Basic Sciences and Humanities

Autonomous Programme Structure (Revision-1) F. Y. B. Tech. Sem-I
E&TC / Instru / Mech Programmes
A. Y.: 2020-21 Onwards

F. Y. B. Tech. First Semester									
Course Code	**Course Title**	**Teaching Scheme Hours / Week**			**Examination Scheme**			**Marks**	**Credit**
20BS01	Linear Algebra and Univariate Calculus	3	1	0	50	50	0	100	4
20BS04	Physics	3	0	0	50	50	0	100	3
20ES02	Fundamentals of Programming Language- I	1	0	0	0	25	0	25	1
20ES03	Sustainable Engineering	3	1	0	50	50	0	100	4
20ES04	Engineering Graphics	2	1	0	50	50	0	100	3
20BS04L	Physics Lab	0	0	2	25	0	0	25	1
20ES02L	Fundamentals of Programming Language- I Lab	0	0	2	25	0	0	25	1
20ES04L	Engineering Graphics Lab	0	0	2	25	0	0	25	1
20ES07L	Technical Skill Development Lab	0	0	2	25	0	0	25	1
Total		**13**	**3**	**8**	**300**	**225**	**0**	**525**	**19**
Grand Total		**24**			**525**			**525**	**19**

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

Cummins College of Engineering For Women ★ MKSSS's
Karve Nagar, Pune 411052.

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

20BS01 Linear Algebra And Univariate Calculus

Teaching scheme	**Examination**
scheme	
Lectures: 3hrs/week	In-Sem Exam: **50** Marks
Tutorial: 1hr/week	End-Sem Exam: **50** Marks
Number of Credits: 4	

Course Objectives:

1. To familiarize the prospective engineers with techniques in linear algebra and calculus of one variable.
2. To equip the students with standard concepts and tools in Linear algebra and calculus of one variable which will find them useful in their disciplines.

Course Outcomes:

CO1: Use matrix method to solve linear system of equations, Linear Transformations.

CO2: Calculate eigenvalues, eigenvectors and apply it to diagonalize a matrix.

CO3: Apply knowledge of linear algebra to solve simple real life problems.

CO4: Compute differentiation, series expansion, integration of function of one variable.

Unit-I: Matrices **(08)**

Rank of a matrix, Echelon form, System of linear equations, Euclidean vector spaces and Linear Transformations

Unit-II: Diagonalization of a Matrix **(08)**

Eigenvalues, Eigenvectors, Properties of Eigenvalues, Diagonalization of a matrix

Unit-III: Applications of Linear Algebra **(09)**

Introduction to Modular Arithmetic, Euclid's algorithm, Encrypt and decrypt the statement using matrix, Applications to simple real life problems

Unit-IV: Differential Calculus **(08)**

Successive differentiation, nth order derivatives of some standard functions, Taylor's and Maclaurin's theorem, Standard series expansions

Unit-V: Integral Calculus **(09)**

Reduction formulae, Beta Function, Gamma function, Differentiation under integral sign, Error function

Text-Books:

1. David Poole,**' Linear Algebra: A Modern Introduction'** , 2nd Edition, Brooks/Cole (2005).
2. B. V. Ramana ,**'Higher Engineering Mathematics'**, *Tata McGraw-Hill Publications*, (2007).
3. B.S. Grewal, '**Higher Engineering Mathematics**', *Khanna publishers*, Delhi (40thedition), (2008).

Reference Books:

1. C.R. Wylie, L. C. Barrette, *'***Advanced Engineering Mathematics***'*, *McGraw-Hill Publications*, *New Delhi* (6 th edition),(2006)
2. Maurice Weir, Joel Hass, Thomas **'Calculus'** , 12th edition, *Pearson India*(2016)
3. George Thomas, Jr., Ross Finney, Late, **Calculus,** 9th edition, *Pearsons India*
4. Sudhir Ghorpade, Balmohan Limaye, *'***A Course in Calculus and Real Analysis** *'*, (Undergraduate Text in Mathematics), *Springer*(2006).

5. Erwin Kreyszig, '**Advanced Engineering Mathematics'**, *Wiley Eastern Ltd*(10th Edition), (2017)

20BS04 Physics

Teaching Scheme	**Examination Scheme**
Lecture 3 Hrs per week	In – SEM Exam: 50 Marks
Number of Credits: 3	End – SEM Exam: 50 Marks

Course Objectives:

To introduce undergraduate students of technology to the principles, notions, basic physical ideas, mathematical relations and applications of physical optics, thermodynamics, quantum physics, solid state physics and the properties of nano as well as bulk materials.

Course Outcomes:

By taking this course, the learner will be able to –

CO – 1: **Apply** the generalized Coulomb law and the law of Electromagnetic Radiation to determine the electric fields due to the stationary and the accelerated charges.

CO – 2: Apply the laws of Physical Optics to determine intensity distributions of interference – diffraction patterns, and to identify polarization-types.

CO – 3: Apply the principles of Statistical Physics to determine the thermal distribution of matter in different energy states and the thermal response of engineering materials.

CO – 4: Justify the selection of — quantum probability rules and single qubit logic gates.

CO – 5: Differentiate between the physical properties of 'nano' materials and of their 'bulk' counterparts.

Title of Module, Brief Description of Course Contents and No. of Lectures

Module – 1: Electromagnetic Radiation and Interference: 8 Lectures

Expression for the electric field beyond Coulomb's law; Two dipole radiators and Physics of interference; Mathematical treatment (propagating waves, rotating vectors, complex functions)

Module – 2: Diffraction and Polarization: 8 Lectures

The resultant amplitude due to *n* equal oscillators; Diffraction Grating; The electric vector of light; Types of Polarized Light; Birefringence; Polarizers

Module – 3: Statistical Mechanics and Thermodynamics: 8 Lectures

Principles of Statistical Mechanics (Distribution of particles in thermal equilibrium); Laws of Thermodynamics (Carnot Cycle, Entropy, Clausius-Clapeyron Equation); Information Entropy

Module – 4: Quantum Physics: 9 Lectures

Laws of combining probability amplitudes; The Hamiltonian matrix & Schrödinger equation; Two-state systems: Pauli spin matrices & Photon polarization states; Single Qubit Logic Gates

Module – 5: Properties of Solids: 9 Lectures

Band Theory; Electrical (conductivity, resistivity), Magnetic (dia-para-ferro), Optical (absorbance, reflectance, transmittance), Mechanical (hardness, elasticity) properties (of 'bulk' & 'nano' solids)

Text Book:

R. P. Feynman, R. B. Leighton and M. Sands, **'The Feynman Lectures on Physics'**, *Pearson Education* (2006)

Reference Books:

1. **J. Walker, D. Halliday, R, Resnick, 'Principles of Physics', Wiley *Student Edition* (10th Edition)**
2. **H. Young and Roger Freedman, 'University Physics', Pearson Addison Wesley (12th Edition)**

20ES02 Fundamentals of Programming Language-1 (ETC,Instru)

Teaching Scheme:
Lecture: 1 Hr/week

Examination Scheme:
End-Sem: 25 Marks

Credits: 1

Course Objectives:
To facilitate the learners:
1. To learn the fundamentals of building blocks of computer system.
2. To develop problem solving ability by developing an algorithm, flowchart for given problem.
3. To implement the logic / solution for given problem using C programming language.
4. To understand the decision and iteration interpretation in a programming language.

Course Outcomes:
By taking this course, the learner will be able to:
1. Illustrate the use of algorithms, flow charts and components of computer systems.
2. Demonstrate the use of appropriate control structure for program development.
3. Make use of variables, data types, operators, expressions, strings and arrays for program development.
4. Solve the given problem using functions.

Unit 1: Introduction **(2)**
Introduction to components of a Computer System, types of programming languages.
Introduction to Algorithm: As flow chart, pseudo code, as a program.

Unit 2: Fundamentals of Procedural Programming Language **(1)**
Keywords, Identifiers, Constants and Variables, concept of memory, Structuring procedural program using exemplary language such as C.

Unit 3: Data Types and operators **(2)**
Data types, Typecasting, variable scope, Operators, Basic Input and Output Operations, Expressions and Precedence of Operators.
Illustration using real life examples and use cases.

Unit 4: Control Structures **(2)**

Selection (if-else ladder), Iteration (for loop, while loop).
Illustration using real life examples and use cases.

Unit 5: Arrays and String **(2)**
Introduction to linear structure (Arrays) and Strings,String functions
Illustration using real life examples and use cases.

Unit 6: Functions **(2)**

Use of function for modularization, Parameter passing.
Illustration using real life examples and use cases.

Text Books:-

1) Kernighan and Ritchie, " The C programming language" (2nd edition)., Prentice Hall of India, 1988.
2) G. Dromey, "How to Solve it by Computer", Prentice-Hall Inc., Upper Saddle River, NJ, 1982.
3) Yashwant Kanetkar, "Let's C", Allied Publishers, 1998.

Reference books:-

1) Reema Thareja, "Introduction to C programming", Oxford University Press (2nd edition), 2015.
2) Alan R. Feuer, "The C Puzzle book", Pearson, 1999

20ES02 Fundamentals of Programming Language-1 (Mech)

Teaching Scheme:
Lecture: 1 Hr/week

Examination Scheme:
End-Sem: 25 Marks

Credits: 1

Course Objectives:
To facilitate the learners:

1. To learn the fundamentals of the building blocks of computer system.
2. To develop problem solving ability by developing an algorithm, flowchart for the given problem.
3. To implement the logic / solution for giving problem using a programming language.
4. To understand the decision and iteration interpretation in a programming language.

Course Outcomes:
By taking this course, the learner will be able to:

1. Illustrate the use of algorithms, flow charts and components of computer systems.
2. Demonstrate the use of appropriate control structure for the program developer.
3. Make use of variables, data types, operators, expressions, strings and arrays for program development.
4. Solve the given problem using functions.

__Unit – I: Introduction (05)

Problem solving, problem solving by using computer and Logic building, Introduction to computer, Anatomy of a computer, Python interpreter, Python language elements, Lines and indentation, identifiers, keywords, operators, delimiters and literals, statements, Numbers: Integers, complex, floating point, Variable types, assignments

Unit – II: Operators and Expressions (05)

Sequences: strings, lists, numpy arrays, tuples, Boolean values, Dictionaries, Numeric operations, Conditional expression

Unit – III: Loops and Functions (04)

Loops, Functions, file operations, exceptions, inbuilt libraries and functions for scientific computing and plotting.

Text Books:

1. Reema Thareja, "Python Programming using problem solving Approach", Oxford University, Higher Education Oxford University Press; First edition (10 June 2017), ISBN-10: 0199480173
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India Education Services Pvt. Ltd., 2016
3. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011

Reference Books:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think- python/)

20ES03 SUSTAINABLE ENGINEERING

Teaching Scheme:
Lectures: 3 Hrs/Week
Tutorial: 1 Hr/Week
Credits: 4

Examination Scheme:
In-Semester : 50 Marks
End-Semester : 50 Marks

Course Objectives:

1. To understand interdisciplinary approach towards sustainable development
2. To acquire knowledge, skills, values & attitudes that empowers to contribute to sustainable development
3. Understand the relevance and importance of natural resources & protection of environment for sustainability
4. To understand the role of engineering & technology within sustainable development

Course Outcomes:
After completion of course, students will be able to

CO1: Identify the need of sustainable development

CO2: Analyze the challenges posed at the interface of natural & man-made environment

CO3: Distinguish between conventional & green building with respect to environmental efficiency

CO4: Apply the knowledge of sustainability in the area of water & energy conservation

CO5: Distinguish between smart cities with other cities with respect to quality criteria

CO6: Specify the role of different stakeholders in sustainable development

Unit – I: Introduction to sustainable engineering **(05)**

Need and concept of sustainability, Principles of sustainability, Pillars of sustainable development, Multidisciplinary approach for sustainable development, Case study on Innovative technologies

Unit – II: Environmental sustainability (06)

Concept of natural and built environment , Concept of integrated built environment, Environmental global issue - Urban sprawl , Role of individual to protect environment

Unit – III: Green materials and green building (06)

Basic concept of Green buildings & its co-relation with sustainability, Material selection for sustainable design of green building, Concept of circular economy, Concept of IGBC, Green building certification, Methods for increasing energy efficiency of buildings

Unit – IV: Sustainable use of water and energy resources (08)

Water resources – use and conservation of water ,sustainable use of drinking water – waste water management- case study

Energy resources – Renewable and non-renewable sources of energy – conservation of non-renewable energy sources – case study, Definition & case study on LCA.

Unit – V: Smart City (05)

Concept and features of smart city, Strategies, Concept of smart village, Two case studies.

