Scheme & Syllabus of Master of Technology in Electrical Engineering (Instrumentation & Control) (Effective from 2018-19)
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-I
Choice Based Credit System (effective from Session 2018-19)

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Teaching Schedule</th>
<th>Marks</th>
<th>Total Credits</th>
<th>Duration of Exam (Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>P</td>
<td>Class-Work</td>
<td>Theory</td>
</tr>
<tr>
<td>1</td>
<td>MIC501C</td>
<td>Modern Control Systems</td>
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<tr>
<td>2</td>
<td>MIC503C</td>
<td>Microcontroller Based Control &amp; Instrumentation</td>
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<td>3</td>
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<td>Research Methodology and IPR</td>
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<td>6</td>
<td>MIC581C</td>
<td>Modelling &amp; Simulation Lab</td>
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<td>Control &amp; Instrumentation lab.</td>
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L= Lecture, T = Tutorials, P = Practicals & C = Credits

List of Programme Electives:

<table>
<thead>
<tr>
<th>PE1</th>
<th>PE2</th>
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<tbody>
<tr>
<td>S. No.</td>
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<td>2.</td>
<td>MIC523C</td>
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<td>MIC525C</td>
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List of AUDIT-I & AUDIT-II:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>AUD533C</td>
<td>Disaster Management</td>
<td>AUD539C</td>
<td>Constitution of India</td>
</tr>
<tr>
<td>2.</td>
<td>AUD531C</td>
<td>English for research Paper Writing</td>
<td>AUD541C</td>
<td>Pedagogy Studies</td>
</tr>
<tr>
<td>3.</td>
<td>AUD535C</td>
<td>Sanskrit for Technical Knowledge</td>
<td>AUD543C</td>
<td>Stress Management by Yoga</td>
</tr>
<tr>
<td>4.</td>
<td>AUD537C</td>
<td>Value Education</td>
<td>AUD545C</td>
<td>Personality Development Through Life Enlightenment Skills</td>
</tr>
</tbody>
</table>

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronics gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.
4. Student can opt any two subjects for electives I & II from given list respectively and one audit course from given list of audit course 1 & 2.
5. The choice of students for any elective shall not be binding on the department to offer, if the department does not have expertise. The minimum strength of the students opting for the particular subject shall not be less than 8.
**SEMMESTER – II**

<table>
<thead>
<tr>
<th>S. No</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Teaching Schedule</th>
<th>Marks</th>
<th>Total</th>
<th>Credits</th>
<th>Duration of Exam (Hrs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>L</strong></td>
<td><strong>P</strong></td>
<td><strong>Class work</strong></td>
<td><strong>Theory</strong></td>
<td><strong>Practical</strong></td>
</tr>
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<td>MIC582C</td>
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<td>6</td>
<td>MIC584C</td>
<td>Microcontrollers &amp; Instrumentation Lab.</td>
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Total: 14     8     175  375  150    700  16

L= Lecture, T = Tutorials, P = Practicals & C = Credits

**List of Programme Electives:**

<table>
<thead>
<tr>
<th>PE3 S.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>PE4 S.No.</th>
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<td>MIC526C</td>
<td>Adaptive Learning &amp; Control</td>
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<td>Digital Control Systems</td>
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<td>Fuzzy Control Systems</td>
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<td>MIC524C</td>
<td>Robust Control</td>
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<td>MIC530C</td>
<td>Genetic Algorithms &amp; Applications</td>
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<td>MIC532C</td>
<td>Advanced Virtual Instrumentation</td>
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**List of AUDIT-I & AUDIT-II:**

<table>
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<th>S.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
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<td>3</td>
<td>AUD535C</td>
<td>Sanskrit for Technical Knowledge</td>
<td>AUD543C</td>
<td>Stress Management by Yoga</td>
</tr>
<tr>
<td>4</td>
<td>AUD537C</td>
<td>Value Education</td>
<td>AUD545C</td>
<td>Personality Development Through Life Enlightenment Skills</td>
</tr>
</tbody>
</table>

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3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.
4. Student can opt any two subjects for electives III & IV from given list respectively and one audit course from given list of audit course 1&2.
5. The choice of students for any elective shall not be binding on the department to offer, if the department does not have expertise. The minimum strength of the students opting for the particular subject shall not be less than 8.
SEMMESTER – III

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Teaching Schedule</th>
<th>Marks</th>
<th>Total</th>
<th>Credits</th>
<th>Duration of Exam (Hrs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td>L</td>
<td>P</td>
<td>Class work</td>
<td>Theory</td>
<td>Practical</td>
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<tr>
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L= Lecture, T = Tutorials, P = Practicals & C = Credits

List of Programme Electives:

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<tbody>
<tr>
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<td>MIC621C</td>
<td>Modelling &amp; Control of Distributed Parameter Systems</td>
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<tr>
<td>2.</td>
<td>MIC623C</td>
<td>Stochastic Control</td>
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<td>3.</td>
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<td>Nonlinear Systems &amp; Control</td>
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List of Open Electives:

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<th>S. No.</th>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
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<td>MTOE651C</td>
<td>Business Analytics</td>
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<td>3.</td>
<td>MTOE653C</td>
<td>Industrial Safety</td>
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<td>MTOE655C</td>
<td>Operations Research</td>
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<td>5.</td>
<td>MTOE657C</td>
<td>Cost Management of Engineering Projects</td>
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<td>6.</td>
<td>MTOE659C</td>
<td>Composite Materials</td>
</tr>
<tr>
<td>7.</td>
<td>MTOE661C</td>
<td>Waste to Energy</td>
</tr>
</tbody>
</table>

NOTES:

1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronics gadgets including cellular phones are not allowed in the examination.
3. Examiners will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.
4. Student can opt any one subject for electives (V) and one subject for open elective from given list.
5. The choice of students for any elective shall not be binding on the department to offer, if the department does not have expertise. The minimum strength of the students opting for the particular subject shall not be less than 8.
6. Dissertation (Phase-II) being an extension of Dissertation (Phase-I), for progression to Dissertation (Phase-II), it is necessary that the candidate must have passed Dissertation (Phase-I).

M.Tech. in Electrical Engg. (Instrumentation & Control)
Choice Based Credit System (effective from Session 2019-20)

**SEMESTER – IV**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Teaching Schedule</th>
<th>Marks</th>
<th>Total</th>
<th>Credits</th>
<th>Duration of Exam (Hrs.)</th>
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<tr>
<td></td>
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<td></td>
<td>L</td>
<td>P</td>
<td>Class Work</td>
<td>Theory</td>
<td>Practical</td>
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<td>32</td>
<td>100</td>
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*The dissertation shall be the extension of dissertation (Phase-I) carried out in the 3rd semester. Every student will be required to present three seminar talks & the committee constituted by the Chairman of the Department will screen all the presentations so as to award the sessional marks.

**EXTERNAL ASSESSMENT:**
The Dissertation will be evaluated by the committee consisting of following three persons:
1. **Chairperson of the Department:** Chairperson
2. **Respective Dissertation Supervisor(s):** Member(s)
3. **External Expert:** To be appointed by the University

**NOTES:** The external expert must be from the respective area of the specialization. The chairperson and M.Tech. (I&C) coordinator with mutual consultation will divide the submitted dissertation into groups depending upon area of specialization and recommend the list of experts for each group separately to the Vice-Chancellor for selecting the examiners with the note that an external expert should be assigned a maximum of four dissertations for the evaluation. The students will be required to submit three copies of dissertation report to the M.Tech.(I&C) Coordinator for record and processing.
Programme Outcomes

At the end of M.Tech. (EE(I&C)) Program, students will have

PO1 An ability to apply knowledge of mathematics, allied sciences, and engineering to the problems related to control system & instrumentation.

PO2 An ability to conduct independent research both of an academic and applied nature in the area of applied control theory & instrumentation.

PO3 An ability to use the techniques, skills, and modern control engineering tools necessary for engineering practice.

PO4 An ability to be conversant with practical control & instrumentation system (Design, operation, control, and testing issues).

PO5 An ability to communicate effectively to convey the ideas acquired through research.

PO6 Enhanced knowledge and skill set required in the field of control & instrumentation.

PO7 Engineering skills for problem solving so as to arrive at appropriate technological solutions.

PO8 An understanding of professional and ethical responsibility

Programme Objectives

1. To provide an advanced knowledge in the field of control & instrumentation through core subjects and flexible program specific electives.
2. To widen the multidisciplinary skills by open electives.
3. To ensure overall personality development through Audit courses.
4. To introduce fundamental concepts and basic tools for mathematical analysis and applications of nonlinear dynamical systems such as robot control.
5. To introduce the concepts, mathematical modelling and design of analog & digital controllers.
6. To introduce the fundamental & computational aspects of optimal, robust and adaptive control.
7. To introduce the fundamental concepts of stochastic filtering, prediction, control & system identification.
8. To inculcate the research aptitude in the students.
9. To understand the working & design aspects of advanced industrial instrumentation & automation systems.
10. To introduce the fundamental concepts and applications of microcontroller based control & instrumentation.
11. To impart the knowledge of soft computing techniques and their use for engineering applications.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-I
Choice Based Credit System (effective from Session 2018-19)

MIC501C MODERN CONTROL SYSTEMS

L T P Class-work Marks: 25
3 - - Exam Marks: 75

Total Marks: 100
Duration of Exam: 3 Hrs.
Credits: 3

COURSE OBJECTIVES:
1. To give students an understanding of foundational concepts of modern control primarily based on State Space concept, rather than on Transfer Function. To impart a review of operations on matrices, followed by defining Fields & Vector Spaces, ‘State’ & related concepts.
2. To derive State Models of different types for a range of systems such as electrical, mechanical, hydraulic, electro-mechanical systems, etc.
3. To get an insight into solutions of state equations for continuous-time & discrete-time systems.
4. To understand controllability & observability concepts & apply tests thereof. To understand Lyapunov’s stability analysis tool for linear dynamical systems.

DETAILED CONTENTS:

UNIT-I
Linear Spaces & Linear Operators: Review of vectors & matrices, Limitations of classical control theory; Axiomatic treatment of Field, Vector, Vector Space; Linear combination, Linear Independence, The notion of bases; Linear function/map/operator & its matrix representation, Scalar product of vectors; Quadratic functions & definite, semi-definite matrices, Gram determinant; vector & matrix norms; Rank & Nullity of a matrix; Eigenvalues, Eigenvectors & Canonical form representation of linear operators; Generalized Eigen vectors. (11 hours)

UNIT-II
State Variable Descriptions: The concept of State: initial state, definition of state, state vector, trajectory, Consistency conditions, State Transition Relation or State Equation; State equations for dynamic discrete-time system; Time invariance; Linearity; State model for linear systems, Non-uniqueness of State model; State diagrams for linear time-invariant continuous-time & discrete-time systems.
Physical System & State Assignment: Linear continuous time models of electrical, mechanical, hydraulic, electromechanical systems (illustorative problems). State variable representation using Phase variables, Observable Phase variable form, Controllable phase variable form, State space representation using Canonical variable or Normal form. (12 hours)

UNIT-III
Solution Of State Equations: Derivation of T.F. from State model; Diagonalization, Determination of diagonalized matrix, J and diagonalizing or Modal matrix, M; State equations for continuous time LTI system, Properties of STM (State Transition System) for LTI system; Computation of STM by Infinite series expansion, by Resolvent matrix method (Inverse Laplace Transform), by Similarity or Canonical transformation & by technique based on Cayley-Hamilton Theorem; Solution of state equations for discrete-time systems; Evaluation of STM, $\phi(k)$, for Discrete Time System; System Modes. (12 hours)

UNIT-IV
Controllability, Observability & Stability: Concept of controllability, Definition of controllability; General concept of observability, Definition of observability; Kalman tests for controllability & observability for Continuous-time system; Gilberts tests (Physical interpretation of Gilberts Tests) for controllability & observability; Lyapunov’s stability theory for linear dynamical systems. (10 hours)
TEXT BOOK:

REFERENCE BOOKS:

COURSE OUTCOMES:
After going through this course, the student shall be able to:
1. Have an understanding of State & related concepts, & carry out operations on matrices, & appreciate the axioms of Fields & Vector Spaces.
2. Derive State Models of different types of systems such as electrical, mechanical, hydraulic, electro-mechanical systems, etc.
3. Solve state equations for continuous-time & discrete-time systems.
4. Apply controllability & observability tests to different system models & to apply Lyapunov’s stability analysis tool for linear dynamical systems.

