Inverters
Uninterruptible Power Supply (UPS): Principle, Construction, Working, Types, Application

Unit 4: Electric Machines (07)
DC Motors - Principle, Construction, Working, Types, Characteristics, efficiency and Applications
Stepper Motors - Principle, Construction, Working, Types, Characteristics and Applications
Induction Motor - One phase and three phase

Unit 5: Protection Devices (07)
Starters for motors, circuit breakers, fuses, over voltage and over current protection circuits for power devices, cooling mechanism for power devices

Unit 6: Controllers for AC Loads (05)
Solid state relays, Firing angle control, AC Synchronous motor drive, Variable frequency drive (VFD)

Text Books:

1. M.D. Singh, K. B. Khanchandani, 'Power Electronics', 2nd edition, 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, 2007
2. Mohamad Rashid,' Power Electronics', PHI, 2ndedition, 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, Oxford University Press
5. Krishnan, Electrical Motor Drives, PHI-2003

Tutorials:
Minimum 8 assignments based on the course contents

20IN405 Unit Operations

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

Examination Scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 4

Prerequisites: Sensors and transducers

Course Objectives:
1. To learn various Unit Operations used in Industry.
2. To describe various equipment involved in various unit operations.
3. To understand different renewable and non-renewable energy sources

Course Outcomes: the students will be able to
1. Delineate the working of various process equipment used for mass transfer, heat transfer, fluid transfer.
2. Compare various process equipment used in specific unit operations.
3. Select unit operation and related instruments for a given application.
4. Analyze various industries like dairy, pharmaceutical, sugar, etc to identify various process units and unit operations.

Unit 1: Unit Operations and Fluid Transportation (08)

A. Introduction, Flow of incompressible fluids through pipes, transportation and metering of fluids, Pipes, Fittings, Valves, Pumps, Fans, Blowers, Compressors, Feeders, Dampers
B. Fluids filtration, solids fluidization

Unit 2: Unit Operations in Chemical Engineering (08)

A. Gas absorption and liquefaction, refrigeration
B. Mechanical processes: including solids transportation, crushing and pulverization, screening and sieving
C. Separation and mixing of fluids

Unit 3: Heat Transfer Operations (08)

A. Principles of heat flow in fluids, Heat transfer to fluids without phase change, Heat Transfer to fluids with phase change
B. Heat Exchange Equipment: Heat Exchangers, Condensers, Boilers and Calandria,
Evaporators, Cooling towers

Unit 4: Mass Transfer Operations and Introduction to Energy Sources (06)

A. Distillation: Flash and Continuous, Multi component Distillation, Leaching and Extraction
B. Drying of Solids and liquids, Crystallization
C. Energy Sources and their classification
D. Introduction to Power generation

Unit 5: Boiler Ancillaries (06)

A. Types of boilers like FBC, CFBC, DIPC, Fluidized Bed, boiler safety parameters Instrumentation for Boiler, water treatment, electro-static precipitator, soot blower, economizer, deaerator, super heater, chemical dosing systems, air preheater, coal and ash handling systems, fuel storage and distribution, Bag House Filters.

Unit 6: Unit Operations in Process Industry (06)

Study of Processes and Unit Operations applied to process industry, viz. sugar, paper and pulp, Dairy, Pharmaceutical, and Fertilizer

Text Books:

1. Unit Operations in Chemical Engineering by McCabe, W.L., Smith, J.C., and Harriot P., McGraw-Hill VII Edn. 2004.
2. Perry, "Chemical Engineer's Handbook", McGraw Hill, 1984.
3. Non-conventional energy resources by B. H. Khan, McGraw Hill, New Delhi.
4. Renewable energy Technology. Chetan Singh Solanki, Prentice Hall Publication.

Reference Books:

1. Process Control, B.G. Liptak
2. Solar Energy, by S. P. Sukhatme, Tata McGraw Hill, New Delhi.
3. Nonconventional Energy Sources. G. D. Rai, Khanna Publication.
4. M. G. Rao and Misting, "Outline of Chemical Technology", Second Edition, East West, 1973.
5. Leverspel O., "Chemical Reaction Engineering", Second Edition Willey Eastern Pvt Ltd

Tutorials:

Minimum 8 assignments based on the course contents

20IN402L Control Systems Lab

Teaching Scheme:
Practical: 2 Hrs/Week

Examination Scheme:
In Semester: 25 Marks
Practical: 25 Marks
Credit: 1

Course Outcomes: the students would be able to

1. Test the System Response for the various Standard Test Signals.
2. Analyse Transient Response of the System.
3. Analyse Frequency Response of the System.
4. Design compensator using Root Locus Method.

List of Practical Assignments:

1. Formation and Study of Standard Test Signals.
2. Response of First/Second Order System to Standard Test Signals.
3. Transient Response of a System.
4. Analysis of Time Domain Specifications of a Control System.
5. Analysis of Stability in Frequency Domain using Bode Plot.
6. Analysis of Stability in Frequency Domain using Nyquist Plot.
7. Analysis of Stability using Root Locus.
8. Design and Performance Analysis of Lead/Lag Compensator using Root Locus.

Or similar type of practical assignments based on the course contents

20IN403L Microcontroller Techniques Lab

Teaching Scheme:
Practical: 2 Hrs/week

Examination Scheme:
In Semester: 25 Marks
Practical: 25 Marks
Credit: 1

Course Outcomes: the students will be able
1. Program microcontroller using C programming.
2. Select appropriate peripheral for given application.
3. Configure the peripherals in different modes.
4. Debug the developed program / given problem statement.

List of Practical Assignments (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 software delay
6. Square wave generation using hardware delays with polling and interrupts
7. Event counter using timer
8. Frequency measurement using time period method
9. Analog input measurement using ADC
10. Interfacing of LCD display
11. Introduction to Arduino system Programming

Or similar type of practical assignments based on the course contents