Unit – VI: Role of community and society in sustainable development (06)

Role of government,Global environmental agreements and protocols (Montreal& Kyoto protocol), Copenhagen summit, Role of citizen, Contribution of NGOs - social networking , Case study

Text Books:

1. *R.L.Rag, Lekshmi dinachandran Ramesh* - ***Introduction to Sustainable engineering***

Reference Books:

1. Bhavik R. Bakshi - **Sustainable engineering (principles and practise)** -*Ohio state university*
2. Allen D.T and shonnard D. R- **Sustainability engineering concept design and case studies**
3. *Mokia schoiz-* ***Sustainable Water treatment engineering solution for variable climate***
4. *DT Alle*DR Shonnard*n,-* Green engineering: environmentally conscious design of chemical processes

5. R.Rajagopalan **– Environmental Studies from Crisis to Cure – *Oxford Publication, Third edition,2016.***
6. A`Sankar R.N.- **Environmental Management** - *Oxford Publication, First edition,2015.*
7. *Shah, Kale, Patki – **Building planning and Built environment** -Tata McGraw Hill*

Websites:

Down to Earth - Magazine (hard copy and softcopies available)-
www.unsdsn.org/ For the World
-www.cseindia.org - For India
- indiaenvironmentalportal.org.in
- TERI - www.teriin.org
-cwmi.css.cornell.edu
-rodaleinstitute.org

20ES04 Engineering Graphics

Teaching Scheme
Theory: 2 Hrs/week
Tutorial: 1 Hr/week
Credits: 3

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

Course Objectives:

1 To develop the visualization and interpretation skills for the physical objects.
2 To provide the basic knowledge and develop the skills for creating 2 D drawings.
3 To provide the basic knowledge and develop the skills for creating Isometric views.
4 To familiarize about the development of solids.
5 To familiarize the construction and applications of Engineering Curves.

Course Outcomes:

After completing the course students will be able to draw
CO1 Orthographic and sectional orthographic projections of an object
CO2 Isometric views of the given object
CO3 Development of surfaces of the given object
CO4 Engineering curves by applying the given method

Unit – 1

Introduction Layout and sizes of drawing sheets, drawing instruments, types of lines used in drawing practice, dimensioning systems, representation of tolerances, standard codes by B.I.S (SP- 46). (Not for Examination**)**

(01)

Unit – 2

Orthographic Projection Theory of projections, methods of obtaining orthographic views, sectional orthographic projections, Missing views.

(08)

Unit – 3

Isometric Views Isometric axes, Isometric scale, isometric projections and views, construction of isometric view from given orthographic views**.**

(08)

Unit – 4

Development of Solids Parallel line development, radial line development, methods to transfer points for development of prisms, pyramids, cylinder and cone.

(05)

Unit – 5

Engineering Curves Construction of ellipse, parabola, hyperbola, involute, cycloid, Archimedean spiral, helix on cone and cylinder. **(06)**

Text Books:

1. N. D. Bhatt and V. M. Panchal,'Engineering drawing, plane and solid geometry', Charotor Publication House.
2. R. K. Dhawan,'A text book of Engineering Drawing', Pearson Education Inc.
3. P.S. Gill, 'Engineering Graphics', Kataria and sons Publications.
4. M. L. Dabhade, 'Engineering Graphics', Vision Publications.

Reference Books:

1. Warren J. Luzzader, 'Fundamentals of Engineering Drawing', Prentice Hall of India, New Delhi.
2. Fredderock E. Giesecke, Alva Mitchell, 'Principles of Engineering Graphics',Maxwell
3. Dhananjay A. Jolhe, 'Engineering Drawing', Tata McGrawHill Publishing Co. Ltd.

20BS04L Physics Laboratory

Teaching Scheme	**Examination Scheme**
2 hours per week	In-SEM Exam : Term work (25 M)
Number of Credits : 1	End-SEM Exam : NA

Course Objectives :
The objective of the Physics Lab course is two-fold :
To inculcate experimental skills, and
To demonstrate the interplay between theoretical & experimental physics.

Course outcomes (CO) for Physics Lab - 20BS04L
By taking this course, the students will be able to —
CO - 1 : Record the observations as per the least counts of measuring instruments and Perform necessary calculations.
CO - 2 : Compare the experimental findings with the corresponding theoretical physics models.
CO - 3 : Determine errors in experimental findings and Analyze their sources and causes.
CO - 4 : Reach the conclusions pertaining to the observed behaviour of physical systems.

List of Experiments :
Physical Optics Experiments :
I. Polarization of light, II. Diffraction Grating : Emission Spectra, III. Michelson Interferometer, and IV. Newton's Rings.
Electromagnetism & Heat Experiments :
I. Dia-Para-Ferromagnetism : Magnetic Permeability, II. Faraday's Law, and III. Hysteresis (B-H) Curve of Iron core, IV : Specific Heat of solid materials.
Modern Physics Experiments :
I. Planck's Constant, II. I - V Characteristic of LED, III. Hall Effect, and IV. Zeeman Effect.

20ES02L Fundamentals of Programming Language -I Lab (ETC, Instru)

Teaching Scheme:
Practical: 2 Hr/week
Credits: 1

Examination Scheme:
In-Sem: 25 Marks

Course Objectives:

To facilitate the learners:
1. To learn the fundamentals of C programming for logic building.
2. To implement solution of given problem using appropriate data type, operators of C language.
3. To understand the decision and iteration interpretation in a programming language.
4. To implement the logic using arrays, strings, functions and structures of C programming language.

Course Outcomes:

By taking this course, the learner will be able to:
1. Apply logic development skills to solve simple real life problems.
2. Implement, test and execute developed logic or algorithm to C program using appropriate data type, operators.
3. Implement the given problem using appropriate control structures available in C language.
4. Identify different functions for a problem to construct a modular solution.

Following example list of problems are grouped into A, B and C, with increasing level of difficulty and understanding. Group A problem statements addresses the concepts of constant, variable, data type, operator and expressions. Group B problem statements addresses the concept of control structures and Group C includes problem which can be solved using functions and string concepts along with the concept covered in Group A and Group B.
Assignments can be framed and expanded in such a way that it explores concepts, language constructs, logic of solution and simple application. Students will be encouraged to solve open problems in different domains. Course tutor will set up assignments to challenge students through code debugging, code improvisation and code transformation. Course tutor will appropriately adopt assignments on similar lines as the examples shown here.

Instructors can conduct a total 10 assignments . Four assignments from Group A, four assignments from Group C and two assignments from Group C.

Example List of Assignments

(Minimum 10 assignments to be implemented, covering maximum Four from each Group. Assignment number 9, 10, 11 from Group C can be considered as extra assignments. Students can explore more on C constructs to implement these assignments.) :-

Group A

Group A problem statements addresses the concepts of constant, variable, data type, operator and expressions.

1) Write C programs for basic problems Engineering Mathematics and Physics like area calculation, sin wave calculation, speed calculation, determine type of trainagle, verify pythogarous theorem etc.
2) Write C program to convert feet to inches, convert inches to centimeters, and convert centimeters to meters. Write a program that prompts a user for a measurement in feet and converts and outputs this value in meters. Facts to use: 1 ft = 12 inches, 1 inch = 2.54 cm, 100 cm = 1 meter.
3) Write a C program to swap 2 numbers.
4) Write C program to convert Kilograms to grams, convert grams to milligrams and vice a versa.
5) Write C program to convert Dollar to Rupees, convert Euro to Rupees, and vice a versa.
6) Write C program for temperature conversion Degree to Fahrenheit and vice a versa.
7) Write a C program to convert specified days into years, weeks and days.
8) Write a C program that accepts three integers and find the maximum of three.

Group B

Group B problem statements addresses the concept of control structures such as for loop, while loop.

1) Write C program to calculate Least common multiple (LCM) and Greatest Common Divisor (GCD) of given number.
2) Write C program to check whether the given number is prime or not.
3) Write C program to print a given pattern.
4) Write a C program to obtain the first 25 numbers of a Fibonacci sequence. In a Fibonacci sequence the sum of two successive terms gives the third term. Following are the first few terms of the Fibonacci sequence: 1 1 2 3 5 8 13 21 34 55 89...
5) Write C program for simple interest and compound interest calculation.

Group C

Group C includes problem which can be solved using functions and string concepts along with the concept covered in Group A and Group B.

1) Write a C program to swap 2 integers using user defined functions (call by value, call by reference).
2) Write a program in C to compute the factorial of the given positive integer using function.
3) Write a menu driven program to perform following operations using Array of integers like (accept, display, sum of all numbers, search a number, maximum and minimum of number).
4) Write a menu driven program to perform string operations.
5) Write a program in C to compute addition / subtraction / multiplication of two matrices.

6) Write a C program to perform employee operations such as accept, display, search by name, search by number, update a record. Explore the possibility of modularity for implementation.
7) Write a C program to perform bank account related operations such as accept, display, withdraw and deposit money, check balance.
8) A string is provided from the user. Calculate the total number of characters in the string and the total number of vowels in the string with the number of occurrence in the string.
9) For a class an examination is conducted and the results for the students of all the 5 subjects are recorded. Write a C program to display the record of students. On the basis of the record compute:
   i. The average score of class
   ii. Highest score and lowest score of class
   iii. Marks scored by most of the students
   iv. List of students who were absent for the test
10) Write a menu-based modular program in C to perform following operations for complex numbers:
   i. reading a complex number
   ii. writing a complex number
   iii. addition of two complex numbers
   iv. subtraction of two complex numbers
   v. multiplication of two complex numbers
11) Two friends issued 5 books each from the library, Write a program in C to compute set operations
   i. List of all books with them
   ii. List common titles with them
   iii. List of books with friend1 but not with friend 2

20ES02L Fundamentals of Programming Language Lab -1(Mech)

Teaching Scheme:
Practical: 2 Hr/week
Credits:01

Examination Scheme:
In-Sem: 25 Marks

Course Objectives:
To facilitate the learners:
1.To learn the fundamentals of python programming for logic building.
2.To implement solution of a given problem using appropriate data type, operators of python language.
3.To understand the decision and iteration interpretation in a programming language.
4.To implement the logic using list, strings, functions and structures of python programming language.

Course Outcomes:
By taking this course, the learner will be able to:
1. Apply logic development skills to solve simple real life problems.
2. Implement, test and execute developed logic or algorithm to python program using appropriate data type, operators.
3. Implement the given problem using appropriate control structures available in the python language.
4. Identify different functions for a problem to construct a modular solution.

List of assignments to be done in Python:
1. Learn logic building using tools such as 'scratch'.
2. Demonstration of installation and configuration of Anaconda and Spyder.
3. A) Accept input (number, name) from the user and print the same.
   B) Display the numbers from 1 to 10.
4. Create an empty dictionary, add elements to the dictionary, update the key values and display the elements of the dictionary.
5. A) Create a tuple, add elements to the tuple and display the elements of the tuple.
   B) Swap two numbers using tuples and display the initial and swapped contents of the tuples.
6. Perform string manipulation functions (concatenation, substring, comparison, palindrome)
7. Find the maximum or minimum number in a given list.
8. Calculate factorial using functions.
9. Generate Fibonacci series using recursion.
10. Implement file operations.
11. Calculate area/circumference of a circle for a given radius using:

a. formula
b. inbuilt function from numpy library.

12. Plot sin(x) and cos(x) functions for values of x between 0 and pi. Use inbuilt libraries numpy and matplotlib.

20ES04L Engineering Graphics Lab

Teaching Scheme	**Examination Scheme**
Practical: 2 Hrs/week	In Semester: 25 marks
Credits: 1	

Course Objectives:

To familiarize student about1

1.Advantages of using software for Engineering drawing

2.2-D drafting using a software

3. 3-D modeling using a software

4. 3-D printing technology

Course Outcomes:

After completing the course using a software package students will be able to

CO1: Draw orthographic projections of a given component

CO2: Draw Isometric projections of a given component

CO3: Draw development of solids

CO4: Draw free hand sketches of the machine elements

Part I

Introduction to 2-D Drafting using a drafting software **(20 Hrs.)**

- Orthographic Projections
- Isometric Projections
- Development of surfaces of solids
- Free hand sketching of standard machine elements

Part II

Demonstration of 3-D Modeling and 3-D Printing **(08 Hrs.)**

Creating a 3-D model of a simple component using a solid modeling software and manufacture using a rapid prototyping technique.

Text Books:

N. D. Bhatt and V. M. Panchal,**'***Engineering drawing, plane and solid geometry'*,Charotor Publication House.

M.L.Dabhade, **'Engineering Graphics'**, *Vision Publications.*

Bethune, J.D., "*Engineering Graphics with AutoCAD 2013*", PHI Learning Private Limited, Delhi, 2013

20ES07 Technical Skill Development Laboratory

Teaching Scheme:

Practical: 2 Hrs/Week

Examination Scheme:

In-Semester:25 Marks

Course Objective: Student will able to learn

I. To identify tools, work material and measuring instruments useful for assembly dissemble of products and different machining operations
2. To handle tools and instruments and use them to prepare joints of specific shape and size.
3. To install software and Operating system on computers

Course Outcome: Student will able to

1. select appropriate tools/equipment for measurement and manufacturing.
2. troubleshoot hardware software in computer systems.
3. produce joints of specific shape, size and material
4. assemble and disassemble components of a product.
5. Implement safety measures required to be taken while using the tools and machines

Sr. No.	Content :	Hrs
1	Use of measuring devices and instruments : Vernier Calliper, Micrometer, Digital Multi-meter, Tachometer, Lux meter etc.	2
2	Assembly -disassembly of products: Electric Iron, Water Purifier, Fan, Mixer Grinder etc.	4
3	Use of joining methods: Soldering and Welding.	4
4	Study and Hands on different day to day machining operations: such as drilling, tapping PVC pipe fitting, hacksaw cutting and filing.	2
5	Use of Machine Tool (Lathe machine)	6
6	Basic troubleshooting computer System in Hardware and Software. Installing and Uninstalling software's (OS 4 APPS) Computer system security aspects (Physical and logical)	6

**NOTE: Practical No. 5 is For Mechanical Engineering Branch and Practical No. 6 is for COMP/IT/E&TC/INSTRU Branch

Text Books:

I. Elements of Mechanical Engineering - Hajra Choudhury & others, Media Promoters 2010.
2. The Elements of Workshop Technology - Vol I & Il, SK. Hajra Choudhury, A.K. Hajra Choudhury, Nirjhar Roy, I Ith edition 2001 others, Media Promoters and Publishers, Mumbai.