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronic gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.

Approved in the 13th meeting of Academic Council held on 18/06/2018.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-I

Choice Based Credit System (effective from Session 2018-19)

MIC503C MICROCONTROLLER BASED CONTROL & INSTRUMENTATION

L         T          P
3         -          -

Class-work Marks: 25
Exam Marks: 75
Total Marks: 100
Duration of Exam: 3 Hrs.
Credits: 3

COURSE OBJECTIVES:
1. To give students an understanding of architecture of advanced microcontrollers.
2. To understand the applications of these controllers.
3. To get an insight into interfacing aspects of microcontrollers with various devices.
4. To apply microcontrollers in control and instrumentation systems.

DETAILED CONTENTS:

UNIT-I
Microcontrollers (8051) and Arduino: Classification of microcontrollers, Concept of embedded systems, Review of 8051Microcontrollers, Architecture, Pin Diagram, Timers, Addressing Modes & Power management features of 8051 microcontrollers. Serial Port operation & interrupts of 8051 microcontroller, Programming applications based on 8051 microcontrollers. Introduction to Arduino, classification of Arduino. (12 hours)

UNIT-II
Interfacing and Applications of 8051/Arduino: Basic issues of interfacing, Interfacing applications of 8051microcontrollers, interfacing of 8051 with External memory, 8255, keyboards, DACs/ADCs, LCD,LED, control of DC Motors, Stepper motor, servomotor etc., Interfacing of Arduino with keypad, LED, LCD, DC motor etc. (12 hours)

UNIT-III
PIC Microcontrollers: Introduction, different types, Salient features of PIC microcontrollers, PIC microcontroller families, The PIC16F877 MC, Features of the PIC16F877, The PIC16F877 architecture, Program memory, Data memory, Ports, I/O devices, serial I/O and data communication, Clock source options, the timer/counter module, Low power operation and the sleep, instructions, The watchdog timer, special function registers. (12 hours)

UNIT-IV
AVR Microcontrollers: Important features, Pins & Signals, Internal architecture, Watchdog Timer. MCS-96 Microcontrollers: Salient features, architecture, Instruction set & addressing modes. ARM Microcontrollers: ARM core architecture, versions of ARM, Important features, intelligent energy manager. Applications of different Microcontrollers in various controls and instrumentation systems. (10 hours)

TEXT BOOKS:

Approved in the 13th meeting of Academic Council held on 18/06/2018.
REFERENCE BOOKS:
2. Myke Predko, “Programming and Customizing the PIC Microcontroller”, TMH.
4. Dhananjay V. Gadre, “Programming and Customizing the AVR Microcontroller”, TMH.
6. Microchip Datasheets for PIC16F877

COURSE OUTCOMES:
After going through this course, the students shall be able to:
1. Learn how to program a processor in assembly language and develop an advanced processor based system.
2. Learn configuring and using different peripherals in digital systems.
3. Compile and debug a program for control systems.
4. Generate an executable file and use it for control applications in instrumentation systems.

NOTES:
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MIC505C  RESEARCH METHODOLOGY AND IPR

**COURSE OBJECTIVES:**
1. To introduce the systematic approach to identify/formulate a good research problem.
2. To introduce various approaches for solving a research problem.
3. Inculcating the skills for good report/technical research paper/project writing.
4. Introduction to Research ethics.
5. Introduction to the process of patenting & new developments in IPR.

**DETAILED CONTENTS:**

**UNIT-I**

**UNIT-II**
**Literature Study, Research Ethics & Report Writing:** Effective literature studies approaches, Plagiarism, Research ethics, Effective technical writing, how to write a report/research paper, Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

**UNIT-III**

**UNIT-IV**

**TEXT BOOKS:**
REFERENCE BOOKS:

COURSE OUTCOMES:
At the end of this course, students will be able to
1. Understand research problem formulation.
2. Analyze research related information.
3. Follow research ethics.
4. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understand the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronic gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.

- - -
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-I 
Choice Based Credit System (effective from Session 2018-19)

MIC581C MODELLING & SIMULATION LAB

L T P
- - 4

Class-work Marks: 25
Exam Marks: 75
Total Marks: 100
Duration of Exam: 3 Hrs.
Credits: 2

LIST OF EXPERIMENTS:
1. To design PI, PD & PID controllers for temperature control of an oven /water level control using MATLAB/PSPICE.
2. To implement Fuzzy controller for temperature control of an oven & for water level control of a single & two tank coupled systems.
3. To observe the effects of parametric disturbances on the performance of PI, PD, PID & Fuzzy controllers.
4. To observe the effects of load disturbances on the performance of PI, PD, PID & Fuzzy controllers.
5. To observe the effects of nonlinearities (such as saturation, backlash etc.) on performance of PI, PD&PID controllers used for a second order system.
6. Design and simulation of Linearized models using MATLAB/PSPICE.
7. Simulation and analysis of State space models for continuous time and discrete time systems using MATLAB/PSPICE
8. Simulation and analysis of Digital Control System using MATLAB/PSPICE.
9. To control speed of dc motor using choppers (MATLAB- Simulink model)
10. Implementation of speed control of a stepper motor.
11. Simulation and Stability analysis of control system with common non-linearities using MATLAB/PSPICE
13. Familiarization and use of PSIM software.
14. Familiarization and use of LabVIEW.

NOTES:
1. Each Laboratory Class / Section shall not be more than about 20 students.
2. To allow fair opportunity of practical hands-on experience to each student, each experiment may either be done by each student individually or in a group of not more than 3-4 students. larger groups be strictly discouraged/disallowed.
3. Pre-Experimental & Post-Experimental Quiz / Questions may be offered for each Lab. experiment to reinforce and aid comprehension of the experiment.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-I  
Choice Based Credit System (effective from Session 2018-19)

**MIC583C  CONTROL & INSTRUMENTATION LAB**

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**LIST OF EXPERIMENTS:**

1. Designing of Ladder logic for various practical applications.
2. Execution of the Ladders using PLC’s.
4. Experiment on Position Control System.
5. Experiment on Velocity Control System.
6. Experiment on Adaptive Control System.
7. To study the position control of DC servomotor with P, PI control actions.
8. Determination of Magnetic Amplifier Characteristics with different possible connections.
9. Characteristics of Synchros: (a) Synchro transmitter characteristics (b) Implementation of error detector using synchro pair.
10. To study the compensation of the second order process by using: (a) Lead Compensator (b) Lag Compensator (c) Lead- Lag Compensator.

**NOTES:**

1. Each Laboratory Class / Section shall not be more than about 20 students.
2. To allow fair opportunity of practical hands-on experience to each student, each experiment may either be done by each student individually or in a group of not more than 3-4 students. Larger groups be strictly discouraged/disallowed.
3. Pre-Experimental & Post-Experimental Quiz / Questions may be offered for each Lab. experiment to reinforce and aid comprehension of the experiment.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-I  
Choice Based Credit System (effective from Session 2018-19)

MIC521C  ROBOTICS & AUTOMATION

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COURSE OBJECTIVES:
1. To study the various parts of robots and fields of robotics.
2. To study the various kinematics and inverse kinematics of robots.
3. To study the trajectory planning for robot.
4. To study the control of robots for some specific applications.

DETAILED CONTENTS:

UNIT-I
Introduction to Automation & Automated Inspection: Reasons for automation, Automation strategies, automated inspection: Principles & methods, Sensor technologies for automated inspection, Coordinate measuring machine, other contact inspection methods, machine vision, optical inspection methods, non-contact inspection methods. (11 hours)

UNIT-II
Basic Concepts of Robotics & Power Sources: Definition and origin of robotics, different types of robots, various generations of robots, Asimov’s laws of robotics, Dynamic stabilization of robots. Hydraulic, pneumatic and electric drives, Determination of HP of motor and gearing ratio, variable speed arrangements, path determination. (11 hours)

UNIT-III
Sensors, Manipulators, Actuators & Grippers: Micro machines in robotics, machine vision, ranging, Laser, acoustic, magnetic, fibre optic and tactile sensors. Construction of manipulators – manipulator dynamics and force control, electronic & pneumatic manipulator control circuits, end effectors, various types of grippers, Design considerations. (12 hours)

UNIT-IV
Kinematics & Path Planning: Solution of inverse kinematics problem, multiple solution, Jacobian work envelop, hill climbing techniques, robot programming languages, robots in manufacturing & non-manufacturing applications, selection of robot. (12 hours)

TEXT BOOKS:

REFERENCE BOOKS:
2. Mittal and Nagrath, "Robotics and Control," TMH.

**COURSE OUTCOMES:**
Students will be able to
1. Obtain forward, reverse kinematics and dynamics model of the industrial robot arm.
2. Propose and synthesize control law for a given application.
3. Classify robots and decide specifications depending on the applications.

**NOTES:**
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronic gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.
MIC523C  INDUSTRIAL INSTRUMENTATION

L  T  P
3  -  -  

Class-work Marks: 25
Exam Marks: 75
Total Marks: 100
Duration of Exam: 3 Hrs.
Credits: 3

COURSE OBJECTIVES:
1. To give students an understanding of foundational concepts of industrial instrumentation and automation with introduction to smart sensors, Compensation methods, smart sensors and related issues.
2. To introduce Interfacing Instruments & Computers with details of Sensor Networks and Communication.
3. To get an insight into signal conditioning circuits used in industrial instrumentation, measurement and automation.
4. To understand basic structure of programmable logic controllers and introduce programming of PLCs.

DETAILED CONTENTS:

UNIT-I
Transducers: Strain gauge, derivation of gauge factor, Link type load cell, beam type load cell, ring type load cell and their sensitivities, Frequency response of link type load cell, Torque cell and its data transmission (slip ring and radio telemetry).
Specific Transducers: Pressure transducer [Bourdon gauge, diaphragm gauge (metal and semiconductor) etc], all vacuum gauges, photo electric transducer and its application, Liquid in glass thermometer, venturimeter, Orifice meter, pitot tube, Rotameter, Weir, electromagnetic flowmeter, Hot wire anemometer, Variable reluctance displacement sensor, tachogenerator, turbine flowmeter. Measurement of viscosity, conductivity and pH of a liquid. Flapper nozzle system and Control Valves. (11 hours)

UNIT-II
Smart Sensors: Primary sensors; Excitation; Compensation (Nonlinearity: look up table method, polygon interpolation, polynomial interpolation, cubic spline interpolation, Approximation & Regression; Noise & interference; Response time; Drift; Cross-sensitivity); information Coding/processing; Data communication; Standards for smart sensor interface. (11 hours)

UNIT-III
Interfacing Instruments & Computers: Basic issues of interfacing; Address decoding; data transfer control; A/D converter; D/A converter; Sample & hold circuit; other interface considerations.