Reference:

I. Workshop manual prepared by Department of Mechanical Engineering.

Basic Sciences and Humanities

Autonomous Programme Structure (Revision-1)
F. Y. B. Tech. Sem-II
E&TC / Instru / Mech Programmes
A. Y.: 2020-21 Onwards

F. Y. B. Tech. Second Semester									
Course Code	**Course Title**	**Teaching Scheme Hours / Week**			**Examination Scheme**			**Marks**	**Credit**
20BS03	Multivariate Calculus	3	1	0	50	50	0	100	4
20BS02	Chemistry	3	0	0	50	50	0	100	3
20ES01	Basic Electrical and Electronics Engg.	3	0	0	50	50	0	100	3
20ES05	Fundamentals of Programming Language- 2 (E/IN)	3	0	0	50	50	0	100	3
20ES05M	Engineering Mechanics (Mech)	2	1	0					
20ES06	Geo Informatics	3	0	0	50	50	0	100	3
20BS02L	Chemistry Lab	0	0	2	25	0	0	25	1
20ES01L	Basic Electrical and Electronics Engg Lab	0	0	2	25	0	0	25	1
20ES05L	Fundamentals of Programming Language- 2 Lab	0	0	2	25	0	0	25	1
20ES05ML	Engineering Mechanics Lab	0	0	2					
20ES06L	Geo Informatics Lab	0	0	2	25	0	0	25	1
Total		**15**	**2**	**8**	**350**	**250**	**00**	**600**	**20**
Grand Total		**24**			**600**			**600**	**20**

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

Cummins College of Engineering For Women ★ MKSSS's Karve Nagar, Pune 411052.

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

20BS03 Multivariate Calculus

Teaching Scheme:
Lectures: 3 Hrs/Week
Tutorial: 1 Hr/Week
Number of Credits: 4

Examination Scheme:
In-Semester: **50** Marks
End-Semester: **50** Marks

Course Objectives:

1. To familiarize the students with techniques of differentiation and integration of multivariable function.
2. To equip the students to deal with advanced level of Mathematics, and applications that would be essential for their disciplines**.**

Course Outcomes:

After completion of this course, students will be able to

CO1: Calculate partial derivatives of multivariate functions.

CO2: Apply partial differentiation to applications like maxima minima, construction of linear model etc.

CO3: Solve double integral, triple integral over the region.

CO4: Determine physical parameters using double and triple integral.

Course Content:

Unit – I: Partial differentiation **(09)**

Function of several variables, partial derivatives, Geometrical interpretation of partial derivatives, chain rule, higher order partial derivatives, Euler's theorem.

Unit – II: Applications of partial differentiation. **(07)**

Maxima, minima and saddle points, second derivative test, constrained extrema and Lagrange's multipliers, applications in optimization of functions of several variables. Applications of first order partial derivatives in data fitting using the method of least squares.

Unit – III: Double integration **(10)**

Tracing of curves in Cartesian and Polar coordinate system, double integrals over a rectangle, double integrals over regions, change of order of integration, Introduction of Jacobian determinant for two variables, double integral in polar coordinates, The Gaussian integral.

Unit – IV: Triple integration **(09)**

Triple integral over a box, triple integrals by iterated integration, change of variables, Cylindrical and Spherical coordinates, The Jacobian determinant for three variables, evaluation of triple integral.

Unit – V: Applications of Double and Triple integration **(07)**

Applications of double integral and triple integral: Area of plane Lamina, mass of plane lamina, surface area, volume, mass of solid.

Text Books:

1. B. V. Ramana, **'Higher Engineering Mathematics',** *Tata McGraw Hill Publications,* (2007).

2. B.S. Grewal, **'Higher engineering Mathematics'**, *Khanna publishers, (*40th edition), (2008).

3. Hughes-Hallett et al., '**Calculus - Single and Multivariable',** *John-Wiley and Sons,* (3rd Edition), (2003).

4. Maurice Weir, Joel Hass, '**Thomas' Calculus'**, *Pearson India*, (13th edition), (2016).

Reference Books:

1. J. E. Marsden, A. J. Tromba and A. Weinstein, '**Basic Multivariable Calculus'**, *Springer,* (3rd edition), (1993).

2. G. B. Thomas and R. L. Finney, '**Calculus and Analytic geometry'**, *Pearson, Reprint* (9th Edition), (2002).

3. Sudhir Ghorpade, Balmohan Limaye, '**A Course in Multivariable Calculus and Analysis'**, (Undergraduate Text in Mathematics), *Springer* (2009).

4. Dennis G. Zill, Warren S. Wright**, 'Multivariable Calculus**, **Early Transcendental'**, *Jones & Bartlett Publisher* (4th edition), (2009).

20BS02 Chemistry

Teaching Scheme	**Examination Scheme**
Lectures: 3Hrs/week	In-Semester: 50 Marks
Credits: 3	End-Semester: 50 Marks

Course Objectives

The Chemistry course is designed such that the learners imbibe chemical principles relevant in the engineering context. The course facilitates undergraduates to understand chemical processes, methods of analysis, structure-property relationship and evaluate role of chemical substances for engineering applications. Further the course inculcates basic problem-solving skills involving chemistry principles.

Course Outcomes

The students will be able to –

1. Interpret properties and applications of molecules based on their atomic structure.
2. Analyze quality parameters for water, coal, petrol using analytical methods.
3. Apply chemical principles for problems related to water, batteries, fuel or polymers.
4. Outline the process of synthesis for inorganic substances and nanomaterials.
5. Elucidate the construction and functioning of a device/chemical reagent.

Module 1: Physical Chemistry (13)

Unit 1. Chemical Bonding: Types of bonds, intermolecular forces, bonding in molecules: valence bond theory, molecular orbital theory for diatomic molecules.

Unit 2. Electrochemistry: Electrochemical cell, Nernst equation, EMF of cell, reference and indicator electrodes, battery characteristics, Lead-acid, Lithium-ion battery, Fuel cell technology.

Module 2: Inorganic and Materials Chemistry (13)

Unit 3. General overview of the Periodic table and properties; chemistry of some elements like H, Si and their compounds, Si for chipmaking, H_2 gas as fuel.

Unit 4. (A) Engineering materials: Structural features, properties and applications of OLEDs - PPV (- solar cell), liquid crystal polymers, conducting polymers – as a chemical sensor, polymer composites.

(B) Nanomaterials:
Introduction to nanomaterials, synthesis by top down and bottom-up methods. Structure, synthesis and some typical applications of nanomaterials.

Module 3: Analytical Chemistry (16)

Unit 5. Analysis of -
(A) Water: Hardness determination in water, TDS, effect of hard water in boilers, Internal and external treatment of hardness, water softening techniques -zeolite and ion exchange method. Desalination methods-Reverse osmosis. Electrodialysis. Waste water recycling.
(B) Carbon based fuels: Analysis of coal/petrol.

Unit 6. Analytical techniques such as spectroscopy, pH-metry, conductometry and their applications.

Text Books:

1. S.S. Dara 'Engineering Chemistry' S. Chand Publications (2010)
2. B.S. Chauhan 'Engineering Chemistry': Univ Sc Press. (Third edition)2009
3. Shashi Chawla 'A Text Book of Engineering Chemistry': Dhanpat Rai & Co. (2015)
4. Jain and Jain 'A Text Book of Engineering Chemistry' Dhanpat Rai & Co.
5. G. Chatwal 'Instrumental methods of Chemical Analysis' Himalaya publication house

Reference Books:

1. Steven S. Zumdahl, 'Chemistry concepts and applications', Cengage learning publication (2009)
2. Ram D. Gupta, 'Hydrogen fuel 'C.R.C. Publications (2009)
3. Puri, Sharma, Pathania 'Principles of Physical Chemistry': Vishal Publ. Co.
4. Robert Braun' Instrumental methods of analysis' Pharma med press (2010)
5. J.D. Lee, 'Concise Inorganic Chemistry', 4th edition, Wiley Publication (2019)

20ES01 Basic Electrical and Electronics Engineering

Teaching Scheme:	**Examination Scheme**
Lectures: 3 Hrs./Week	In-Semester: **50** Marks
Credits: 3	End-Semester: **50** Marks

Course Objectives:

1. To educate the students about the realization of basic theoretical concepts & laws in electrical engineering in real physical world.
2. To make students familiar with three phase supply.
3. To make students familiar with single phase transformers.
4. To understand the construction and applications of diode and BJT
5. To understand basics of combinational logic, Boolean algebra and flip -flops.

Course Outcomes:

After completion of course, students will be able to

CO1: Analyze and calculate parameters of DC circuits

CO2: Analyze and calculate parameters of AC circuits

CO3: Calculate performance parameters of single-phase transformer.

CO4: Analyze I-V characteristics of semiconductor diodes and transistors and design simple analog circuits using these devices

CO5: Build simple combinational and sequential logic circuits.

Unit – I: DC Networks **(08)**

Kirchhoff's laws, Mesh and Nodal Analysis, Thevenin and Superposition Theorems, maximum power transfer theorem, Network Simplifications using star-delta / delta-star transformations.

Unit – II: AC Circuits **(07)**

Series and parallel RL, RC and RLC circuits , concept of Impedance and admittance, power triangle and power factor. Resonance in series and parallel RLC circuit, Three phase voltage generation and waveform, star and delta balanced systems. Relationship between phase and line quantities, phasor diagram, power in a three phase circuit.

Unit – III: Electromagnetism and Single Phase Transformers (06)

Magnetic materials and B-H curve, self and mutual inductance,1 Φ transformer: concept, types, working, ideal transformer, practical transformer, equivalent circuit, phasor diagram, efficiency and regulation calculations.

Unit – IV: Diodes and rectifiers (07)

Construction and characteristic of p-n junction diode, LED, photodiode, Half wave, full wave and bridge rectifiers, need of capacitor filter, rectifier operation with capacitor filter, Zener diode as a voltage regulator, block diagram of Regulated power supply

Unit – V: Junction Transistor Amplifiers (07)

Bipolar junction transistor, Construction of BJT, Types of biasing:-fixed bias and self bias circuit, BJT characteristics for-CE,CB,CC configurations, relationship between α and β, load line for a transistor, application of transistor as a switch and amplifier.

Unit – VI: Digital Electronics (07)

Basic gates, implementation of basic gates using universal gates, Boolean algebra, standard representation of logic functions (SOP and POS forms), Introduction of Combinational logic circuits like multiplexer ,demultiplexer, half adder and full adder, Introduction of Sequential logic circuits like flip- flops (SR, D), counters and shift registers.

Text Books:

1. Hughes, 'Electrical and Electronic Technology', Pearson education, (10th edition), (2008)

Reference Books:

1. D.P. Kothari and I.J. Nagrath, 'Basic Electrical Engineering', McGraw-Hill, (3rd edition), (2010)
2. A.E.Fitzgerald, A.Grabiel,'Basic Electrical engineering',McGraw-Hill, (5th edition), (2009)
3. Floyd, 'Electronic Devices and Circuits', pearson education, (7th edition),(2008)
4. AP Malvino & Donald Leach,'Digital Principles and Applications', McGraw Hill Education,(6 th edition), (2009)

20ES05 Fundamentals of Programming Language-2 (ETC, Instru)

Teaching Scheme:
Lecture: 3 Hr/week

Examination Scheme:
In-Sem: 50 Marks
End-Sem: 50 Marks
Credits: 3

Course Objectives:

To facilitate the learners:

1)To understand and apply object-oriented principles for application development.
2)To develop programming applications using Java.
3)To make use of class, object, constructor.
4)Learn programming construct of Java.

Course Outcome:

By taking this course, the learner will be able to:

1) Develop basic object oriented program using class, object and constructor.