UNIT-IV
Signal Conditioning: Integrated circuit operational amplifiers, Inverting and non-inverting amplifiers. Amplifiers to perform: logarithms, sum, subtraction, differentiation, integration, voltage level detection, voltage to frequency and frequency to voltage conversion. Schmitt trigger, comparator, oscillators. (11 hours)
TEXT-BOOKS:
3. Electronic Devices and Circuits By David A. Bell, Oxford university Press.
4. Programmable Logic Control, NIIT book published by PHI.

REFERENCE BOOKS:

COURSE OUTCOMES:
After going through this course, the student shall be able to:
1. Have an understanding of smart sensors, compensation and smart sensor interface.
2. Understand the smart sensor networking and communication schemes.
3. Know about details of different signal conditioning circuits.
4. Learn about basics of programmable logic controllers and their programming issues.

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronic gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.

- - - -
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-I
Choice Based Credit System (effective from Session 2018-19)

MIC525C  SYSTEMS BIOLOGY

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Total Marks: 100  
Duration of Exam: 3 Hrs.  
Credits: 3

COURSE OBJECTIVES:
1. Introduction to Mathematical Model and Frame Work.  
2. Learning of core –Process, Pulses and Oscillations.  
3. Introduction to Feed Forward Loops, Fundamental tradeoffs.

DETAILED CONTENTS:

UNIT-I  
(11 hours)

UNIT-II  
Pulses and Oscillations, Circadian Rhythms and Clocks Spatial patterns, Morphogenesis and Development.  
(11 hours)

UNIT-III  
Robustness to Perturbations, Integral Feedback Control, Homeostasis and Perfect Adaptation Feed-forward Loops.  
(12 hours)

UNIT-IV  
Fold Change Detection, Fundamental Tradeoffs, Internal Model Principle.  
(12 hours)

TEXT BOOKS:  

COURSE OUTCOMES:
1. Understand and apply mathematical models to design a particular system.  
2. Apply feed-forward loops to design a biological control system.

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.  
2. Electronic gadgets including cellular phones are not allowed in the examination.  
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.

Approved in the 13th meeting of Academic Council held on 18/06/2018.
COURSE OBJECTIVES:
1. To understand what is meant by SCADA and its functions.
2. To know SCADA communication.
3. To get an insight into its application.
4. To know the basics of PLC and Ladder diagram programming.

DETAILED CONTENTS:

UNIT-I
Basics of SCADA:- Introduction to SCADA, Data acquisition systems, Evolution of SCADA, Communication technologies, Monitoring and supervisory functions, SCADA applications in Utility Automation. (10 hours)

UNIT-II
Components of SCADA:- Industrial SCADA System Components, Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems. (11 hours)

UNIT-III
SCADA Architecture and Communication Technology:- SCADA Architecture, Various SCADA architectures, advantages and disadvantages of each System single unified standard architecture - IEC 61 50. SCADA Communication, various industrial communication technologies, wired and wireless methods and fiber optics, Open standard communication protocols. (12 hours)

UNIT-IV
SCADA Applications and PLC:- Utility applications, Transmission and Distribution sector operations, monitoring, analysis and improvement, Introduction of PLC, Architecture, discrete I/O Systems, Analog I/O systems, definition of discrete state process control, discrete state variables, event sequence description, Ladder diagram: Background, ladder diagram elements, ladder diagram symbols, development of ladder diagrams, Programming, Advanced features and study of at least one industrial PLC. (12 hours)

TEXT BOOKS:

REFERENCE BOOKS:
COURSE OUTCOMES:
After going through this course, the student shall be able to:
1. Describe the basic tasks of Supervisory Control Systems (SCADA) as well as their typical applications.
2. Acquire knowledge about SCADA architecture, various advantages and disadvantages of each system.
4. To learn about SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server.
5. Learn and understand about SCADA applications in transmission and distribution sector, industries etc.

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronic gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-I
Choice Based Credit System (effective from Session 2018-19)

MIC529C DESIGN ASPECTS IN CONTROL

L T P Class-work Marks: 25
3 - - Exam Marks: 75

Total Marks: 100
Duration of Exam: 3 Hrs.
Credits: 3

COURSE OBJECTIVES:
1. The student is introduced to the tools and techniques of control system design.
2. Introduction to various aspects of controller design philosophy.
3. Learning PID Controller.

DETAILED CONTENTS:

UNIT-I

UNIT-II
Classical Control System Design: Introduction, Steady state error behaviour, Proportional, Integral, Derivative Controllers and PID Controllers, review PID Tuning – Ziegler Nichols, Cohen-Coon techniques. (10 hours)

UNIT-III

UNIT-IV
Frequency Domain Design: Frequency Domain Loop Shaping, Lag, Lead and Lag-lead compensators, Zero dynamics in servo control, Unstable zero dynamics – control design, Observer – concept and design, Case studies – Applications. (12 hours)

TEXT BOOKS:

REFERENCE BOOK:

COURSE OUTCOMES:
After going through this course, the student shall be able to:
1. Model a control system given its parameters.
2. Decide gains of the controllers like PI,PID in a given control system.

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronics gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.
COURSE OBJECTIVES:
1. To give students an understanding of foundational concepts of instrumentation systems used in health care systems.
2. To introduce Biomedical Instruments & Equipments Technology with basic concepts.
3. To get an insight into monitoring systems used in health care industry.
4. To understand basics of Telemetry in Medical Applications and health care systems.

DETAILED CONTENTS:

UNIT-I
Introduction to Biomedical Instrumentation: Overview, role of technology in modern healthcare, role of biomedical engineer, man-instrument system, origin of Biosignals, classification of biomedical instruments, performance parameters of instruments, physiological systems. (10 hours)

UNIT-II
Biomedical Instruments & Equipments Technology: Bio-potential electrodes, amplifiers and measurements Systems, Bio-Potential electrodes-Electrode-Electrode interface, Half-cells and their potentials, Silver-Silver chloride electrodes, biomedical Recording electrodes, circuit model of electrode. Bioelectric amplifiers-carrier amplifiers, chopper amplifiers, phase sensitive or lock-in amplifiers, isolation amplifiers, instrumentation amplifiers. (11 hours)

UNIT-III
Monitoring Systems: Sensory and behavioral measurements & patient monitoring systems. audiometer, galvanic skin Response (GSR), biofeedback instrumentation. Computer-assisted patient monitoring system: Bedside monitors, central monitors, measurement of heart rate, measurement of blood pressure, measurement of respiratory rate, impedance pneumography, apnea detectors, Intelligent patient monitoring: Intelligent monitoring system architecture. (12 hours)

UNIT-IV
Telemetry in Medical Applications: Telemedicine & Medical Informatics. Telemedicine and its applications: Teleradiology, telecardiology, telepsychiatry, teledermatology, telesurgery, advantages and disadvantages of telemedicine. Hospital Information systems, Computer Networks in healthcare. (11 hours)

TEXT BOOKS:
1. R.S. Khandpur, “Handbook of Biomedical Instrumentation,” TMH.

REFERENCE BOOKS:

COURSE OUTCOMES:
After going through this course, the student shall be able to:
1. Have an understanding of instrumentation system used in health care industry.
2. Understand the Biomedical Instruments & Equipments Technology details.
3. To understand details of monitoring systems in health care industry.
4. Details of Telemetry in Medical Applications and related issues.

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronic gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-I/II  
(Common for all branches)  
Choice Based Credit System (effective from Session 2018-19)  

**AUD533C**  
**DISASTER MANAGEMENT**  

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**COURSE OBJECTIVES:**  
1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response  
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives  
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations  
4. Critically understand different aspects of disaster management  

**DETAILED CONTENTS:**  

**UNIT-I**  
**Introduction to Disaster Management:** Definitions: Disaster, Emergency, Hazard, Mitigation, Disaster Prevention, Preparedness and Rehabilitation, Risk and Vulnerability, Classification of Disaster, Natural and Man made Disasters, Disaster Management Act 2005, Role of NDMA, NDRF, NIDM Risk and Vulnerability to disaster mitigation and management options: Concept and Elements, Risk Assessment, Vulnerability, Warning and Forecasting.  

**UNIT-II**  
**Hydro-meteorological based disasters I:** Tropical Cyclones, Floods, droughts, mechanism, Causes, role of Indian Metrological Department, Central Water Commission, structure and their impacts, classifications, vulnerability, Early Warning System, Forecasting, Flood Warning System, Drought Indicators, recurrence and declaration, Structural and Non-structural Measures.  

**Hydro-meteorological based disasters II:** Desertification Zones, causes and impacts of desertification, Characteristics, Vulnerability to India and Steps taken to combat desertification, Prevention.  

**UNIT-III**  
**Geological based disasters:** Earthquake, Reasons, Direct and Indirect Impact of Earthquake; Seismic Zones in India, Factors, Prevention and Preparedness for Earthquake, Tsunamis, Landslides and avalanches: Definition, causes and structure; past lesson learnt and measures taken; their Characteristic features, Impact and prevention, structural and non-structural measures.  

**UNIT-IV**  
**Manmade Disasters I:** Chemical Industrial hazards; causes and factors, pre- and post disaster measures; control; Indian Standard Guidelines and Compliance; Oil Slicks and Spills, Outbreak of Disease and Epidemics, Traffic accidents; classification and impact, War and Conflicts; Fire risk assessment; Escape routes; fire fighting equipment; Use of remote sensing and GIS in disaster mitigation and management.
TEXT / REFERENCE BOOKS:

5. Savindra Singh and Jeetendra Singh, Disaster Management, Pravalika Publications, Allahabad
7. Selected Resources Published by the National Disaster Management Institute of Home Affairs, Govt. of India, New Delhi.

COURSE OUTCOMES:
A student will be able to:
1. Know the significance of disaster management,
2. Study the occurrences, reasons and mechanism of various types of disaster
3. Learn the preventive measures as Civil Engineer with latest codal provisions
4. Apply the latest technology in mitigation of disasters.

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronic gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-I/II
(Common for all branches)
Choice Based Credit System (effective from Session 2018-19)

AUD531C ENGLISH FOR RESEARCH PAPER WRITING

L T P Class-work Marks: 25
2 - - Exam Marks: 75
Total Marks: 100
Duration of Exam: 3 Hrs.
Credits: 0

COURSE OBJECTIVES:
Students will be able to:
1. Understand that how to improve your writing skills and level of readability,
2. Learn about what to write in each section,
3. Understand the skills needed when writing a Title, and
4. Ensure the good quality of paper at very first-time submission

DETAILED CONTENTS:

UNIT-I
Basics of Writing Skills: Subject Verb Agreements; Parallelism; Structuring Paragraphs and Sentences; Being Concise and Removing Redundancy; Avoiding Ambiguity and Vagueness; Dangling Modifiers

UNIT-II
Reviewing and Citation: Clarifying Who Did What; Highlighting Your Findings from Literature; Hedging and Critiquing; Paraphrasing; Avoiding Plagiarism; Formatting and Citation (Publication Manual of the American Psychological Association)

UNIT-III
Sections of a Research Paper: Writing Effective and Impressive Abstract; Writing Introduction; Review of Literature; Defining Objectives of the Study; Methodology Adopted; Results Obtained; Discussion and Conclusion; Editing and Proof Reading to Ensure Quality of paper

UNIT-IV
Oral Presentation for Academic Purposes: Oral Presentation for Seminars, Conferences and Symposiums; Poster Presentation; Choosing Appropriate Medium; Interaction and Persuasion

TEXT / REFERENCE BOOKS:

COURSE OUTCOMES:
The Students will become conscious citizens of India aware of their duties, rights and functions of various bodies of governance and welfare; thereby well equipped to contribute to India.