2) Differentiate between different types of polymorphism

3) Demonstrate object-oriented programming concepts of exceptions using inbuilt classes and user-defined exceptions

4) Make use of principles of object-oriented programming language Java to solve given problem

Unit-I : Introduction to Object Oriented Programming Paradigm (5)

Role and need of programming languages, characteristics of a good programming language, introduction to various programming paradigms. Need of object-oriented paradigm, basic concepts of object oriented programming (OOP), benefits of OOP. General characteristics for OOP, Object oriented concepts: Class, Object, abstraction, encapsulation, polymorphism, and inheritance.
Illustration through real life examples and use cases

Unit-II : Introduction to Java Programming Language (6)

History of Java, Features of Java, Java and Internet, Java virtual machine, First java Program, Command line arguments, Java Programming elements: Data types, Control Structures, Encapsulation, Abstraction and Polymorphism, Class, object, constructor
Illustration through real life examples and use cases

Unit-III : Polymorphism **(5)**

This keyword, static method, function overloading, argument passing, constructor overloading. String and Array's in Java, Java Collection Framework – Arraylist, HashSet
Illustration through real life examples and use cases

Unit-IV: Inheritance **(6)**

Types of inheritance, base class and derived class, access specifiers, method overriding.
Illustration through real life examples and use cases

Unit-V: Abstract Class, Interfaces and Packages **(6)**

Abstract class, interfaces, run time polymorphism. Creating and importing packages.
Illustration through real life examples and use cases

Unit-VI: Exception Handling in Java **(5)**

Errors and Exceptions, Types of exceptions, try, catch, throw, throws and finally keywords, Build-in exceptions, creating and using custom exceptions.
Illustration through real life examples and use cases

Text Books:

1) Herbert Schilt, "JAVA Complete Reference", Tata McGraw Hill, (9thEdition), (2014)
2) Eckel B., "Thinking in Java", Pearson Education, (3rd Edition)

Reference Books:

1. Kathy Sierra & Bert Bates, "Head First Java", Oreilly publication,(2nd Edition) (2009)
2. Barry Burd "Beginning Programming with Java for Dummies", Oreilly publication, (5th Edition) (2017)
3. Paul Deital and Harvey Deital,"Java How to program", Prentice Hall Publication,(9th Edition) (2011)

20ES05M Engineering Mechanics (Mech)

Teaching scheme	**Examination scheme**
Lectures: 2hrs/week	In-Sem Exam: **50** Marks
Tutorial: 1hr/week	End-Sem Exam: **50** Marks
Number of Credits: 3	

Course Objectives:

1. To familiarize the **concepts of equilibrium and friction**.
2. To study and analyze the motion of moving particles and bodies**.**

Course Outcomes:

CO1: Apply the concept of force, moment and equilibrium in two and three dimensional systems with the help of FBD

CO2: Estimate force of friction, C.G. and Moment of Inertia of the bodies.

CO3: Analyze the motion of a particle to find the relation between velocity and acceleration.

CO4: Analyze particles in motion using force and acceleration, work-energy and impulse-momentum principle.

Unit-I: Rigid body: Statics (06)

Equivalent force systems, Equations of equilibrium, free body diagram, reactions.

Static, intermediately and partial constraints, two and three force systems.

Structures: 2D truss, method of joints, method of selection. Frame, beams, types of loading and supports. Shear force and bending moment diagrams.

Unit-II: Friction (03)

Dry friction (static and kinetic) wedge friction, disk friction, belt friction, journal bearings, wheel friction and rolling resistance

Unit-III: Center of Gravity and Moment of Inertia (04)

First and second moment of inertia and mass. Radius of gyration, parallel axis theorem, product of inertia, rotation of axes and principal M.I. by direct method. Composite bodies.

Unit-IV: Kinematics of Particles (04)

Rectilinear motion, curvilinear motion, rectangular, normal-tangential, polar, cylindrical co-ordinates, relative and constrained motion, space curvilinear motion.

Unit-V: Dynamics of Particles (03)

Force, mass and acceleration, work-energy, impulse-momentum principle, impact of bodies.

Unit-VI: Kinetics of Rigid Bodies (04)

Translation, fixed axis rotation, general planner motion, work-energy, power, potential energy, impulse-momentum and associated conservation principle, Euler equation of motion and its applications.

Text-Books:

1. R. C. Hibbeler, 'Engineering Mechanics (statics and Dynamics), 12th Edition, Pearson
2. A. Nelson, 'Engineering Mechanics (statics and Dynamics), 12th Edition, Mc Graw Hill Education.

Reference Books:

1. Timoshenko and Young, 'Engineering Mechanics', Tata Mc-Graw Hill, New Delhi.
2. Mclean, and Nelson, 'Theory and problems of Engineering Mechanics (Statics and Dynamics)', Schaum Series.
3. Beer and Johnson, 'Vector Mechanics for Engineers-Dynamics' McGraw Hill Education.
4. Engineering Mechanics (Statics and Dynamics)', Dorling Kindersley (India) Pvt. Ltd. Pearson Education.
5. Dr. R. K. Bansal , Sanjay Bansal, 'A Text book of Engineering Mechanics', Lakshmi publications.

20ES06 GEO-INFORMATICS

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs/Week	In-Semester : 50Marks
Credits: 3	End-Semester : 50Marks

Course Objectives:

1. To introduce the science and technologies involved in Remote sensing
2. To understand the application of GIS in various fields
3. To explain the earth and mapping principles
4. To learn basics about the Geodata & GIS software

Course Outcomes:

After completion of course, students will be able to

CO1: Analyse the parameters affecting visual interpretation of physical features of an image

CO2: Justify use of various types of maps applicable in different scenarios

CO3: Identify use of components of GIS for spatial and attribute data relationship

CO4: Apply GPS technologies to real world examples using an understanding of GPS theory

CO5: Relate GIS and remote sensing technologies with maps, images and apps

Unit – I: Principles of remote sensing **(05)**

Concept of Remote Sensing, Working Principle, Types of remote sensing , Platforms of remote sensing , Output of remote sensing – photography, satellite imaginary and visual interpretation data

Unit – II: Data interpretation method in remote sensing (05)

Types of data, Visual interpretation of images-Natural and false colour composites, Image resolution, Limitations, Applications

Unit – III: Photogrammetry & Cartography (06)

Fundamentals of aerial photography, satellite images, virtual images, Image processing, Digitalization of maps

Cartography: Conventional Maps, Definition, Map Basics Elements/components of map, Map Scale, Large & Small Scale maps, Thematic maps , Coordinate system , Polar & Cartesian (Latitude-Longitude & x, y coordinates)

Unit – IV: Geographical information system (GIS) & Database management for geoinformatics (08)

GIS : Concept & definition of GIS (based on components, based on functions), GIS vs. Conventional Mapping, Components of GIS, Working Principle of GIS, Strengths of GIS, Geoinformatics Vs. GIS

Database management for geoinformatics : GIS Data and Data Models, Concept of Query, Concept of Spatial Analysis

Unit – V: Global Positioning System (GPS) (05)

History of GPS, Types of GPS, Working principle, Applications of GPS, Case study

Unit – VI: Application of geoinformatics (07)

Case studies to be used for demonstration-

Navigational services : available on phones (travel direction from A to B), Vehicle tracking system / Fleet management : Cabs, City buses, Trains, Aircrafts, City Planning (urban sprawl, master planning) , Solid waste management (identifying location for waste disposal site, route optimization of waste collection, online/offline monitoring of waste collection); Identifying suitable location for business outlet (Pizza hut, Teco bell, General Motors), GIS for location based services (courier & other home delivery services) – Fedex, DHL, Telecom sector uses GIS (planning of OFC network, identifying suitable location for mobile towers, marketing, operations), Disaster Management using GIS (modelling & simulation tools – through videos)

Text Books:

1. **Information Systems**, *Prentice-Hall of India, New Delhi, 2006.*
2. Ian Heywood, Sarah Cornelius and Steve Carver -**An Introduction to Geographical Information Systems**- *(4th Edition) by 2012*
3. A.M. Chandra, S.K. Ghosh,- "**Remote Sensing and Geographical Information System**", *1 st Edition, Narosa Publishing house, 2007.*

Reference Books:

1. 1. Peter A. Burrough and Rachael A. Mc. Donnell- **Principles of Geographical Information** System, *Oxford University Press Inc., New York, 2004.*
2. 2. Ian Heywood, Sarah Cornelivs and Steve Carver, **An Introduction to Geographical Information System**, *Pearson Education Pvt .Ltd., New Delhi, 2007.*
3. Arthur H. Robinson et al. **Elements of Cartography**, *V Edition, John Wiley & Sons, New Delhi, 2002.*
4. Misra, R.P.and Ramesh, A**, Fundamentals of Cartography concept**-*Publishing Company, New Delhi, 2002.*
5. Lillesand M. Thomas and Ralph W.Kiefer **- Remote Sensing and Image Interpretation**

20BS02L Chemistry Laboratory

Teaching Scheme:
2 hours per week
Number of Credits: 1

Continuous assessment
Term Work: 25 Marks

Course outcomes

CO	On completion of this course, student will be able to:
CO1	Apply chemistry principles for quantitative analysis.
CO2	Make use of an instrument for chemical analysis.
CO3	Calculate chemical parameter based on recorded observations .
CO4	Evaluate quality of coal and polymer based on their chemical properties.
CO5	Prepare a chemical substance such as soap,zeolite,biopolymer etc. based on experimental procedure.

LIST OF EXPERIMENTS:

1. Determination of total hardness of sample water by EDTA Method (complexometric titration)
2. Determination of total alkalinity of sample water .
3. Measuring EMF of electrochemical cell to predict spontaneity as well as to calculate Gibb's free energy and equilibrium constant.
4. Viscometric method to determine Molecular weight of a Polymer.
5. Estimation of sodium from given solution using flame photometry.
6. Colorimetric estimation of $KMnO_4$ from solution.
7. Proximate analysis of coal samples and Comment on it's quality.
8. Laboratory preparation of soap.

20ES01L Basic Electrical and Electronics Engineering Lab

Teaching Scheme:
Practical: 2 Hrs./Week
Credits: 1

Examination Scheme:
Term Work: 25 marks

Course Outcomes:

After completion of course, students will be able to

- Perform basic domestic wiring
- Apply circuit laws to find the parameters of given electrical network
- Build a basic regulated DC power supply
- Obtain frequency response of CE amplifier
- Build basic digital circuits

List of experiments:

- Introduction of different electrical and electronics components and instruments.
- To perform electrical wiring to control lamps using one way and two-way switches.
- To verify Thevenin's theorem & superposition theorem.
- To determine phase angle of L-C-R series circuit.
- To perform load test on single phase transformer to determine regulation and efficiency.
- To determine output voltage and ripple voltage of half wave, full wave rectifier with center tap transformer and bridge rectifier with and without filter.
- Assemble and build simple DC regulated power supply.
- To determine frequency response of CE amplifier.
- Assemble and build half adder & full adder circuits.

20ES05L Fundamentals of Programming Language Lab-2 (ETC, Instru)

Teaching Scheme:
Practical: 2 Hr/week
Credits: 1

Examination Scheme:
In-Sem: 25 Marks

Course Objectives:
To facilitate the learners:

1) To explore the principles of object oriented programming
2) To apply object oriented programming concept for developing applications using Java
3) To make use of class, object and constructor for coding basic object oriented program
4) To handle built-in and user defined exceptions

Course Outcome:
By taking this course, the learner will be able to:

1) Develop basic object oriented program using class, object and constructor
2) Develop readable and reusable code using inheritance and polymorphism
3) Make use of exceptions using inbuilt classes and user defined exceptions
4) Develop application using object oriented programming language Java to solve given problem

A large part of ESFL205 lab would be for understanding the basic concepts of object-oriented programming and implementation of some real-world simple applications. Assignment statements are in brief and should be implemented in JAVA programming language. Faculty members are encouraged to expand problem statements with variations. Assignments can be framed and expanded in such a way that it explores concepts, language constructs, logic of solution and simple application. Students will be encouraged to solve open problems in different domains. Faculty will appropriately adopt assignments on similar lines as the examples shown here.

Example List of assignments:-

Group A: Assignment to write program in OO language to understand concept of data abstraction and encapsulation

1. Write a MyDate class which has attributes as day, month and year. Create five objects of MyDate and display them.
2. Design a user defined abstract data type 'Complex' in Java. Write a program to perform arithmetic operations of two complex numbers.
   A complex number has a real part and an imaginary part.

a) Given the values of real part and imaginary part of a complex number, the magnitude of the complex number can be calculated as square root of the sum of squares of real part and the imaginary part.
b) The argument of the complex number can be calculated as tan inverse of ratio of imaginary part(numerator) and real part(denominator)
c) The complex number can be added to another complex number and the answer of the addition is a complex number. When one adds two complex numbers, the real parts of each of the complex numbers is added which becomes a real part of the answer and imaginary part of each complex number is added together which becomes imaginary part of the answer. Both these results are real and imaginary parts for a complex number which is the answer of the addition complex conjugate of the complex number can be calculated by negating the imaginary part of the complex number
d) The complex number can be subtracted from another complex number and the answer of the subtraction is a complex number.
e) When one subtracts a complex number from the other, the real part one complex number is subtracted from the other and the result becomes a real part of the answer and imaginary part of one complex number is number is subtracted from the other and the result of subtraction becomes imaginary part of the answer. Both these results are real and imaginary parts for a complex number which is the answer of the subtraction.

3. Create a student result database in Java. Calculate the grades of students. Decide criteria for best student and short-list students who satisfy the criteria.
   a) A student has a roll No, name, marks in five courses and a grade. A student list has many students. If a student has grade equal or beyond 8, he is considered as a top band student.
   b) Create at least ten students. From these, find all such students which satisfy the criteria of top band student. Create a list of such students and display the students in the list.

4. A circle has a radius. Its area can be calculated. The area is a double number. Its perimeter can be calculated as $2\pi r$. The perimeter is a double number. Given two circles one can find out which is large and which is small.
   Create two circles c1 and c2 with radius as 10 and 7 respectively. Calculate the area and perimeter of each. Compare two circles with each other and display which is large and which is small.
5. Write a JAVA program to perform String operations using String/String Buffer class
   a) Write a program that reads a word and then prints the first character, the last character, and the characters in the middle. For example, if the input is Cummins, the program prints Cummins.

b) Write a program that reads a name (such as Ranbeer Rishi Kapoor) and then prints a monogram consisting of the initial letters of the first, middle, and last name (such as RRK).

Group B: Assignment to write program in OO language to understand concept of class inheritance and polymorphism.

1. Implement Java program to calculate area and perimeter of various shapes-circle, triangle and rectangle.
2. Create an application like book shop and maintain the inventory of books that are being sold at the shop
3. Find appropriate class hierarchy, polymorphic behavior in applications like banking and implement it.
4. Model the HRD application using the concepts of inheritance, interface, polymorphism
5. A company has many employees. An employee has employee Id, basic salary, house rent allowance, dearness allowance, profession tax and total salary. An employee has an address. The address has apartment number, apartment name, road and PIN code.

   The total salary of an employee is the summation of basic salary, house rent allowance which is 20 percent of basic salary, dearness allowance which is 45 percent of basic salary. The take home salary is calculated after deducting profession tax from which is 7 percent of basic salary from the total salary. When an employee is appointed, he is assigned with an employee Id and basic salary. One can ask for total salary of the employee and take-home salary of the employee.
   Identify a class/classes from the above statement, identify the attributes, the data types, the behaviour. Test your program for ten employees
   Display all the details of the employees as per id and as per pin code.
   Display take home salary for all the employees, display the tax to be deducted across all employees.
6. Reading material has title and price. A book is a reading material. It has ISBN number. A magazine is a reading material, it has month of issue. A CD is a reading material, it has duration in minutes. Represent the above description as a generalization, specialization tree. Identify the parent class, its attributes, child class and their attributes. Write all of them clearly.
7. A vehicle has engine no and chassis number. It can be locked, unlocked. Every vehicle is movable (interface). It can be started, stopped, turned, accelerated, turned, and decelerated. A car is a vehicle. It has steering. An airplane is a vehicle. It has wings. A boat is a vehicle. It has propeller.

Group C: Assignment to write program in OO language to understand concept of exception handling

1) Write a program to catch various in-built exceptions (try, catch and finally block)

2) Create User defined exception to check the specific conditions for systems like recruitment etc and throw the exception if the criterion does not met in Java.

3) Consider student data consist of fields such as roll number, name, and marks of various subjects. Write a program using inbuilt and user defined exceptions to avoid invalid entry.

20ES05ML Engineering Mechanics Lab (Mech)

Teaching scheme **Examination scheme**

Practical: 2hrs/week In-Sem Exam: **25** Marks

Number of Credits: 1

Course Objectives:

1. To demonstrate the basic principles of Engineering Mechanics namely Engineering Statics and Engineering Dynamics.

Course Outcomes:

CO1: Verify law of Force Polygon

CO2: Verify the law of moments using parallel force apparatus

CO3: Analyze co-efficient of friction, C.G. and M.I. of the system

CO4: Estimate mechanical advantage, velocity ratio and Mechanical efficiency of a mechanical system

List of Experiments

1. To verify the law of force polygon.
2. To verify the law of moments using parallel force apparatus. (simply supported type).
3. To determine the co-efficient of friction between wood and various surface (like leather, wood, aluminum) on an inclined plane.
4. To find the forces in the members of jib crane.
5. To determine the mechanical advantage, velocity ratio and mechanical efficiency of a screw jack.
6. To determine the mechanical advantage, velocity ratio and mechanical efficiency of the wheel and axle.
7. Verification of force transmitted by members of given truss.
8. To verify law of moments using bell crank lever.
9. To find the C.G. and Moment of Inertia of an irregular body experimentally and verify using computational method.

20ES06L GEO-INFORMATICS Lab

Teaching Scheme:

Practical : 2 Hr/Week

Credit1: 1

Examination Scheme:

Term Work: 25 Marks

Course Objectives:

1. To introduce students basics of spatial data and its creation.
2. To learn basics about the Geodata & GIS software.

Course Outcomes:

After completion of course, students will be able to

CO1: **Interpret** satellite images and their characteristics with the use of software features

CO2: **Apply** basic data visualization concepts for identification of physical features

CO3: **Use software to interpret** aspatial attribute data and relate it with spatial data

CO4: **Use software to interpret** vector layer and relate it with attribute data

List of Experiments

1) Exploring Digital Map
2) Study and observations of paper map and digital map
3) Measurement of area using Digital planimeter.
4) Study of Layers, Display Controls, Locating a place
5) Adding place marks - Saving KMZ/ KML files

6) Study of ground profile between given two points

7) Visual Interpretation of multispectral image

8) Creating csv file (attribute data) and importing in GIS platform

9) Understanding QGIS interface

10) Working with vector data – Point, Line, Polygon

MKSSS's Cummins College of Engineering for Women, Pune
(An Autonomous Institute Affiliated to SavitribaiPhule Pune University)

Autonomous Program Structure of
Second Year B. Tech. Third Semester
(Instrumentation & Control Engineering)
Academic Year: 2021-2022 Onwards

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Marks	Credit
		Lecture	Tutorial	Practical	In Semester	End Semester	Oral	Practical		
20BSIN301	Transform Calculus and Statistics	3	1	0	50	50	0	0	100	4
20IN301	Sensors and Transducers	3	1	0	50	50	0	0	100	4
20IN302	Industrial Instrumentation	3	1	0	50	50	0	0	100	4
20IN303	Analog and Digital Electronics	3	1	0	50	50	0	0	100	4
20HS301	Universal Human Values-II	2	1	0	50	50	0	0	100	3
20IN301L	Sensors and Transducers Lab	0	0	2	25	0	0	25	50	1
20IN302L	Industrial Instrumentation Lab	0	0	2	25	0	25	0	50	1
20IN303L	Analog and Digital Electronics Lab	0	0	2	25	0	0	25	50	1
20IN304L	Programming Practice Lab	0	0	4	25	0	0	25	50	2
20AC301	Audit Course	0	0	1	0	0	0	0	0	No Credit
	Total	**14**	**5**	**11**	**350**	**250**	**25**	**75**	**700**	**24**
	Grand Total	**30**			**700**				**700**	**24**

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CUMMINS COLLEGE OF ENGINEERING FOR WOMEN
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20BSIN301 Transform Calculus and Statistics

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

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

Prerequisites:
1. Basics of integral and multiple integral.
2. Beta function, Gamma function.
3. Partial fractions.
4. First order linear differential equation.
5. Basic statistics and basic probability

Course Objectives:
Mathematics is a necessary path to scientific knowledge which opens a new perspective of mental activity. Our aim is to provide sound knowledge of engineering mathematics to make the students think mathematically and strengthen their thinking power to analyze and solve engineering problems in their respective areas.

Course Outcomes:
On completion of this course the students will be able to,
1. Obtain Laplace Transform of given functions, solve differential equations using Laplace Transform.
2. Obtain Fourier transform and Z transform for discrete sequences.
3. Obtain the solution of higher order Linear differential equations
4. Apply concepts of Statistics to interpret given data, calculate probabilities of random events.

Unit 1: Laplace Transforms **(07)**
Definition of Laplace Transform, Inverse Laplace transforms (LT), Properties and theorems, LT of standard functions, LT of some special functions viz. periodic, unit step, unit impulse, application of LT for solving Differential Equations, electrical circuits,

Unit 2: Fourier Transforms **(07)**
Periodic functions, Dirichlet's condition, Complex form of Fourier series, Introduction to continuous Fourier Transforms, basics of Sequences, Discrete Fourier Transforms (DFT) of standard sequences, Existence of DFT, Properties of DFT, Inverse DFT.

Unit 3: Z- Transform **(07)**
Definition, standard properties, Z- Transform of standard sequences, Inverse Z – Transform using standard results, Inversion integral method, solution of difference equation, Relation between Fourier , Z and Laplace Transforms.

Unit 4: Higher Order Linear Differential equation and application **(07)**
Higher order linear differential Equation with constant coefficients, complementary function, Particular integral, short cut methods, Method of variation of parameter. Cauchy's and Legendre's D.E., Modelling of electrical circuits.

Unit 5: Statistics **(06)**

Measures of central tendency, Standard deviation, Coefficient of Variation, Covariance, Correlation and Linear Regression, Moments, Skewness, Kurtosis

Unit 6: Probability and Probability Distribution **(08)**

Theorems on probability, Random Variables – Discrete & continuous, Mathematical expectations, Probability density functions, Standard discrete and continuous distributions like Binomial, Poisson, Normal, Introduction to Testing of hypothesis, Chi-square distribution test.

Text Books:

1. B. V. Ramana, 'Higher Engineering Mathematics', Tata McGraw Hill Publications, (2007).
2. B.S. Grewal, 'Higher Engineering Mathematics', Khanna publishers, Delhi (40th edition), (2008)
3. S.C. Gupta, V. K. Kapoor, 'Fundamental of Mathematical Statistics', S. Chand & Sons (10th revised edition), (2002).

Reference books:

1. C.R.Wylie, L.C. Barrette, 'Advanced Engineering Mathematics', McGraw Hill Publications, New Delhi (6th edition), (2003).
2. Erwin Kreyszig, 'Advanced Engineering Mathematics', Wiley Eastern Ltd. (8th Student Edition), (2004).
3. Peter V. O'neil, 'Advanced Engineering Mathematics', Thomson Brooks / Cole, Singapore (5th edition), (2007).

Tutorials:

Minimum 8 assignments based on the course contents

20IN301 Sensors and Transducers

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

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

Prerequisites:
Electrical and Electronics Measurement
Methods of Measurement, Measurement System

Course Objectives:
1. To acquire the knowledge of basic principles of sensing various parameters
2. To study principles, working, mathematical relation characteristics, advantages and limitations of various sensors and transducers
3. To select appropriate transducer for the particular application

Course Outcomes:
By the end of the course, students should be able to
1. Students will be able to define and list performance characteristic of different sensors
2. Students can compare features of different sensors and transducers.
3. They can select sensors and transducers for particular applications.
4. Analyze the performance of sensors and transducers for various applications.

Unit 1: Temperature sensors (07)
Scope of sensors and transducers, concepts and terminology of measurement system, classification and selection criteria of transducers, temperature scales, units and relations, classification of temperature sensors, various Mechanical and Electrical temperature sensors, Non Contact temperature sensors - Radiation and optical.

Unit 2: Pressure and Level sensors (08)
Pressure scales, units and relations, types of manometers, various types of elastic pressure sensors, Calibrating Instruments, various types of Gauges, Direct and Indirect types of pressure measurement
Various level measurement techniques, Direct and Indirect types of level measurement, Electrical: Float, displacer (torque tube unit), ultrasonic, radioactive, radar , thermal. Capacitive, resistance. Optical level sensor, Inductive level sensor. Level switch.

Unit 3: Flow sensors (08)
Classification of Flow transducers, types of flow, Bernoulli‟s equation for incompressible flow, Head type flow meters,Variable area type, Other flow meters like Turbine, Target, Electromagnetic, Ultrasonic (Doppler, transit time), Vortex shedding, Positive displacement.

Unit 4: Force and Torque Measurement: (07)
Basic methods of force measurement, elastic force transducers, strain gauge, load cells, shear web, piezoelectric force transducers, vibrating wire force transducers, Strain gauge torque meter, Inductive torque meter, Magneto-strictive transducers, torsion bar dynamometer.

Unit 5: Allied sensors **(06)**

pH and conductivity, leak detector, flame detector, smoke detector, humidity, density, viscosity and Sound sensors, Displacement transducers-LVDT, RVDT, Encoders.

Unit 6: Smart and MEMS sensors: **(06)**

Principles of Smart Sensing, Classification and Terminology of Smart Sensors. MEMS (Piezoresistive, capacitive, conductive, optical), Introduction to sensor modeling.

Text Books:

1. A.K. Sawhney, "Electrical & Electronic Instruments & Measurement", Dhanpat Rai and Eleventh ed., 2000.
2. B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis", Tata McGraw Hill Education, Second ed., 2004.
3. D.V.S. Murty, "Instrumentation and Measurement Principles", PHI, New Delhi, Second ed 2003
4. R. K. Jain, "Mechanical and Industrial Measurement", Khanna Publications - 9th print
5. C.S. Rangan ,G..R.Sharma, V.S.V Mani , "Instrumentation Devices and Systems"
6. HKP Neubert. 'Instrument Transducers'

Reference Books:

1. E.O. Doebelin, "Measurement Systems", McGraw Hill, Fourth ed., 1990.
2. D. Patranabis, "Principle of Industrial Instrumentation", Tata McGraw Hill, Second ed.,1999
3. Sabrie Soloman, "Sensors Handbook", McGraw Hill Publication, First ed., 1998.
4. B.G. Liptak, "Process Measurement & Analysis", Chilton Book Company, Third ed., 1995.

Tutorials:

Minimum 8 assignments based on the course contents

20IN302 Industrial Instrumentation

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

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

Prerequisites:
Basics of Electrical measurements and Network Theory

Course Objectives:
1. To explain the concept of different characteristics of measurement systems.
2. To use different types of ADC and DAC used for various applications.
3. To measure different parameters using different modes of measurement instruments.
4. To use and design analog filters based on different applications.