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronics gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.

Approved in the 13th meeting of Academic Council held on 18/06/2018.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-I/II 
(Common for all branches) 
Choice Based Credit System (effective from Session 2018-19) 

AUD535C  SANSKRIT FOR TECHNICAL KNOWLEDGE 

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Exam Marks: 100 
Total Marks: 100 
Duration of Exam: 3 Hrs. 
Credits: 0 

COURSE OBJECTIVES: 
1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world 
2. Learning of Sanskrit to improve brain functioning 
3. Learning of Sanskrit to develop the logic in Mathematics, Science & other subjects 
4. Enhancing the memory power 

DETAILED CONTENTS: 

TEXT / REFERENCE BOOKS: 
1. “Abhyaspustakam” – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi  
2. “Teach Yourself Sanskrit” Pratham Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi 
Publication  

COURSE OUTCOMES: 
Students will be able to 
1. Understand basic Sanskrit language 
2. Understand Ancient Sanskrit literature about science and technology 
3. Get equipped with Sanskrit and explore the huge knowledge from ancient literature 

NOTES: 
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination. 
2. Electronics gadgets including cellular phones are not allowed in the examination. 
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit. 

Approved in the 13th meeting of Academic Council held on 18/06/2018.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-II
Choice Based Credit System (effective from Session 2018-19)

AUD537C  VALUE EDUCATION

L  T  P          Class-work Marks: 25
2 - -                           Exam Marks: 75
                                      Total Marks: 100
                                      Duration of Exam: 3 Hrs.
                                      Credits: 0

COURSE OBJECTIVES:
The students will be able to
1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

DETAILED CONTENTS:

UNIT-I
Hierarchy and Classification of values, Values and Belief Systems, Competence in professional ethics, Value judgment based on cultural, tradition and interdependence.

UNIT-II

UNIT-III
Understanding the meaning and realizing the effect of the following: Aware of self- destructive habits, Knowledge, Acceptance, Love, Situations, happiness, Bliss, Peace, Power, Purity, Realization, Assertiveness, Regard, Respect, Sensitive, Divinity, emotions, Repentance, hurt, Ego, Attachment, worry, Resentment, Fear, Anxiety, Greed, Criticism, Tension, Frustration, Expectation, Irritation, Anger, Guilt, Jealous, Pear Pressure, True Friendship, Cooperation - Coordination- competition. Enhancing self esteem and personality.

UNIT-IV

TEXT / REFERENCE BOOKS:
3. Value Education in Spirituality- Course-I, course -II by Brahma Kumaris Education Wing, Rajyoga Education & Research Foundation, Mount Abu, Rajasthan.

COURSE OUTCOMES:
The students will be able to
1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality 4. Strengthen the “EQ”

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronics gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-II
Choice Based Credit System (effective from Session 2018-19)

AUD539C CONSTITUTION OF INDIA

L T P Class-work Marks: 25
2 - - Exam Marks: 75

Total Marks: 100
Duration of Exam: 3 Hrs.

Credits: 0

COURSE OBJECTIVES:
Students will be able to:
1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism. 3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

DETAILED CONTENTS:

UNIT-I
Making of the Indian Constitution and its Philosophy Sources of Indian Constitution, its Preamble and Salient Features.

UNIT-II

UNIT-III
Organs of Governance Legislature: Parliament and its Composition; Qualifications and Disqualifications of its members Executive: President, Governor and Council of Ministers Judiciary: Appointments, Qualifications, Powers and Functions of judges

UNIT-IV
Local Administration and institutes for welfare District Administration Head: Role and Importance; Municipalities: Introduction, Mayor and role of Elected Representative Panchayati Raj Institutions: Introduction, Gram Panchayat, Panchayat Samiti and Zila Panchayat Institutes and Bodies for the welfare of SC/ST/OBC and women.

TEXT / REFERENCE BOOKS:
1. The Constitution of India, 1950 (Bare Act), Government Publication.

COURSE OUTCOMES:
The Students will become conscious citizens of India aware of their duties, rights and functions of various bodies of governance and welfare; thereby well equipped to contribute to India

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronics gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-II
Choice Based Credit System (effective from Session 2018-19)

AUD541C  PEDAGOGICAL STUDIES

L  T  P
2  -  -

Class-work Marks: 25
Exam Marks: 75
Total Marks: 100
Duration of Exam: 3 Hrs.
Credits: 0

COURSE OBJECTIVES:
The course will enable the student teachers:
1. To understand the concept of pedagogy and conceptual framework.
2. To gain insight on the meaning and nature of different pedagogies.
3. To determine aims and strategies of teaching-learning.
4. To understand the principals, maxims of successful teaching and different methods of teaching.
5. Comprehend the need and importance of various devices of teaching and learning and their relationship between the two.
6. Point out and illustrate the difference between teaching and learning and their relationship between the two.
7. To appreciate that science/engineering is a dynamic and expanding body of knowledge.

DETAILED CONTENTS:

UNIT-I
Introduction and Methodology: Aims and Rationale, Conceptual Framework, Terminology related to Pedagogy; Contexts, Research Questions; Theories of Learning, Curriculum, Scope of Pedagogy

UNIT-II
Teaching: Meaning and importance of Behavioral Objectives; Writing of Objectives in Behavioral Terms; Phases and Variables of Teaching; Principles, levels and maxims off teaching; Relationship between Teaching and Learning

UNIT-III
Methods of Teaching: Methods: Inductive, Deductive, Project, Analytic, Synthetic, Brain Storming, Case Discussion; Concept and Significance of Individualized and Cooperative Teaching-Language Laboratory, Tutorials, Keller’s Plan (PSI), Computer Supporting Collaborative Learning; Mastery Learning: Concept, Basic Elements, Components and Types of Mastery Learning Strategies

UNIT-IV
Evaluation Strategies: Evaluation in Teaching: Concept of Evaluation, Relationship between Teaching and Evaluation, Types of Evaluation (Formative and Summative); Methods of Evaluation through Essay Type. Objective Type and Oral Method, Comparative merits and demerits of evaluation methods; Latest Trends in Evaluation

TEXT / REFERENCE BOOKS:

**COURSE OUTCOMES:**

Students will be able to understand:
1. It will improve teaching effectiveness of prospective teachers.
2. A prospective teacher will be able to design curriculum and assess the curriculum of their discipline in an effective way by understating the needs of the learners.
3. How can teacher education, school curriculum and guidance support effective pedagogy?
4. It will be functional for professional development among teachers.

**NOTES:**
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronics gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit. All questions will carry equal marks.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-II
Choice Based Credit System (effective from Session 2018-19)

AUD543C STRESS MANAGEMENT BY YOGA

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Class-work Marks: 25
Exam Marks: 75
Total Marks: 100
Duration of Exam: 3 Hrs.
Credits: 0

COURSE OBJECTIVES:
1. To achieve overall health of body and mind
2. To overcome stress

DETAILED CONTENTS:

UNIT-I
2. Difference and relation b/w Yog and Yoga,
3. benefits of meditation and Yoga,
4. Rules and Regulation of Yog and Yoga.
5. Empowerment of Soul and fitness of body.

UNIT-II
1. Do’s and Don’ts in life.
2. How to be and not to be?
3. Understanding spirituality and materials.
4. Impact of: Truth at mouth/ Truth in thoughts Non Violence outside / Compassion in thoughts, Celibacy (kamnayn- desire), purity of mind, noncovetousness, Cleanliness, satisfaction, self study and surrender to almighty, Austerity, Penance

UNIT-III
1. Role of Meditation in reducing Stress.
2. Role of Yoga in reducing Stress.
3. Pranyama: AnulomVilom, Ujjai, Costal Breathing, Abdominal Breathing, Sunyak, Kumbhak

UNIT-IV

TEXT / REFERENCE BOOKS:
1. "Yogic Asanas for Group Tarining-Part-I": Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama, (Publication Department), Kolkata
3. “Value Education in Spirituality- Course-IV” by Brahma Kumaries Education Wing, Rajyoga EducationResearch Foundation, Mount Abu, Rajasthan.
4. “Stress Management for Dummies” by Allen Elkin, IDG Books India (P) Ltd. 5. “Yoga Courses for All” by Dr Hansraj Yadav, BhartyaVidyaBlawan, Mumbai

Approved in the 13th meeting of Academic Council held on 18/06/2018.
COURSE OUTCOMES:
Students will be able to:
1. Develop healthy mind and healthy body thus improving social health also
2. Improve efficiency
3. Improving “SQ”

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronics gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit. All questions will carry equal marks.
AUD545C PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

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COURSE OBJECTIVES:
Students will be able to:
1. To learn and achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

DETAILED CONTENTS:

UNIT-I
Holistic Development of Personality: Neetisatakam- Verses-19,20,21,22 (Wisdom), Verses-29, 31 32 (Pride and Heroism), Verses-26,28,63,65 (Virtue)

UNIT-II
Approach to Day to Day Work and Duties: Shrimad BhagwadGeeta: Chapter 2 (Verses- 41, 47, 48), Chapter 3 (Verses- 13, 21, 27, 35), Chapter 6 (Verses- 05, 13, 17, 23, 35), Chapter 18 (Verses- 45, 46, 48)

UNIT-III
Statements of Basic Knowledge: Shrimad BhagwadGeeta: Chapter 2 (Verses- 56, 62, 68), Chapter 12 (Verses- 13, 14, 15, 16, 17, 18)

UNIT-IV
Personality of a Role Model: Shrimad Bhagwad Geeta: Chapter 2 (Verses- 17), Chapter 3 (Verses 36, 37, 42), Chapter 4 (Verses 18, 38, 39), Chapter 18 (Verses 37, 38 63)

TEXT / REFERENCE BOOKS:
1. Srimad Bhagavad Gita by Swami Swarupananda Advaita Ashram (Publication), Kolkata
2. Bhartrihari’s Three Satakam (Niti-sringar-vairagya) by P. Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

COURSE OUTCOMES:
1. The study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life.
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity.
3. Study of Neetishatakam will help in developing versatile personality of students.

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronics gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit. All questions will carry equal marks.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-II
Choice Based Credit System (effective from Session 2018-19)

MIC502C  OPTIMAL CONTROL THEORY

L  T  P  
3 - -

Class-work Marks: 25
Exam Marks: 75
Total Marks: 100
Duration of Exam: 3 Hrs.
Credits: 3

COURSE OBJECTIVES:
1. To introduce the basic and fundamental concepts of optimal control theory, controller design
2. Introduction to computational aspects of optimal control.
3. To get the students acquainted with the matrix Riccati equation and Pontryagin’s minimum principle.
4. To discuss the Dynamic programming and its applications in solving optimal control problems.
5. To explain the numerical techniques for obtaining the optimal trajectories.