Course Outcomes:
At the end of this course, students will be able to:
1. Define different characteristics of instruments.
2. Choose ADC and/or DAC for a given application.
3. Differentiate different modes of operation in a given measuring instrument.
4. Measuring different parameters by selecting appropriate testing and measuring instruments for given application.

Unit 1: Introduction **(08)**
Introduction to Instrumentation System, General Measurement System, Classification of Instruments, Static and Dynamic characteristics of instruments, Error: limiting error, Types of Errors, Loading effect, Calibration: Definition, calibration report & certification, traceability

Unit 2: ADC and DAC **(08)**
Sampling Theorem, Sample and Hold Circuit, ADC characteristics definition, ADC Specifications, Various types of analog to digital converters (ADC), Various types of digital to analog conversion (DAC) techniques, Pulse Width Modulation Technique, Interpretation of ADC and DAC ICs, their specifications and selection for a given application.

Unit 3: Digital Panel Meter and Virtual Instrumentation **(07)**
Digital Panel Meters, Scale adjustment, Digits and display, Significance of ½ and ¾ digit. Need of VI, Advantages of VI, Define VI, block diagram and architecture of a virtual instrument, Application of Virtual Instrumentation

Unit 4: Measuring Instruments and Test Equipment **(07)**
RMS definition, RMS measurement, RMS value of sine and pulse, True RMS meter, DMM, Standard AC and DC sources, Automation in DVM, Universal Counter and different modes, Digital Storage Oscilloscope, Measurement of voltage, frequency, phase difference, sampling rate, bandwidth, roll mode

Unit 5: Signal Sources and Signal Analyzers **(06)**
Sine wave generator, sine wave synthesis, audio and function generator, arbitrary waveform generator and its applications in instrumentation.

Introduction to total harmonic distortion, wave analyzer and its applications, FFT analyzer and their applications

Unit 6: Filters and application **(06)**

Introduction to filters, Characteristics, Definition, Realization of filters, Butterworth filters, applications of filters

Text Books:

1. A K Sawhney: A course on electrical and electronic measurements and instrumentation, Dhanpat Raj & Co, 2005
2. D Patranabis: Principle of Industrial Instrumentation, Tata McGraw-Hill, New Delhi 2004
3. John P.Bentley: Principles of measurement systems, 3rd edition, Addison Wesley Longman, 2000.
4. David A Bell: Electronic Instrumentation and measurement, Prentice Hall of India
5. M.M.S.Anand: Electronic instruments and instrumentation Technology, Prentice-Hall of India, 2004.

Reference Books:

1. Alan S.Morris: Principles of measurement and instrumentation, 2nd edition, Prentice-Hall of India,2004.
2. Electrostatic Discharge and Electronic Equipment, Warren Boxleitner IEEE press.
3. Measurement Fundamentals, National Instruments, www.ni.com
4. Elements of Electronic Instrumentation and Control, J.J.Carr, Prentice Hall, 3rd edition
5. Electronic Instrumentation and Measurement Techniques, W.Cooper, A.Helfric, PHI, 3rd edition
6. Handbook of Electronic Instrumentation, Coombs,

Tutorials:

Minimum 8 assignments based on the course contents

20IN303 Analog and Digital Electronics

Teaching Scheme: **Examination Scheme:**

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

In Semester: 50 Marks
End Semester: 50 Marks

Credit: 4

Prerequisites:
1. Concepts in basic electrical and electronics engineering
2. Concept of logic gates, number systems, Transistor theory and application

Course Objectives:
1. To illustrate the concepts of the basic characteristics, construction, open loop & close loop operations of Operational-Amplifier (Op-amp)
2. To enable students to analyze and design different linear and non-linear circuits using Op- amp and to introduce applications of various configurations of amplifiers.
3. To enable students to demonstrate different digital circuits.
4. To design different applications using digital circuits.

Course Outcomes:
At the end of this course, students will be able to:
1. Define different characteristics of operational amplifier (op-amp).
2. Select proper configuration of op-amp for different analog circuits.
3. Design counters, multiplexers, demultiplexers using the various building blocks.
4. Implement and test the performance of designed digital circuits.

Unit 1: Operational Amplifier Fundamentals **(05)**
Block diagram of Operational amplifier, Characteristics of Operational amplifier, comparative study of different amplifiers (LM741, LM324, OP07)

Unit 2: Linear Applications of Op Amps **(08)**
Introduction to feedback, Non-inverting, Inverting and differential amplifier, Instrumentation amplifier, Equation solving with Op-amp, I/V and V/I, Current booster converter, voltage regulator, SMPS, Signal conditioning circuits

Unit 3: Non-Linear Applications of Op Amp and timer LM555 **(07)**
Comparator, Zero Crossing Detector (ZCD), Schmitt trigger, window detector,: Wein bridge, LM555 timer, Signal conditioning circuits

Unit 4: combinational and clocked logic circuits **(08)**
Universal logic circuit: Mux, Demux. Decoders, Encoders, Interfacing TTL-CMOS and CMOS-TTL, Flip-flops: SR, JKMS, DFF and their truth table

Unit 5: Counters and timers **(07)**
Sequential and non-sequential counters: Ring, Johnson, BCD, Binary counters, programmable counters, shift registers

Unit 6: Applications of flip-flops, Counters and shift registers **(07)**

Digital Display, Digital clock, Alarm annunciator, Digital timer, call bell system and similar applications

Text Books:

1. Ramakant Gaikwad, "Operational Amplifiers" PHI, 3 rd ed., 1992.
2. William D. Stanley, "Operational Amplifiers with Linear Integrated Circuits", 4th edition, Pearson Education India, 2002.
3. Malvino and Leach, "Digital Principles & Applications", 4th Edition, Tata-McGraw-Hill
4. Gothman, "Digital Electronics", 2nd Edition, PHI

Reference Book:

1. Paul Horowitz, Winfield Hill , "The Art of Electronics", 2nd Ed., Cambridge University press,
2. Ronald J. Tocci, Neal S. Widmer and Gregory L. Moss, "Digital Systems, Principles and Applications", 10th Edition, Pearson Education International.

Tutorials:

Minimum 8 assignments based on the course contents

20HS301 Universal Human Values-2: Understanding Harmony

Teaching Scheme:
Lectures: 2 Hrs/week
Tutorial: 1 Hr/week

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

Credit: 3

Prerequisites: -

Course Objectives:

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Course Outcomes:

After completion of the course, students will be able to

1. Understand human values which are only the solution of most of the present-day problems and a sustained solution could emerge only through understanding of value-based living.
2. Compare desires of 'I' and 'Body' distinctly. If any desire appears related to both, students are able to see that the feeling is related to I while the physical facility is related to the body.
3. Develop Natural acceptance which is always for living in harmony which leads to fulfillment in relationship.
4. Understand the whole existence to see the interconnectedness in the Nature.
5. Make use of sustainable solutions to the problems in the society and the Nature.

Unit 1: Introduction to Value Education (06)

Understanding Value Education ,Self exploration as the Process for Value Education, Continuous Happiness and Prosperity which is the Basic Human Aspirations, Right Understanding, Relationship and Physical Facility, Current Scenario for Happiness and Prosperity, Method to Fulfill the Basic Human Aspirations.

Unit 2: Harmony in the Human Being (06)

Understanding Human being as the Co-existence of the Self and the Body, distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Program to ensure self-regulation and Health.

Unit 3: Harmony in the Family and Society (06)

Harmony in the Family, Family being the Basic Unit of Human Interaction, Values in Human-to-Human Relationship, Trust which is the Foundational Value in Relationship,

Respect as the Right Evaluation, Understanding Harmony in the Society, Vision for the Universal Human Order.

Unit 4: Harmony in the Nature or Existence (04)
Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels and the Holistic Perception of Harmony in Existence.

Unit 5: Implications of the Holistic understandings, a look at professional ethics (06)
Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human order, Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models, Typical Case Studies with Strategies for Transition towards Value-based Life and Profession.

Text Books:

1. R. R. Gaur, R. Asthana, G. P. Bagaria, "The Textbook A Foundation Course in Human Values and Professional Ethics", Excel Books, New Delhi, (2nd Revised Edition), (2019).
2. R. R. Gaur, R. Asthana, G. P. Bagaria, "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", Excel Books, New Delhi, (2nd Revised Edition), (2019).

Reference Books:

1. A.Nagaraj,"Jeevan Vidya: EkParichaya", Jeevan Vidya Prakashan, Amarkantak, (1999).
2. A.N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi, (2004).
3. Mohandas Karamchand Gandhi, "The Story of My Experiments with Truth", Prakash books
4. Publishers, Daryaganj, New Delhi, (1983).
5. E. F. Schumacher, "Small is Beautiful", Harper CollinsPublishers, Noida, Uttar Pradesh,
6. (2010).
7. Cecile Andrews, "Slow is Beautiful", New Society Publishers, Canada, (2006).
8. J. C. Kumarappa, "Economy of Permanence", Sarva Seva Sangh Prakashan, Wardha,
9. Sevagram, (2017).
10. Pandit Sunderlal ,"Bharat Mein Angreji Raj", Prabhat Prakashan, New Delhi (2018).
11. Dharampal,"Rediscovering India", Society for Integrated Development of Himalayas, (2003).
12. Mohandas Karamchand Gandhi, " Hind Swaraj or Indian Home Rule", Navajivan Publication House, Ahemadabad (2003).
13. Maulana Abdul Kalam Azad, "India Wins Freedom", Orient BlackSwan, (1989)
14. Romain Rolland, " Swami Vivekananda", Advaita Ashram Publication Ramkrishna Math, (2nd Edition), (2010).
15. Romain Rolland, "Gandhi", Srishti Publishers & Distributor, (2002).
16. Annie Leonard, "The story of stuff", Little, Brown Book Group, (2005).

Online Resources:
NPTEL course on Humanities and social sciences
https://nptel.ac.in/courses/109/104/109104068/

Tutorials:
Minimum 8 assignments based on the course contents

20IN301L Sensors and Transducers Lab

Lab Scheme:
Practical: 2 Hrs/Week

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

Course Outcomes: by the end of the course, students should be able to
1. Students will be able to do characterization of sensors
2. Students can compare characteristics of different sensors and transducers.
3. They can select sensors and transducers for particular applications.
4. Analyze the sensors and transducers for various applications.

List of Practical Assignments:
1. Study the working of Dead weight pressure gauge tester and calibration of pressure gauge using it
2. Study the working of a vacuum gauge tester and calibration of vacuum gauge using it
3. Plot the characteristics of RTD and Thermistor calculate its time constant.
4. Plot the characteristics of Thermocouple and study cold junction compensation.
5. Design and Test Air purge probe/capacitive for Level Measurement.
6. Flow measurement using Rotameter, orifice and Electromagnetic flow meter.
7. Measurement of viscosity of various liquids using Red wood Viscometer.
8. Water level measurement using Piezoresistive MEMS sensor.
9. Weight measurement using cantilever beam/load cell.
10. Conductivity measurement using virtual lab platform.

Or similar type of practical assignments based on the course contents

20IN302L Industrial Instrumentation Lab

Lab Scheme:
Practical: 2 Hrs/Week

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

Course Outcomes: at the end of this course, students will be able to

1. Measure/Test various parameters using appropriate measuring/testing instruments
2. Use appropriate ADC and/or DAC for given application.
3. Calibrate the instruments for minimizing errors in the measurement.
4. Develop Virtual instrumentation systems for practical applications

List of Practical Assignments:

1. Study and implementation of ADC IC 0809
2. Study and implementation of DAC IC 0808
3. Measurement of True RMS value using True RMS meter
4. Study and verify different modes of Universal Counter
5. To measure time constant of relay using Digital Storage Oscilloscope
6. To build a function generator using IC
7. Hand-on on Lab View software
8. Design and realization of filter
9. Study and application of distortion meter

Or similar type of practical assignments based on the course contents

20IN303L Analog and Digital Electronics Lab

Teaching Scheme
Practical: 2 Hrs/week

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

Course Outcomes: the student will be able to
1. Verify and compare the performance characteristics of different configurations of OPAMP.
2. Design and implement linear and non-linear circuits using OPAMP.
3. Select appropriate components for given application
4. Design and test signal conditioning circuits for industrial application.

List of Practical Assignments:

(Any 3 from)
1. Measurement of CMRR, Slew rate and output offset voltage.
2. Verification of gain for inverting and non- inverting amplifier.
3. Designing and implementation of Instrumentation amplifier using IC LM324.
4. Designing and implementation of Wien bridge oscillator.
5. Designing and implementation of Comparator, Schmitt trigger and Zero Crossing Detector.

(Any 1 from)
1. Designing and implementation of buzzer using LM555.
2. Designing and implementation of flasher light using LM555
3. Designing and implementation of porch-light control unit using LM555

(Any 2 from)
1. Study and implementation of logic circuit using Mux/Demux
2. Study and implementation of Johnson and Ring Counter using D-FF IC 7474 or Shift Register IC 7495
3. Study of Presettable Up/Down Counter using IC 74193.
4. Design of Non Sequential Counter using flip –flop ICs.

(Any 2 from)
1. Implementation of running light using shift register
2. Alarming annunciator circuit using Mux. for 3 conditions stated in process
3. Implementation of digital timer using IC 74193
4. Simulation of Digital Clock using digital ICs

Or similar type of practical assignments based on the course contents

20IN304 Programming Practice Lab

Teaching Scheme:
Practical: 4 Hrs/week

Examination Scheme:
In Semester: 25 Marks
Practical: 25 Marks
Credit: 2

Course Outcomes: the student will be able to
1. List and identify the steps for the given problem statement.
2. Apply different programming tools for logic development.
3. Implement the developed logic in the given programming language.
4. Develop and design appropriate programs for practical applications.

List of Practical Assignments-:

Group A: [Any 3 minimum]

1. Write a Python program to enter marks of five subjects and calculate total and percentage.
2. A. Write a Python program to swap two numbers/digits in a number.
   B. Write a python program to find the greatest number among three given numbers by using ternary operator.
3. Write a Python program to perform the sum of digits of a 3 digit number.
4. Write a Python program to calculate DA and HRA on the following conditions
   Enter basic salary as user input user.

Salary	*DA as per salary*	*HRA as per salary*
<=2000	*10%*	*20%*
>2000	*20%*	*30%*
&&		
<=5000		
>5000	*30%*	*40%*
&&		
<=10000		
>10000	*50%*	*50%*

5. Write a Python program to find out the average and median among three given numbers.

Group B: [Any 5 minimum]

6. Write a Python program to print all alphabets (Capital and small) using while loop
7. Write a Python program to find the sum of all even numbers between 1 to n.
8. Write a Python program to find the sum of the first and last digit of the entered number.

9. Write a Python program to check whether the entered number or string is palindrome or not.
10. Write a Python program to print the following pattern
2 3 5 7 11 13… till 100
11. Write a Python program to find the power of a number using a for loop.
12. Write a Python program to find all factors of a number.
13. Write a Python program to find the sum of all prime numbers between 1 to n.

Group C: [Any 4 minimum]

14. Write a Python program to get a string made of the first 2 and the last char from a given string. For eg: Input : beautiful Expected Output : bel
15. Write a Python program to get a string from a given string where all occurrences of its first char have been changed to '#', except the first char itself. For eg: Input: abracadabra Expected Output : abr#c#d#br#
16. Write a Python program to add 'ing' at the end of a given string (length should be at least 3). If the given string already ends with 'ing' then add 'ly' instead. If the string length of the given string is less than 3, leave it unchanged. For eg: Input: test Expected Output: testing If the Input : testing Expected Output: testingly
17. A.Write a Python program to get the largest number from a list
B. Write a Python program to multiply all the items in a list.
18. Write a program to remove all the duplicate elements from the list.
19. Write a Python program to count the number of strings where the string length is 4 or more and the first and last character are the same from a given list of strings.

Group D: [Any 4 minimum]

20. Write a Python program to find common items from two lists.
21. Write a Python script to add a key to a dictionary.
22. Write a Python program to concatenate following dictionaries to create a new one. d1={1:110, 2:210}
d2={3:301, 4:401}
d3={5:5010, 6:6010}
23. A.Write a Python program to check if a given key already exists in a dictionary.
B. Write a Python script to print a dictionary where the keys are numbers between 1 and 10 (both included) and the values are squares of keys.
24. A.Write a Python program to sum all the items in a dictionary.
B. Write a Python program to remove a key from the given dictionary.
D = {'a':9,'b':8,'c':7,'d':6}
25. A.Write a Python program to sort a dictionary by key.
B. Write a Python program to remove duplicate values from the Dictionary.
26. Write a program to determine the occurrence of numbers in a list of numbers.

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

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

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20IN401 Fundamentals of Computer Networks

Teaching Scheme:
Lectures: 3 Hrs/week

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

Prerequisites: -

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

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

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

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

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

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

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

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

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

Books:

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

20IN402 Control Systems

Teaching Scheme:
Lectures: 3 Hrs/Week

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

Prerequisites: Basics of Linear Algebra and Laplace Transform

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

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

Unit 1: Introduction to Control System **(07)**
Introduction and brief classification of Control System, Representation of Electrical, Mechanical, Electromechanical, Thermal and Pneumatics Control System with Differential Equations, Concept of Transfer Function

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

Unit 3: Time Domain Analysis **(07)**
Standard Test Signal, Dynamic Error Constants, First and Second Order System and Its Response to the Standard Test Signals, Time Domain Specifications, Static Error Constants – kv, kp, ka and ess.

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

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

Unit 6: Compensation Techniques **(06)**

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

Text Books:

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

Reference Books:

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

20IN403 Microcontroller Techniques

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

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

Prerequisites:
1. Concepts of Digital Electronics
2. Hexadecimal number systems and their arithmetic/ logical operations
3. Basics of C programming

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

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

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

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

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

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

Unit 5: Interrupts and ADC **(06)**

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

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

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

Text Books:

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

Reference Books:

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

Tutorials:

Minimum 8 assignments based on the course contents

20IN404 Power Electronics and Drives

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

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

Prerequisites: Linear Integrated Circuits and Digital Electronics

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

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

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

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

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

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

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

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

Text Books:

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

Reference Books:

1. P. C. Sen,' Power Electronics', TMH, 2007
2. Mohamad Rashid,' Power Electronics', PHI, 2ndedition, 2004
3. G.K.Dubey, Power semiconductor controlled drives, Prentice Hall- 1989
4. Bhag S. Guru, Huseyin P. Hiziroglu,"Electric Machinery and Transformers", Third Edition, Oxford University Press
5. Krishnan, Electrical Motor Drives, PHI-2003

Tutorials:
Minimum 8 assignments based on the course contents

20IN405 Unit Operations

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

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

Prerequisites: Sensors and transducers

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

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

Unit 1: Unit Operations and Fluid Transportation **(08)**

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

B. Fluids filtration, solids fluidization

Unit 2: Unit Operations in Chemical Engineering **(08)**

A. Gas absorption and liquefaction, refrigeration

B. Mechanical processes: including solids transportation, crushing and pulverization, screening and sieving

C. Separation and mixing of fluids

Unit 3: Heat Transfer Operations **(08)**

A. Principles of heat flow in fluids, Heat transfer to fluids without phase change, Heat Transfer to fluids with phase change

B. Heat Exchange Equipment: Heat Exchangers, Condensers, Boilers and Calandria, Evaporators, Cooling towers

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

A. Distillation: Flash and Continuous, Multi component Distillation, Leaching and Extraction

B. Drying of Solids and liquids, Crystallization

C. Energy Sources and their classification

D. Introduction to Power generation

Unit 5: Boiler Ancillaries **(06)**

A. Types of boilers like FBC, CFBC, DIPC, Fluidized Bed, boiler safety parameters

B. Instrumentation for Boiler, water treatment, electro-static precipitator, soot blower, economizer, deaerator, super heater, chemical dosing systems, air preheater, coal and ash handling systems, fuel storage and distribution, Bag House Filters.

Unit 6: Unit Operations in Process Industry (06)

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

Text Books:

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

Reference Books:

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

Tutorials:

Minimum 8 assignments based on the course contents

20IN402L Control Systems Lab

Teaching Scheme:
Practical: 2 Hrs/Week

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

Course Outcomes: Students would be able to

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

List of Practical Assignments:

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

Or similar type of practical assignments based on the course contents

20IN403L Microcontroller Techniques Lab

Teaching Scheme:
Practical: 2 Hrs/week

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

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

List of Practical Assignments (any 8):

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

Or similar type of practical assignments based on the course contents

MKSSS's Cummins College of Engineering for Women, Pune
(An Autonomous Institute Affiliated to SavitribaiPhule Pune University)

Autonomous Program Structure
Third Year B. Tech. Fifth Semester
(Instrumentation and Control)
Academic Year: 2022-2023 Onwards

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Marks	Credit
		Lecture	Tutorial	Practical	In Semester	End Semester	Oral	Practical		
20IN501	Process Loop Components	3	0	0	50	50	0	0	100	3
20IN502	Digital Signal Processing	3	1	0	50	50	0	0	100	4
20IN503	Internet of Things (IoT)	3	1	0	50	50	0	0	100	4
20PEIN501	Programme Elective-I	3	0	0	50	50	0	0	100	3
20PEIN502	Programme Elective-II*	3	0	0	50	50	0	0	100	3
20OEHS501	Open HS Elective –I	3	0	0	50	50	0	0	100	3
20IN501L	Process Loop Components Lab	0	0	2	25	0	0	25	50	1
20IN502L	Digital Signal Processing Lab	0	0	2	25	0	0	25	50	1
20PEIN501L	Programme Elective Lab-I	0	0	2	25	0	25	0	50	1
20AC501	Audit Course	0	0	2	0	0	0	0	0	No Credit
	Total	**18**	**2**	**8**	**375**	**300**	**25**	**50**	**750**	**23**
	Grand Total	**28**			**750**				**750**	**23**

*** NPTEL/Swayam Course**

Department of Instrumentation & Control Engineering

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

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

Programme Elective-I
20PEIN501A Modern Control Theory
20PEIN501B Biomedical and Analytical Instrumentation
20PEIN501C Advanced Micro controller Techniques

Open Elective I (Humanities)

Sr. No.	Course Code	Course Title
1	20OEHS501A	Entrepreneurship Development
2	20OEHS501B	Intellectual Property Rights
3	20OEHS501C	Introduction to Digital Marketing
4	20OEHS501D	Law for Engineers
5	20OEHS501E	Organizational Behaviour
6	20OEHS501F	Project Management

APPROVED BY
Secretary Governing Body
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APPROVED BY
Chairman Governing Body
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20IN501 Process Loop Components

Teaching Scheme:
Lectures: 3 Hrs /week

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

Prerequisites: Sensors and transducers, pneumatic flapper nozzle system**,** op amp circuits

Course Objectives:

1. To understand the different types of systems and basics of process control.
2. To explain the need, construction, working, types of process control components
3. Develop process control circuits/loops for various applications using standard symbols and notations
4. To demonstrate PLC programming skill for industrial applications

Course Outcomes:

1. Delineate the working of different process control components.
2. Compare to select different process control components for various applications.
3. Analyse the performance of the process control components with respect to calibration, configuration, tuning.
4. Develop process control circuits/loops and PLC programs for various industrial applications using standard symbols and notations.

Unit 1: Types of systems and process control components (08)

Introduction to different types of systems, process control components related to different types of systems like switches, contactors, miniature circuit breaker, relays, actuators, FRL, Relief/safety valve, DCV, NRV etc, and applications.

Unit 2: Process Control Fundamentals (07)

Elements of process control loop, Types of process variables, Representation of process loop components using standard symbols (basics with reference to control loop), P & ID for temperature, flow, level, pressure process loops, Process Characteristics like process load, plant lags, dead time, capacity and regulation. Auxiliary components like alarm annunciator.

Unit 3: Transmitters and Converters (06)

Need of transmitter (concept of field area & control room area) ,Need for standardization of signals, Current, voltage, and pneumatic signal standards, Concept of live & dead zero, Types of transmitters (Two and four wire transmitters), Types, mounting (Installation), manifold, calibration setup, of electronic Differential Pressure Transmitter (DPT). DPT for Level measurement, zero elevation, zero suppression, Square root extractor, Block schematic and

calibration of Smart transmitter, Comparison of SMART with conventional transmitter, Difference between converter and transmitter, Converters like Current to pressure converter and Pressure to current converter

Unit 4: Controllers **(08)**

Discontinuous (Two position, time-proportional), Continuous controllers (Proportional, Integral, Derivative, Proportional-Integral, Proportional- Derivative, Proportional-Integral-Derivative (PID), Reset windup, Anti reset windup, Rate before reset, Bump less transfer, Effect of process characteristics on PID combination, Tuning of controllers, Block schematic and face plate of digital controllers, Position and Velocity algorithms

Unit 5: Programmable Logic Controller **(07)**

Continuous versus Discrete Process Control, Limitations of relay based system, PLC architecture, Types of Input & Output modules, Fixed & Modular PLC, Interfacing pneumatic systems to PLC, PLC specifications, PLC manufacturers, PLC Basic instructions, Timers & Counters, PLC programming languages, Ladder programming for process applications

Unit 6: Control valve **(06)**

Parts of pneumatic control valve, Control valve terminologies, Inherent and Installed control valve characteristics, types of control valves, Control valve selection criteria, Control valve accessories, types of actuators, Introduction to Control valve sizing and cavitation and flashing

Text Books:

1. Petruzella, "Industrial Electronics", McGraw-Hill
2. Andrew Parr, "Hydraulics and pneumatics: A Technician's and Engineer's guide",
4. Butterworth Heinemann Ltd
5. C. D. Johnson, "Process control and Instrument technology", Tata McGraw Hill Publications
6. B. G. Liptak, "Process Control", Instrument Engineering Handbook CRC Press.
7. N.A. Anderson, Boca Ratan, "Instrumentation for Process measurement and control" CRC Press, Third ed., 1980.
9. Frank Petruzella, "Programmable Logic Controllers" McGraw-Hill, 2011
10. Gary Dunning, "Introduction to Programmable Logic Controller", Cengage Learning India Pvt. Ltd., Third ed., 2006.