DETAILED CONTENTS:

UNIT-I
Calculus of Variations in Optimal Control:- Review of matrix computations, fundamentals of calculus of variations and optimal control, definition of an optimal control problem, concept of functionals, increment and variations of a functional, performance measures for optimal control problems, selecting a performance measure, maximization/minimization of functionals of a single and several functions using calculus of variations, constrained extremals, Euler-Lagrange Equation. (12 hours)

UNIT-II
Pontryagin’s Minimum Principle:- Necessary conditions for optimal control, Pontryagin’s minimum principle and state inequality constraints, minimum time problems, minimum control effort problems, linear quadratic regulator problems, Riccati Equation, Singular intervals in optimal control problems. (12 hours)

UNIT-III
Dynamic Programming:- The optimal control law, principle of optimality, Application of The principle of optimality to decision making, Dynamic programming applied to routing problems, solving optimal control problems using dynamic programming, a recurrence relation of dynamic programming, Discrete linear regulator problems, Hamilton-Jacobi-Bellman Equation. (12 hours)

UNIT-IV
Determination of Optimal Trajectories:- Two point boundary value problems, Numerical techniques to determine optimal trajectories, Numerical aspects of optimization, the method of steepest descent for minimization of functionals, variation of extremals, quasi-linearization, gradient projection method. (10 hours)

TEXT BOOKS:

REFERENCE BOOKS:

**COURSE OUTCOMES:**

After going through this course, the students shall be able to:

1. Combine the mathematical methods used in optimal control to derive the solution to variations of the problems studied in the course.
2. Use the standard algorithms for numerical solution of optimal control problems and use Matlab to solve fairly simple but realistic problems.
3. Integrate the tools learnt during the course and apply them to more complex problems.
4. Apply Dynamic programming and Pontryagin’s Minimum principle to different optimal system models.

**NOTES:**

1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronics gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-II
Choice Based Credit System (effective from Session 2018-19)

MIC504C STOCHASTIC FILTERING AND IDENTIFICATION

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COURSE OBJECTIVES:
1. To introduce fundamental concepts of random variables and their distribution.
2. To give understanding of functions of single and two random variables.
3. To get insight into stochastic filtering and Kalman filtering.
4. To introduce parameter estimation for static and dynamic non-linear systems.

DETAILED CONTENTS:

Unit I

Random Variable: Concept of Random Variable, Distribution function, Properties of Distribution function, Probability density function, Normal Distribution, Exponential distribution, Uniform Distribution, Conditional Distributions, Total Probability and Bayes' theorem using condition distribution. (12 hours)

Unit II

Function of Random Variable: Random variable, Distribution of Random variable, fundamental theorem for random theorem, mean, variance, Characteristic functions, Moment theorem, Moment generating functions.
Function of Two Random Variable: Bivariate distributions, Joint Distribution, Properties of Distribution function, Joint Density, Joint statistics, Marginal statistics, Probability Masses, Independence, one function of two random variables, Two function of two random variables. (12 hours)

Unit III

Filtering: System, Noise filtering, Smoothing, Prediction; Gauss-Markov discrete-time model description, noise description, initial state description, Gaussian and Markov properties of the system state, propagation of means and co-variances, dropping the Gaussian assumption, minimum variance estimate, minimum variance estimator property, unbiased estimates and estimator properties, other estimation criteria, main points of the section.
Kalman Filter: Filtering problem, discrete-time Kalman filtering problem, solution of the Kalman filter problem, first-principles derivation of the Kalman filter equations, obvious properties of the filter, a generalization, main points of the section, Best linear estimator property of Kalman filter. Identification as a Kalman filtering problem, application of Kalman filters, Kalman filter properties, Solution procedure for the Wiener filtering problem, rapprochement with Kalman filtering. (12 hours)
Unit IV

**Least Squares Parameter Estimation for Static Processes:** Least square parameter estimation for static processes, non-linear static processes, geometrical interpretation, maximum likelihood, Cramér-Rao bound.

**Least Squares Parameter Estimation For Dynamic Processes:** Non-recursive method of least squares, fundamental equations, convergence, covariance of parameter estimation and model, definition of parameter identifiability, implicit estimation of a constant, explicit estimation of a constant, spectral analysis with periodic parametric signal models, Recursive methods of least squares. (12 hours)

**TEXT BOOKS:**

**REFERENCE BOOKS:**

**COURSE OUTCOMES:**
Students will be able to
1. Develop skills in analyzing and interpreting the concept of random variables and functions of random variables.
3. Formulate and solve problems which involve designing the filtering process and Kalman filters.

**NOTES:**
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronics gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-II
Choice Based Credit System (effective from Session 2018-19)

MIC582C  ADVANCED CONTROL & INSTRUMENTATION LAB

L  T  P  
-  -  4

Class-work Marks: 25
Exam Marks: 75
Total Marks: 100
Duration of Exam: 3 Hrs.
Credits: 2

LIST OF EXPERIMENTS:

1. Determine State Space Model of a given transfer function and determine its controllability and observability in MATLAB.
2. Software programming for determination of STM.
3. Verify State feedback control using pole placement.
4. Design State observer and validate it by software.
5. To analyse design of digital Kalman filter and discrete systems.
6. Convert a continuous time system into digital control system and check response using MATLAB.
7. Study of saturation and dead zone non-linearity using describing function technique of a relay control system.
8. To draw phase trajectory of a given non-linear system.
9. To determine AC servomotor Characteristics.
10. To design controller using root locus in MATLAB.

NOTES:
1. Each Laboratory Class / Section shall not be more than about 20 students.
2. To allow fair opportunity of practical hands-on experience to each student, each experiment may either be done by each student individually or in a group of not more than 3-4 students. Larger groups be strictly discouraged/disallowed.
3. Pre-Experimental & Post-Experimental Quiz / Questions may be offered for each Lab. experiment to reinforce and aid comprehension of the experiment.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-II  
Choice Based Credit System (effective from Session 2018-19)  

MIC584C  MICROCONTROLLERS & INSTRUMENTATION LAB  

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Class-work Marks: 25  
Exam Marks: 75  
Total Marks: 100  
Duration of Exam: 3 Hrs.  
Credits: 2  

LIST OF EXPERIMENTS:  

1. Write an assembly language program in 8051 for generating a triangular waveform.  
2. Write a program in 8051 to find the largest from a set of ten numbers and display it using LEDs.  
3. Write a program in 8051 for displaying the decimal numbers in 7 Segment display.  
4. Write a program in 8051 to read the DIP switches for displaying the reading using 7-Segment display.  
5. Write a program in 8051 to rotate the given motor in clockwise and anticlockwise direction.  
6. Write a program in 8051 to display a message in LCD display.  
7. To interface PIC microcontroller with servomotor.  
8. To interface PIC microcontroller with DC motor.  
9. Write an ALP to control mouse using 68HC11.  
10. Write an ALP to generate PWM using 8096 microcontroller.  
11. Minor project on Microcontroller based interfacing of stepper motor.  
12. Minor project on Microcontroller based temperature controller.  
13. Write an ALP to switch ON alarm when MC receives interrupt.  
14. Write an ALP to interface one MC with another using serial/parallel communication.  
15. Write an ALP using 8051 & interface traffic light.  
16. Write an ALP using 8051 & interface LED display.  
17. Write a program to interface 7 segments Display/Keypad Interface using Arduino.  
18. Write a program using Arduino to generate square wave of different frequency with different duty cycles.  
19. Write a program to control the speed of DC motor using Arduino.  
20. Write a program to interface 8x8 LED matrix using Arduino.  
21. Interfacing of Arduino with MATLAB.  

NOTE:  
1. Each Laboratory Class / Section shall not be more than about 20 students.  
2. To allow fair opportunity of practical hands-on experience to each student, each experiment may either be done by each student individually or in a group of not more than 3-4 students. Larger groups be strictly discouraged/disallowed.  
3. Pre-Experimental & Post-Experimental Quiz / Questions may be offered for each Lab. experiment to reinforce and aid comprehension of the experiment.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-II
Choice Based Credit System (effective from Session 2018-19)

MIC520C MODEL REDUCTION IN CONTROL

L T P Class-work Marks: 25
3 - - Exam Marks: 75

Total Marks: 100
Duration of Exam: 3 Hrs.
Credits: 3

COURSE OBJECTIVES:
1. To introduce the concept of model reduction of large scale dynamics models from various engineering disciplines.
2. Introduction to model reduction in control.

DETAILED CONTENTS:

UNIT-I
Introduction to Model Reduction: Model reduction problem, Importance of model order reduction, Sources of Large Models: Circuits, Electromagnetic Systems, Mechanical Systems, Modal analysis approach for modal order reduction & Control of large scale systems. (11 hours)

UNIT-II
Frequency Domain Methods For Model Order Reduction: Moment matching, Pade approximation methods; Pade approximation for SISO systems & multivariable systems in frequency domain, Time domain Modal-Pade method, Routh Approximation techniques; Routh approximation using $\alpha - \beta$ and $\gamma - \delta$ parameters respectively, Continued fraction method. (11 hours)

UNIT-III
Modern Methods For Model Reduction: SVD based methods; Singular Value Decomposition, Empirical (Grammian), Balanced truncation, Hankel approximation, Proper Orthogonal Decomposition (POD) Methods, Krylov based methods; Realization, Interpolation, Lanczos & Arnoldi processes, SVD-Krylov based methods. (12 hours)

UNIT-IV
Model Reduction in Control: Control Design on Reduced Models – Sub-optimal control; Review of continuous time & discrete sliding mode control (SMC), Design aspects of sliding mode control, Sliding Mode Control as model reducing control - First Order SM, Higher Order Sliding Mode. (12 hours)

TEXT BOOKS:

REFERENCE BOOKS:

COURSE OUTCOMES:
After going through this course, the students shall be able to:
1. Apply model reduction techniques for a given control design problem.
2. Design control loops for all techniques.

Approved in the 13th meeting of Academic Council held on 18/06/2018.
3. Know modern methods of control.

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronics gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.
MIC522C DIGITAL CONTROL SYSTEMS

L T P Class-work Marks: 25
3 - - Exam Marks: 75

Total Marks: 100
Duration of Exam: 3 Hrs.
Credits: 3

COURSE OBJECTIVES:
1. To familiarize the student with the concept of discretization.
2. Introduction to discrete-time system representations and digital control.
3. Learn to design controller for digital systems.

DETAILED CONTENTS:

UNIT-I
Introduction: Block diagram of a digital control system, importance of Sampling in control systems. Mathematical analysis of the sampling process, ideal sampler, evaluation of starred transform function and their properties, Shannon’s sampling theorem. (12 hours)

UNIT-II
Reconstruction of Sampled Signals & Z-Transform: Data reconstruction by polynomial extrapolation, zero order hold, first order hold, fractional order hold, definition & evaluation of the z-transform, mapping of the s-plane into the z-plane, inverse z-transform, theorems of the z-transform, Pulse transfer function, limitations of the z-transform method, response of open loop sampled data systems between sampling instances, theorems of the modified z-transforms. (11 hours)

UNIT-III
Block Diagram, Signal Flow Graph and Matrix Representation of Sampled Data systems: Block diagram analysis and transfer functions of closed loop sampled data systems, signal flow graphs of sampled data systems, transmission matrix of sampled data systems, the state variable approach, system characteristic equation, time response, steady state accuracy, stability techniques, Bi-linear transformation, Routh-Hurwitz criterion, Jury stability test & Root locus. (11 hours)

UNIT-IV
Frequency Response & Digital Controller Design: Nyquist criterion, Bode diagram, interpretation of frequency response, closed loop frequency response. Introduction to controller design, need for compensation, phase lag compensator, phase lead compensator, phase lead design procedure, lag lead compensator, PID controllers, analysis and design of digital control systems using root locus and transform techniques. (11 hours)

TEXT BOOKS:

REFERENCE BOOKS:
1. K. Ogata, “Discrete Time Control System,” PHI.

COURSE OUTCOMES:
1. At the end of this course, students will be able to
   1. Model digital filters and systems.
   2. Analyse digital systems in time domain and frequency domain.
4. Design controllers for digital systems in state space representation.

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronics gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.
COURSE OBJECTIVES:
1. To appreciate the role of robustness in control system design.
2. Be familiar with uncertainty models including additive, multiplicative & parameter uncertainty. Introduction to parameter variations, presence of disturbances & noise.
3. To get an insight into different norms & their interpretations.
4. To understand design issues of robust control systems.
5. To attempt $H_2$ and $H_\infty$ optimization with LQG methodology & Ricatti equation, etc.

DETAILED CONTENTS:

UNIT-I
Introduction: Definition & rationale of robust control; Elements of robust control theory; Inaccuracies & uncertainties in models of physical systems; Modelling of uncertain systems; Adaptive & Multiplicative perturbations; Plant-Controller configuration; Sensitivity function; Analysis of robustness, systems with uncertain parameters, Design objectives (stability, performance, robustness); Translating design objectives into mathematical relationships: Tracking error, Disturbance rejection, Insensitivity to noise, Model uncertainty (low frequency), model uncertainty (high frequency); Shaping the loop gain. (12 hours)

UNIT-II
Signals, Systems, Norms: Signals and their norms; Physical interpretation/ significance of Norms; Signal spaces, Signals in frequency domain; The $L_2$-norm; The $L_\infty$ norm; $H_2$ norm; $H_\infty$ norm; All pass systems. (10 hours)

UNIT-III
Design of Robust Control Systems: Design objectives; Determining the structure of the controller; Adjusting the parameters of the controller; Robust Stability criterion; Systems with uncertain parameters; Stability of uncertain system; Sensitivity & compensation; Internal model principle; Design of robust PID-controlled systems; Determination of pre-filter; Coprime factorization of controller; Stabilizing controller. (11 hours)

UNIT-IV
$H_2$ and $H_\infty$ Optimization: Linear Quadratic Regulator (LQR); Linear Quadratic Gaussian (LQG) problems; Ricatti equations; Ricatti equation solution; H-infinity control; Linear matrix inequalities for robust control; Pseudo-quantitative feedback system. (12 hours)

TEXT BOOKS:

REFERENCE BOOKS:
1. L. Fortuna, M. Frasca (Eds.), “Optimal and Robust Control”, CRC Press.

**COURSE OUTCOMES:**
Upon going through this course, the students will be able to:
1. Have an understanding of robustness in control system design.
2. Deal with uncertainty models, parameter variations, presence of disturbances and noise.
3. Appreciate different norms.
4. Understand design issues of robust control systems.
5. Carry out $H_2$ and $H_\infty$ optimization.

**NOTES:**
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronics gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.
MIC526C  ADAPTIVE LEARNING AND CONTROL

L  T  P
3   -

Class-work Marks: 25
Exam Marks: 75
Total Marks: 100
Duration of Exam: 3 Hrs.
Credits: 3

COURSE OBJECTIVES:
1. To impart the knowledge of neural network based learning for adaptive control.
2. To understand adaptive control techniques for uncertain dynamical systems.
3. To learn about stability analysis of adaptive controllers.
4. To introduce robustness to disturbances in adaptive controllers.

DETAILED CONTENTS:

UNIT-I
Single Layer Classifiers: Classification model, features & decision regions; discriminant functions; linear machine and minimum distance classification; training and classification using discrete perceptron algorithm, single layer continuous perceptron networks for linearly separable classification, multicategory single layer perceptron networks, linearly inseparable pattern classification.

UNIT-II
Multilayer Perceptron Classifiers: Delta learning rule for multilayer perceptron, generalized delta learning rules; error back-propagation training, learning factors.
Adaptive Control: Introduction, approaches to adaptive control, Direct and Indirect adaptive control schemes, parameter perturbation, Sensitivity method, gain scheduling, Model reference adaptive control (MRAC), Direct MRAC, Indirect MRAC, Self tuning regulators, stochastic control approach.

UNIT-III
Persistence Excitation: Persistence excitation in adaptive systems, properties of persistently exciting functions, Application of persistence excitation to adaptive systems, relation between persistence excitation and uniform asymptotic stability parameter convergence using averaging techniques, applications of parameter convergence to adaptive control.

UNIT-IV
Adaptive Control of Nonlinear Systems: Introduction, linearizing control for nonlinear systems: minimum phase nonlinear systems, model reference control for nonlinear systems; adaptive control of linearizable minimum phase systems.
Robust adaptive Control: Introduction, adaptive observers in the presence of disturbances, adaptive control of a first-order plant in the presence of bounded disturbances, adaptive control of \( n^{th} \) order plant, robustness without persistent excitation, robustness with persistent excitation.

TEXT BOOKS:

REFERENCE BOOKS:

COURSE OUTCOMES:
   After going through this course, the students shall be able to:
   1. Understand detailed knowledge of neural network based learning and the development and properties of various neural networks.
   2. Understand knowledge of adaptive control systems and their development and properties.
   3. Understand knowledge of methods and tools for stability analysis of adaptive systems.
   4. Understand detailed knowledge of robustness in adaptive control.

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronics gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.
   -   -   -
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-II  
Choice Based Credit System (effective from Session 2018-19)  

MIC528C  FUZZY CONTROL SYSTEMS  

L  T  P  Class-work Marks: 25  
3 - - Exam Marks: 75  
3 - - Total Marks: 100  
Duration of Exam: 3 Hrs.  
Credits: 3

COURSE OBJECTIVES:  
1. To give students an understanding of foundational concepts of fuzzy control primarily based on fuzzy set theory. To know operations on fuzzy sets, fuzzy relations.  
2. To understand basic building blocks of Mamdani & Sugeno Fuzzy Logic Controllers (FLCs).  
3. To get an insight into Fuzzification, Fuzzy Inferencing, Defuzzification.  
4. To understand the nonlinearity of different blocks of FLC.  
5. To analyze adaptive issues in FLC & the stability issues of FLCs.

DETAILED CONTENTS:  

UNIT-I
Introduction: Fuzzy control from an industrial perspective; Knowledge-Based Controllers (KBCs); Knowledge representation in KBCs; Precision v/s Significance; The all-pervasive uncertainty; Core control algorithms & surrounding heuristic logic;  
The Mathematics of Fuzzy Control: Vagueness; Fuzzy logic versus probability theory; Fuzzy set definition. (Function method, List/ Enumeration method); Properties of & operations on fuzzy sets, Shapes of Membership Functions & their Elicitation methods; Fuzzy relations & operations on fuzzy relations; The Extension Principle, Fuzzy propositions; N-valued Logic & Fuzzy logic; Classical inference rules; Classical & Fuzzy implications. (12 hours)

UNIT-II
FKBC Structure & Design Parameters: The architecture of Mamdani Type FKBC; Choice of variables; Content & Derivation of rules; Choice of membership functions; Rationale for Normalization; Choice of scaling factors; Rationale for Denormalization; Choice of fuzzification procedure; Fuzzy or Approximate Reasoning (Inferencing); Composition of crisp relations; Composition of fuzzy relations; The Compositional Rule of Inference, Individual Rule-based Inferencing; Choice of defuzzification procedure; Comparison and evaluation of defuzzification methods. (11 hours)

UNIT-III
Nonlinear Fuzzy Control: Linear & nonlinear fuzzy rules & FLCs; The FKBC as a Non-Linear Transfer Element; Mathematical proofs of each element’s linearity / non-linearity; Types of FKBC such as Fuzzy PID controller and Fuzzy Controller of PID Type; Takagi-Sugeno-Kang (TSK or TS) FKBC structure, TSK rules; Distinctions between TSK type & Mamdani type FLCs. (11 hours)

UNIT-IV
Adaptive Fuzzy Control: Rationale; Extra components & Tunable parameters in adaptive FKBC; Design & Performance Evaluation; The Process Monitor; Performance Measures; Parameter Estimators; The adaptation mechanism: Altering scaling factors, Altering fuzzy set definitions, Altering rules; Approaches to Design such as membership function tuning using gradient descent, membership function tuning using performance criteria; The self-organizing fuzzy controller, model based controller. (11 hours)

TEXT BOOK:

REFERENCE BOOKS:
2. Timothy Ross, “Fuzzy Logic with Engineering Applications”, TMH.

COURSE OUTCOMES:
After going through this course, the students shall be able to:
1. Understand the nuances of the fuzzy set, distinct from crisp set.
2. Understand the operations on fuzzy sets.
3. Understand the concepts of fuzzy inferencing.
4. Apply the learnt concepts to further decipher the non-linearities in FLCs.
5. Appreciate the advanced concepts such as adaptive FLCs.

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronics gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.
**M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-II**

**Choice Based Credit System (effective from Session 2019-20)**

**MIC530C  GENETIC ALGORITHMS & APPLICATIONS**

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**COURSE OBJECTIVES:**

1. To give students an understanding of foundational concepts of Genetic Algorithms (GAs). To impart a distinction of basic concepts of classical & stochastic optimization.
2. To understand the terminology & elements of Genetic Algorithm (GA).
3. To get an insight into Fundamental Theorem of GAs.
4. To understand applications of GAs.

**DETAILED CONTENTS:**

**UNIT-I**

**Traditional & Modern Optimization:** Review of traditional search & optimization methods: Calculus based, Enumerative search, Random search; Evolution; Early developments in Genetic Algorithms (GAs); Distinction of GAs from Evolution Programs; Definition of GAs; Distinction of GAs from traditional computer programs; Distinction between GAs and traditional optimization / search methods; Uni-modality v/s multimodality; Comparison of GAs terms with those of natural biology. (10 hours)

**UNIT-II**

**Elements of Canonical Gas and Schema Theorem:** Random initialization of population; Selection; Crossover; Mutation; Algorithms for three operators: algorithm for Roulette Wheel selection, Algorithm for single point crossover, Algorithm for mutation; Genesis of GA’s processing power: implicit parallelism; Similarity templates (schemata); Schema order and Defining length; The fundamental theorem of GAs (Schema Theorem): Individual effects of selection, crossover and mutation on schemata and their combined effect; Derivation of schema growth equation, Building blocks hypothesis. (12 hours)

**UNIT-III**

**Operators Variants and Implementation Issues:** Problems / limitations of Roulette wheel selection and ways to overcome limitations: Stochastic universal sampling, Sigma scaling, Boltzmann selection, Rank selection, Steady state selection; Problems with single point crossover: Positional bias, Spurious correlation, End point effects; Two point crossover; Parametrized Uniform crossover; Evolving crossover hotspots; Inversion. (12 hours)

**UNIT-IV**

**Applications of GAs:** Evolving computer programs, Evolving Lisp programs, Koza’s algorithm; Data analysis and prediction; Predicting dynamical systems, GAs for predicting chaotic time series; Evolving neural networks; Evolvable aspects of NNs, Evolving weights in a fixed network. PID tuning by GAs. (11 hours)

**TEXT BOOKS:**

REFERENCE BOOKS:

COURSE OUTCOMES:
After going through this course, the student shall be able to:
1. Have an understanding of evolution & Genetic Algorithms.
3. Develop algorithms for operators of GAs.
4. Dig into implicit parallelism of GAs.
5. Apply GAs to practical problems.

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronics gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-II
Choice Based Credit System (effective from Session 2018-19)

MIC532C ADVANCED VIRTUAL INSTRUMENTATION

L T P Class-work Marks: 25
3 - - Exam Marks: 75
3 3 3 Total Marks: 100
3 3 3 Duration of Exam: 3 Hrs.
3 3 3 Credits: 3

COURSE OBJECTIVES:
1. To give students an understanding of foundational concepts of Basics of LabVIEW and Modular programming.
2. To understand strings and input-output file handling along with instrument control.
3. To get an insight into data acquisition and Cluster of instruments in VI system.
4. To understand Graphical Programming Environment in Virtual Instruments.

DETAILED CONTENTS:

UNIT-I
Introduction to LabVIEW: Software environment, front panel, block diagram, palettes, loops, structures and tunnels, arrays, clusters, plotting data.
Modular Programming: Modular programming in LabVIEW, creating an icon, building a connector pane, displaying sub VIs and express VIs as icons or expandable nodes, creating sub VIs from sections of VIs, opening and editing sub VIs, placing sub VIs on block diagrams, creating stand alone applications. (12 hours)

UNIT-II
Strings and File I/O: Creating string controls and indicators, string functions, editing, formatting & parsing strings, configuring string controls and indicators, basics of file input/output, file I/O VIs.
Instrument Control: GPIB communication, hardware and software architecture and specifications, instrument I/O assistant, VISA, Instrument Drivers, Serial Port communications. (12 hours)

UNIT-III
Data Acquisition: Transducers, signal conditioning, DAQ hardware configuration, DAQ hardware, Analogy I/O, counters, digital I/O, DAQ assistant, selecting & configuring a data acquisition device.

UNIT-IV
Graphical Programming Environment in VI: Concepts of graphical programming - Lab-view software - Concept of VIs and sub VI - Display types - Digital - Analog - Chart - Oscilloscopic types - Loops - Case and sequence structures - Types of data - Arrays - Formulae nodes - Local and global variables - String and file I/O. (12 hours)

TEXT BOOKS:
2. Jovitha Jerome, Virtual Instrumentation using LabVIEW”, PHI.

REFERENCE BOOKS:

Approved in the 13th meeting of Academic Council held on 18/06/2018.

COURSE OUTCOMES:
After going through this course, the student shall be able to:
1. Have an understanding of Basics concepts in LabVIEW and programming.
2. Get the knowledge of input-output file handling along with instrument control.
3. Have good insight into data acquisition and Cluster of instruments in VI system.

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronics gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-III
Choice Based Credit System (effective from Session 2019-20)

MIC681C        DISSERTATION (PHASE-I)

L     T     P  
0     0     20

Class-work Marks: 50
Exam Marks: 100
Total Marks: 150
Credits: 10

The objective of this course is to develop in students the capacity for analysis & judgment and the ability to carry out independent investigation in design/development through a dissertation work involving creativity, innovation and ingenuity. The work should start with comprehensive literature search and critical appreciation thereof so as to select a research problem and finalize the topic of dissertation.

Each student will carry out an independent dissertation under the supervision of a supervisor; in no case, more than two supervisors may be associated with one dissertation work. The first supervisor must be from the department, however, for interdisciplinary research work, the second supervisor may be from other department of the university/ outside university/industry. In the latter case, consent of the second supervisor with justification thereof needs to be submitted to the dissertation coordinator.

The Dissertation (Phase-I) involving literature survey and problem formulation along with data collection (if required) commences in 3rd semester & will be completed as Dissertation (Phase-II) in 4th semester. Each student will be required to present two seminar talks, first towards the beginning of the Dissertation (Phase-I) to present the scope of the work and to finalize the topic, and the second towards the end of the semester, presenting the progress report containing literature survey, partial results (if any) of the work carried out by him/her in the semester. The student will be required to submit one copy of spiral-bound progress report to the M.Tech. Coordinator.

Internal evaluation of Dissertation (Phase-I) will be done by following committee:

1. Chairperson / Head of Department / Nominee : Chairperson
2. M.Tech. Coordinator/Senior Faculty : Member-Secretary
3. Respective Dissertation Supervisor(s) : Member(s)

Final exam will be conducted by the internal examiner (M.Tech. Coordinator/ faculty nominated by Chairperson) & an external examiner to be appointed by Controller of Examinations from a panel of examiners submitted by the Dept.

For this course, M. Tech. coordinator will be assigned a load of 1 hour per week excluding his/ her own guiding load. Dissertation supervisor (guiding teacher) will be assigned a load of 1 hour per week for the first student and additional 1 hour per week (for their own department only) for the subsequent student(s) subject to a maximum load of 2 hours. Work load allocated for the joint supervision within the department will be treated as half for each supervisor.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-III
Choice Based Credit System (effective from Session 2019-20)

MIC621C    MODELING AND CONTROL OF DISTRIBUTED PARAMETER SYSTEMS

L  T  P Class-work Marks: 25
3  -   - Exam Marks: 75
                   Total Marks: 100
                   Duration of Exam: 3 Hrs.
                   Credits: 3

COURSE OBJECTIVES:
1. Introduction to modelling, analysis and control of distributed parameter systems.
2. Introduction to finite discretization.

DETAILED CONTENTS:

UNIT-I
Overview & Modelling: Overview: Motivation and examples (wave propagation, fluid flow, network traffic, electromagnetism), Modelling of Distributed Parameter Systems: Parabolic and Hyperbolic Partial Differential Equations (PDEs), Analytic and Numerical Solution of Partial Differential Equations (12 hours)

UNIT-II
Stability & Design of DPS: Lyapunov stability analysis of Distributed Parameter System (DPS), Boundary control and Observer Design of DPS (10 hours)

UNIT-III
Discretization: Finite Difference discretization of Distributed Parameter System, Finite Element discretization of DPS, Boundary Elements discretization of DPS, Reduction of discretized models (12 hours)

UNIT-IV
Applications: Applications: Control of systems with time delays, control of fluid flow, network control. (12 hours)

TEXT BOOKS:

REFERENCE BOOK:

COURSE OUTCOMES:
After going through this course, the student shall be able to:
1. Mathematically model a distributed parameter system.
2. Obtain numerical solutions for distributed parameter system.
3. Reduce the complexity of discretized models.

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronics gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-III
Choice Based Credit System (effective from Session 2019-20)

MIC623C STOCHASTIC CONTROL

L T P Class-work Marks: 25
3 - - Exam Marks: 75
      Total Marks: 100
      Duration of Exam: 3 Hrs.
      Credits: 3

COURSE OBJECTIVES:
1. To understand dynamics of stochastic systems and their control strategies
2. To introduce about different stochastic state models and its calculus.
3. To introduce about linear stochastic control theory, prediction and filtering theory of stochastic processes.

DETAILED CONTENTS:

UNIT I
Stochastic Process: Stochastic control theory, concept of stochastic process.

UNIT II
Stochastic State Models: Discrete time systems, solution of stochastic difference equations, Linear equations, Mean value function, Covariance function, Continuous time systems, Stochastic Integrals, Integrals of a deterministic function, Integrals of Stochastic Processes, Integration by Parts, comparison with formal Integration, Linear stochastic differential equations, Nonlinear stochastic differential equations, Stochastic Calculus- Stochastic Differentiation rule, Evaluation of Loss function, Modelling of Physical Process by stochastic differential equations, Sampling a stochastic differential equations, Application. (12 hours)

UNIT III
Analysis of Dynamical Systems: Analysis of Dynamical systems whose inputs are stochastic processes, Discrete time systems, stationary process, Spectral factorization of Discrete time processes, Analysis of continuous time systems whose inputs are stochastic processes, Spectral factorization of Continuous time processes.
Parametric Optimization: Introduction, Evaluation of loss function for discrete time systems, Notations and Preliminaries, Computational Aspects, Evaluation of loss function for Continuous time systems, Reconstruction of State variables for discrete time systems, Parametric optimization problem, Reconstruction of State variables for continuous time systems. (11 hours)

UNIT IV
Linear Stochastic Control Theory: Formulation, Preliminaries, A static Optimization problem, complete state Information, Incomplete state information, Mean value of a quadratic form of Normal Stochastic Variables, Complete state information, A functional equation, Solution of the Bellman equation, incomplete state information, Continuous time problems, properties of the closed loop system. (12 hours)

Approved in the 13th meeting of Academic Council held on 18/06/2018.
TEXT BOOKS:

REFERENCE BOOKS:

COURSE OUTCOMES:
Students will be able to
1. Design stochastic models for a given system.
2. Understand different stochastic processes and stochastic calculus.
3. Apply control techniques to stochastic processes.
4. Understand about prediction and filtering process in stochastic systems.

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronics gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-III
Choice Based Credit System (effective from Session 2019-20)

MIC625C NONLINEAR SYSTEMS & CONTROL

L T P Class-work Marks: 25
3 - - Exam Marks: 75

Total Marks: 100
Duration of Exam: 3 Hrs.
Credits: 3

COURSE OBJECTIVES:
1. To introduce fundamental concepts of nonlinear dynamical systems.
2. Understanding of basic tools for mathematical analysis as well as applications.
3. To get an insight into phase plane analysis and describing function analysis for nonlinear systems.
4. To understand controllability & observability concepts & apply tests thereof. To understand Lyapunov’s stability analysis tool for nonlinear systems.

DETAILED CONTENTS:

UNIT-I

UNIT-II
Describing Function: Definition of describing function, derivation of describing function, Describing function method and applications to various nonlinear components such as backlash, relay with dead-zone and hysteresis, saturation with dead-zone, combined coulomb with viscous friction, square nonlinearity, cubic nonlinearity, etc., stability analysis of nonlinear systems using describing function analysis, Circle criterion. (12 hours)

UNIT-III

UNIT-IV
Non-Linear Systems Analysis: Lie algebra, Basic results on Lie algebra, Concepts of Controllability and Observability of nonlinear systems, Analysis of nonlinear systems based on controllability and observability, Various techniques to test the controllability and observability of nonlinear systems, phenomena of Bifurcations, Chaos, and Synchronization in nonlinear systems. (10 hours)

TEXT BOOKS:

REFERENCE BOOKS:

**COURSE OUTCOMES:**
After going through this course, the students shall be able to:

1. Explore tools for stability analysis and response evaluation of control problems with significant nonlinearities.
2. Identify the design problems and distinguish between the controls strategies.
3. Correlate between design parameters and the system performance.
4. Apply controllability & observability tests to different system models & to apply Lyapunov’s stability analysis tool for nonlinear systems.

**NOTES:**
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronics gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-III
Choice Based Credit System (effective from Session 2019-20)

MTOE663C      INDUSTRIAL INTERNET OF THINGS

L  T  P
3  -   -                                      Class-work Marks: 25

Exam Marks: 75
Total Marks: 100
Duration of Exam: 3 Hrs.
Credits: 3

COURSE OBJECTIVES:
1. To introduce the Internet of things (IoT) and its vision.
2. To introduce the IoT market perspective.
3. Introduction to Data and Knowledge Management and use of Devices in IoT Technology.
4. To introduce the real World IoT Design Constraints, Industrial Automation and Commercial Building Automation in IoT.

DETAILED CONTENTS:

UNIT-I

UNIT-II
M2M to IoT- A Basic Perspective: Introduction, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies, M2M to IoT-An Architectural Overview: Building architecture, Main design, principles and needed capabilities, An IoT architecture outline, standards considerations. (10 hours)

UNIT-III

UNIT-IV

TEXT BOOKS:

REFERENCE BOOKS:

COURSE OUTCOMES:
After learning the course, the student will:
1. Get the vision of IoT from a global context.
2. Learn about the applications & market perspective of IoT.
3. Know about the use of Devices, Gateways and Data Management in IoT.
4. Be able to build state of the art architecture in IoT.
5. Learn about Application of IoT in Industrial and Commercial Building Automation and Real World Design Constraints.

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronics gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-III
Choice Based Credit System (effective from Session 2019-20)

MTOE 651C     BUSINESS ANALYTICS

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Class-work Marks: 25
Exam Marks: 75
Total Marks: 100
Credits: 3

COURSE OBJECTIVES:
The main objective of this course is to give the student a comprehensive understanding of business analytics methods
1. Understand the role of business analytics within an organization.
2. Business Analytics industry sequence is to familiarize the students with the concept of Data Analytics (Big Data) and its applicability in a business environment
3. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
4. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
5. To become familiar with processes needed to develop, report, and analyze business data.
6. Use decision-making tools/Operations research techniques.
7. Mange business process using analytical and management tools. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc

DETAILED CONTENTS:

UNIT-I

UNIT-II

UNIT-III
Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT-IV
TEXT / REFERENCE BOOKS:
1. Project Management: The Managerial Process by Erik Larson and, Clifford Gray
2. Business Analysis by James Cadle et al.
4. Whigham David, Business Data Analysis, Oxford University, Press, Delhi.
5. Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie or Die.Eric Siegel.

COURSE OUTCOMES:
1. At the end of the Fall semester, students should have acquired an understanding of Analytics – the terminology, concepts and familiarity of potential tools and solutions that exist today. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability to think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predictive and prescriptive modeling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights. Students should be better familiar with overall analytics tools/techniques and their use in corporate.

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronics gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit. All questions will carry equal marks.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-III
Choice Based Credit System (effective from Session 2019-20)

MTOE653C  INDUSTRIAL SAFETY

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DETAILED CONTENTS:

UNIT-I

**Industrial safety:** Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe the salient points of factories act 1948 for health and safety, washrooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc., Safety color codes. Fire prevention and firefighting, equipment and methods.

**Fundamentals of maintenance engineering:** Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of the maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation to replacement economy, Service life of the equipment.

UNIT II


UNIT III


UNIT IV


TEXT / REFERENCE BOOKS:

1. Maintenance Engineering Handbook Higgins & Morrow Da Information Services
2. Maintenance Engineering H. P. Garg S. Chand and Company
3. Pump-hydraulic Compressors, Audels Mcgraw Hill Publication
NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
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3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit. All questions will carry equal marks.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-III
Choice Based Credit System (effective from Session 2019-20)

MTOE655C OPERATIONS RESEARCH

Class-work Marks: 25
Exam Marks: 75
Total Marks: 100
Credits: 3

COURSE OBJECTIVES:
1. To develop modeling skills in students.
2. To develop skill in students for efficient designing analysis and control of complete system.
3. To make students capable of formulating the practical problems into mathematical problems.
4. To acquaint student with linear as well as non-linear programming problem and their application.

DETAILED CONTENTS:

UNIT-I

UNIT-II
Non liner programming: NLPP Mathematical formulation and solution with equally constraints, Lagrange’s method, Graphical method, Kuhn—Tucker necessary &sufficient conditions for the optimality of objective function in GNLP problem. Dynamic programming: Kuhn –Tucker condition’s, Wolfe’s and Bcale’s method.

UNIT III
Deterministic inventory control models: Meaning & function role of inventory control, reason for carrying inventory, single item inventory control model with & without shortages. Probabilistic inventory control models: Inventory control models without set up cost and with set up cost.

UNIT IV
Project management; PERT and CPM, Basic difference between PERT & CPM, Phases up project management PERT /CPM network component & precedence relationships, critical path analyses, projects scheduling with uncertain activity times, project time –cost trade-off. Sequencing problem: Processing an jobs through two machines, three machines and through m-machines. Theory of games: Two- person zero –sum games,pure strategies (with saddle points) mixed strategies (without saddle point), algebraic method only.

TEXT / REFERENCE BOOKS:
2. H.M. Wanger, Principles of Operation Research PHI, Delhi, 1982

COURSE OUTCOMES:
1. Students will be able to apply the dynamic programming to solve problems of discrete and continuous variables.
2. Students will be able to carry out sensitivity analysis.
3. Student will be able to model the real world problem and simulate it.
4. The students will be able to carry forward the operation research techniques in practical problems.

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronics gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit. All questions will carry equal marks.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-III
Choice Based Credit System (effective from Session 2019-20)

MTOE657C COST MANAGEMENT OF ENGINEERING PROJECTS

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Class-work Marks: 25
Exam Marks: 75
Total Marks: 100
Credits: 3

DETAILED CONTENTS:

UNIT I
INTRODUCTION AND OVERVIEW
Chapter 1: Introduction, basic economic concepts, interest formulae, present worth, rate of return, Elements of financial accounting: depreciation, taxes and their impact in economic studies
Chapter 2: Cost concepts in decision making; elements of cost, relevant cost, overheads, differential cost, incremental cost and opportunity cost, objectives of a costing system, inventory valuation, creation of a data base for operational control, provision of data for decision making.

UNIT II
PROJECT
Chapter 3: Meaning, different types, why to manage, cost overrun centres, various stages of project execution, concept to commissioning. Project execution as conglomeration of technical and non technical activities. Detailed engineering activities, Pre project execution main clearances and documents project team: Role of each member.
Chapter 4: Importance Project site: Data required with significance. Project contracts. Types and contents. Project cost control. Bar charts and network diagram. Project commissioning: Mechanical and process. Project appraisal and selection, recent trends in project management

UNIT III
ECONOMIC ANALYSIS FOR ENGINEERING PROJECTS
Chapter 5: Cost behavior and profit planning, Marginal costing, distinction between marginal costing and absorption costing, Break even analysis, cost volume profit relationship, various decision making problems. Standard costing and variance analysis, pricing strategies Pareto analysis, Target analysis, life cycle costing, Costing of service sector.
Chapter 6: just in time approach, material requirement planning, enterprise resource planning, Total Quality management and theory of constraints, Activity based cost management, Bench marking, Balanced score card, value chain analysis, Budgetory control, Flexible budget, Perforame budget, Zero based budget, Measurement of divisional profitability pricing decisions including transfer pricing.

UNIT IV
QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT
Chapter 7: PERT CPM; Activity networks, basic PERT/CPM calculations, Planning and scheduling of activity networks, Assumptions in PERT modeling, time cost tradeoffs, PERT/ cost accounting, Scheduling with limited resources, Generalized activity networks GERT, Prospects of PERT/CPM
Chapter 8: Linear programming, Transportation problems, Assignment problems, Simulation, Learning curve theory

TEXT / REFERENCE BOOKS:
5. Principles and Practice of cost accounting Ashish K Bhattacharya A H Wheeler
NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronics gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit. All questions will carry equal marks.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-III
Choice Based Credit System (effective from Session 2019-20)

MTOE659C    COMPOSITE MATERIALS

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DETAILED CONTENTS:

UNIT-I


UNIT II

UNIT III

UNIT IV
Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT / REFERENCE BOOKS:

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
2. Electronics gadgets including cellular phones are not allowed in the examination.
3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit. All questions will carry equal marks.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-III
Choice Based Credit System (effective from Session 2019-20)

MTOE661C WASTE TO ENERGY

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COURSE OBJECTIVES:
To give an idea about different biomass and other solid waste materials as energy source and their processing and utilization for recovery of energy and other valuable products. A comprehensive knowledge of how wastes are utilized for recovery of value would be immensely useful for the students from all fields.

DETAILED CONTENTS:

UNIT I

UNIT II
Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste, MSW

UNIT III
Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification, Biomass conversion processes, Thermo chemical conversion, Direct combustion, Types of biogas Plants, Applications.

UNIT IV

TEXT / REFERENCE BOOKS:

COURSE OUTCOMES: In these days of energy crisis and environmental deterioration, students will understand the concept of energy by waste products. It is being used globally to generate electricity and provide industrial and domestic applications. Students will also enable to understand the environmental issues related to harnessing and utilization of various sources of energy and related environmental degradation

NOTES:
1. The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.

2. Electronics gadgets including cellular phones are not allowed in the examination.

3. Examiner will set total eight questions in all, selecting two questions from each unit. Students are required to attempt five questions in all, selecting at least one from each unit. All questions will carry equal marks.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-III
Choice Based Credit System (effective from Session 2019-20)

MIC683C MINI PROJECT

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The objective of mini project is to develop in students the professional quality of synthesis employing technical knowledge obtained in the field of Engineering & Technology through a project work involving design / analysis augmented with creativity, innovation and ingenuity.

The student shall take up investigative study on a topic in the broad relevant field of engineering, involving hardware or software or both hardware & software, to be assigned by the department on an individual basis, under the guidance of a supervisor from the department. This is expected to provide a good initiation for the student(s) in R&D work.

The activities under mini project may normally include:
1. Literature survey on an assigned topic.
2. Working out a preliminary approach to the problem relating to the assigned topic.
4. Compilation of the work and presenting it in two seminar talks in the semester, before a committee having M.Tech. coordinator and supervisor(s).
5. Submit a written spiral-bound report on the work undertaken to the M.Tech. Coordinator.

Internal evaluation of Mini Project will be done at the end of the semester through a seminar by the committee consisting of the following:

1. Chairperson/Head of Department/ Nominee : Chairperson
2. M.Tech. Coordinator : Member-Secretary
3. Respective Project Supervisor(s) : Member(s)

Final exam. will be conducted by the internal examiner (M.Tech. Coordinator / faculty nominated by Chairperson) and external examiner to be appointed by Controller of Examinations from a Panel of Examiners submitted by the Dept.

M.Tech. coordinator will be assigned a load of 1 hour per week excluding his/ her own guiding load. Project supervisor (guiding teacher) will be assigned a load of 1 hour per week per student subject to a maximum load of 2 hours.
M.Tech. in Electrical Engg. (Instrumentation & Control), Semester-IV
Choice Based Credit System (effective from Session 2019-20)

MIC680C       DISSEYRATTON (PHASE-II)

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The Dissertation (Phase-II) shall be the extension of Dissertation (Phase-I) carried out in 3rd semester. Each student will be required to present three seminar talks, first at the beginning of the semester to present the progress made during the winter break; second in the middle of the semester involving partial results obtained and comparative analysis; and third towards the end of the semester, presenting the dissertation report of the work carried out. Each student will be required to submit two copies of dissertation report to M.Tech. coordinator. The committee constituted by the Chairperson of the department will screen all the presentations so as to award the sessional marks.

**INTERNAL ASSESSMENT:**
The internal assessment (Class-work evaluation) will be effected through presentation and discussion thereon by the following committee:

1. Chairperson/Head of Department / Nominee : Chairperson
2. M.Tech. Coordinator/Senior Faculty : Member-Secretary
3. Respective Dissertation Supervisor(s) : Member(s)

**EXTERNAL ASSESSMENT:**
Dissertation will be evaluated by the following committee:

1. Chairperson/Head of the Department / Nominee : Chairperson
2. Respective Dissertation Supervisor(s) : Member(s)
3. External Expert : To be appointed by the University.

For this course, supervisor(s) will be assigned a load of 2hours per week for the first student and additional 1 hour per week for the subsequent student(s) subject to a maximum load of 3 hours. Work load allocated for the joint supervision within the department will be treated as half for each supervisor.

**NOTE:** There is a desirable requirement of one publication in a UGC-listed journal / unpaid journal. The external expert must be from the respective area of the specialization. Chairperson & M.Tech. Coordinator in mutual consultation will divide the submitted dissertations into groups depending upon area of specialization and recommend the list of experts for each group separately to the Vice-Chancellor for selecting the examiners (one examiner for not more than four students of a group).