Reference Books:

1. Armando B. Corripio,"Tuning of industrial control systems", ISA.

2. James W. Hutchinson, "Control valve Handbook", ISA
3. E. B. Jones, "Instrument Technology", Butterworth's, Forth ed., 1985
4. William Andrews, "Applied Instrumentation in Process Industries", Gulf, Second ed., 19

20IN502 Digital Signal Processing

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

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

Prerequisites: Linear Algebra, Complex numbers, basics of ZT and FT

Course Objectives:
1. To understand the concept of digital different types of signals and systems.
2. To learn the use of various transforms for different applications.
3. To understand designing steps of various types of digital filters for given applications.

Course Outcomes: After the successful completion of the course the students will be able to:
1. Analyse the signals in time and frequency domain.
2. Apply the transformation tools on signals and systems and analyse their significance and applications.
3. Design the structures of different types of digital filters.
4. Design various digital filters and analyse their frequency response

Unit 1: Introduction to Signals and Systems (08)
Introduction to Signals, Classification of Signals, Continuous Time and Discrete Time Signals, Step and Impulse Functions, Transformation of Independent Variable. Introduction to Systems, Classification of Systems, Properties of Systems, Normal Form of System Equation, Initial Conditions, Impulse Response of a Physical System, system Impulse Response

Unit 2: Analysis of Discrete-LTI Systems (07)
Introduction to Convolution, Convolution Sum, Linear and Circular Convolution, Sampling theorem, reconstruction, aliasing, sampling in the frequency domain, sampling of discrete time signals, autocorrelation, cross correlation, decimation and interpolation

Unit 3: Z-Transform, Discrete Fourier Transform and its Properties (08)
Z-transform and its properties, solving difference equations and analysis of discrete-time systems in z-domain, Transfer function, pole-zero plot.
Discrete Fourier Transform (DFT) and its properties, Fast Fourier Transform (FFT), Divide and Conquer Approach, Decimation in Time and Decimation in Frequency FFT Algorithms.

Unit 4: Design of Digital Filters: FIR (07)
FIR Filters: Concept of analog filter design, Ideal filter requirements, Gibbs phenomenon, windowing techniques, characteristics and comparison of different window functions, Design of linear phase FIR filter using windows and frequency sampling method. Magnitude and Phase response of Digital filters, Frequency response of Linear phase FIR filters

Unit 5 : Design of Digital Filters: IIR **(06)**

IIR Filters: IIR filter design by approximation of derivatives, IIR filter design by impulse invariance method, Bilinear transformation method, warping effect. Butterworth filter design, Characteristics of Butterworth filters

Unit 6: DSP Practical Application: 1-D Signal Processing **(06)**

Applications of Convolutions, Auto-correlation, Cross-correlations, DFT, Digital filters.
Biomedical Signal Processing:
Baseline Wander removal techniques, Power line Interference removal techniques, EMG noise removal techniques, Motion Artifacts removal techniques, Feature extraction like RR interval, Heart rate, Time vs Frequency domain filtering
Audio Signal Processing: Basics of LPC, MFCC, Introduction to SVD, PCA, ICA, NMF, Spectrogram, Time vs Frequency domain filtering Applications of Audio Signal Processing: Audio Equalizer, Noise Filtering, Audio Compression
Vibration Analysis: Vibration signature analysis for defective gear teeth

Text Books:

1. Nagoor Kani, Digital Signal Processing, Tata McGraw-Hill Education
2. Salivahanan, A Vallaraj, C. Gnanapriya, "Digital Signal Processing", Tata McGraw-Hill Publishing Company Limited.
3. P. Ramesh Babu, "Digital Signal Processing", Sci-Tech Publications
4. S. K. Mitra, "Digital Signal Processing-A Computer Based Approach", MGH

Reference Books:

1. J. G. Proakis and D. J. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", PHI, 2000.
2. V. Oppenheim and R. W. Schafer, "Discrete Time Signal Processing", Pearson Education.
3. Rabiner, Gold, "Theory and Applications of Digital Signal Processing", TMH.
4. E. C. Ifeachor and B. W. Jervis, "Digital Signal Processing-A practical Approach", Addison-Wesley publication

Tutorials:
Minimum 8 assignments based on the course contents

20IN503 Internet of Things

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

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

Prerequisites: Basics of sensors and actuators, networks, logic building ability

Course Objectives:
1. To understand building blocks and components of IOT
2. To understand technologies used in IOT
3. To understand the role of platforms and big data in IOT

Course Outcomes: the students will be able to
1. Compare connectivity technologies for IoT
2. Compare protocols used for IoT applications
3. Select appropriate IoT technology for given application
4. Design small system solution for given problem statement

Unit 1: Introduction to IoT **(08)**

IoT Basics, Components, architecture, Interdependencies, categories, gateways, associated technologies, Challenges, Considerations, Scalability
Role of sensors, actuators and networks in IoT
Study of Raspberry Pi/ Arduino/ equivalent for integration of sensors/ actuators/ devices in IoT based systems. Small system examples of interfacing sensors and devices to embedded systems for IoT applications

Unit 2: Connectivity Technologies -I **(08)**

Connectivity technologies: Introduction, Features, working principle, addressing, Routing and applications of Zigbee, IEEE 802.15.4, ZWave, LoRa WAN, Bluetooth and BLE. System examples and case studies using these technologies.

Unit 3: Connectivity Technologies -II **(07)**

Connectivity technologies: Introduction, Features, working principle, addressing, Routing and applications of GSM, Low Power WiFi, Power Line Communication, RFID, NFC, Sigfox. System examples and case studies using these technologies.

Unit 4: Networking Protocols and Security **(07)**

Introduction, features, components, methods, variants, communication, Response models, message types, addressing, Routing and applications of 6LoWPAN, MQTT, CoAP, XMPP, AMQP. System examples and case studies using these technologies.
Privacy and Security issue in IoT. Overview of Governance in IoT.

Unit 5: Communication Protocols in Industrial IoT **(06)**

Introduction, features, components, methods, variants, communication, Response models, message types, addressing, Routing and applications of Wireless HART, ISA100.11A, IEEE1451, OPC UA. Case Studies from Home, Infrastructures, Buildings, Industries, Health Care, Inventory Management and Equivalent.

Unit 6: Wireless Sensor Networks and Big Data **(06)**

Introduction, Features, Components, Multi-hop Paths, Challenges of WSN, Detection and Connectivity, Event Aware Topology Management, Information Theoretic Self-Management of WSN, Applications
Platforms in IoT, Functions, Types, Privacy and Trust in IoT-Data-Platforms for applications
Introduction to Big Data, Cloud Computing, Edge computing and Fog computing
Case Studies from Home, Infrastructures, Buildings, Industries, Health Care, Inventory Management and Equivalent.

Books:

1. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by CRC Press.
2. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press.
3. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving".
4. Dieter Uckelmann, Mark Harrison, Florian, "Architecting the Internet of Things", Springer.
5. "The Internet of Things: Key Applications and Protocols", by, Wiley
6. Olivier Hersent, David Boswarthick, Elloumi, Daniel Kellmereit, Daniel Obodovski, "The Silent Intelligence: The Internet of Things", Publisher: Lightning Source Inc; 1st Edition (15 April 2014). ISBN-10: 0989973700, ISBN-13: 978- 0989973700.

Tutorials:
Minimum 8 assignments based on the course contents

20PEIN501A Modern Control Theory

Teaching Scheme:
Lectures: 3 Hrs/Week

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

Prerequisites: Control Systems

Course Objectives: To
1. Learn basics of Compensator, its types, and Electrical Network.
2. Learn how to Choose and Design a Compensator.
3. Learn PID Control Actions, Requirements, Constraints and Tuning Procedures.
4. Learn and Analyse Controller Design Methods using Modern Control Theory.

Course Outcomes: Students will be able to
1. Investigate and Interpret System Requirements in Time and Frequency Domain.
2. Classify, Choose, Compare suitable Compensator.
3. Determine, Compare and Choose Controller Tuning Parameters.
4. Apply Modern Control Techniques in Continuous and or Discrete Domain.

Unit 1: Introduction to Modern Control **(08)**
Introduction to Modern Control Techniques, Classical Control Vs Modern Control, Need to Modern Control Techniques, Advantages and Limitations of Modern Control Techniques, Basic Representation of Modern Control.

Unit 2: Basics of Control Actions and Controller Tuning **(06)**
Control Actions: ON/OFF, Proportional, Proportional plus Integral, Proportional plus Integral plus Derivative, Controller Tuning Methods.

Unit 3: Controller Design **(07)**
Design of PI/PD/PID using Root Locus and Bode Plot Approach, Direct Synthesis of Controller, Controller Design for System with and without Dead Time through Controller Synthesis Formula.

Unit 4: State Space Analysis **(07)**
State Transition Matrix, Concept of Controllability and Observability, Controllability and Observability Matrix, Necessary and Sufficient condition for State Controllability and State Observability.

Unit 5: Design Concepts in State Space **(08)**

State Variable Feedback, Control System Design using Pole Placement, State Observer, Quadratic Optimal Control System, Design of Optimal State Regulator using Riccati Equation, Concept of Performance Indices.

Unit 6: Fundamentals of Digital Control (06)

Introduction to Digital Control, Analog Control Vs Digital Control, Need of Digital Control, Advantages of and Limitations of Digital Control, Sample and Hold, Nyquist Theorem, Interpolation and Extrapolation.

Text Books:

1. B. C. Kuo, "Digital Control Systems", John Wiley and Sons, 2003.
2. K. Ogata, "Modern Control Engineering", 4th Edition, Pearson Education.
3. D. Roy Choudhury, "Control System Engineering", PHI.

Reference Books:

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

20PEIN501B Biomedical and Analytical Instrumentation

Teaching Scheme:
Lectures: 3 Hrs/week

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

Prerequisites: Human Anatomy and Physiology and Basics of optical Instrumentation.

Course Objectives:
1. To learn functioning of various body organs
2. To study the characteristics of signals generated during the functioning of the organ.
3. To learn bio signal acquisition and measurement techniques
4. To understand laws of photometry
5. To interpret instrumentation required for all types of spectroscopy

Course Outcomes:
1. Identify the characteristics of bio-signal generated during the functioning of an organ.
2. Analyse the various bio-signals recovered using different biomedical instruments
3. To interpret instrumentation required for all types of spectroscopy
4. To apply various principles for analysing different samples using suitable analytical technique

Unit 1: Cell Anatomy (08)
Structure and function of Cell. Generation and Conduction of Bio potential, Homeostasis, Sensors: Study of Bio transducers, Biochemical Sensors (Glucose, pH, Po2,Pco2), Electrode as sensor, Types of electrodes, Electrode circuit model.

Unit 2: Cardiovascular System and measurement (08)
Function of heart as Pump, electro conduction system, Basics of ECG, Einthoven triangle, 12 lead Configuration & Electrocardiograph, Types of ECG monitors, Analysis of ECG signal. Correlation of Blood Pressure, Heart Sounds, Blood Flow with ECG, Phonocardiography, Plethysmography Pulse transit time, Pulse wave Velocity, Blood pressure measurement-Manual and Automatic, Blood Flow meters- Electromagnetic, Ultrasound and Dye dilution.

Unit 3: Physiological Systems (08)
Respiratory system: lungs anatomy, Regulation of Respiration. Pulmonary function test: lungs volume and capacities, Artificial respiration, Spirometers, ventilators.
Structure and function of Neurons, brain anatomy, 10-20 electrode system, EEG basics.
Structure and function of Neurons, brain anatomy, 10-20 electrode system, EEG basics, Electroencephalograph.
Structure and function of kidneys and Nephron, regulation of water and electrolyte balance, dialysis.

Unit 4: Overview and Introduction of Spectroscopy **(06)**

Introduction to Analytical methods and its classification, Laws of Photometry, components of optical systems (source, wavelength selector, detectors, signal processor, readout device), UV- Visible Spectroscopy, IR Spectroscopy.

Unit 5: Absorption & Emission Spectroscopy **(06)**

Fluorescence & Phosphorescence Spectroscopy, Atomic absorption spectroscopy: Principle, Hollow cathode source, Types, working, Background correction methods.

Atomic emission spectroscopy: Principle, Sources (AC & DC Arc Excitation, Plasma Excitation), Types, working and Flame photometer.

Unit 6: Separative Methods & Gas Chromatography **(06)**

Components of mass spectrometry, Mass analyser types, Quantitative analysis of mixtures Chromatography: Fundamental of chromatographic separation, Gas chromatography, High Performance Liquid Chromatography**.**

Text Books:

1. Human Physiology- The Mechanism of Body Function By Vander, Sherman, TMH Ed.1981
2. Introduction to Biomedical Equipment Technology By Carr& Brown
3. Biomedical Instrumentation and Measurements By Cromwell, 2nd edition, Pearson Education.
4. Handbook of Biomedical Instrumentation By R. S. Khandpur, TMH
5. Text book of clinical Ophthalmology- Ronald Pitts Crick, Pang Khaw, 2nd Edition, World Scientific publication. ISBN 981-238-128-7.
6. Medical Instrumentation, John G Webster
7. Khandpur R. S., Handbook of Analytical Instruments, Tata McGraw–Hill Publications, 3rd ed.
8. Ewing Galen W., Instrumental Methods of Chemical Analysis, McGraw-Hill Book Company, 5th ed.
9. Willard, Merritt, Dean, Settle, Instrumental Methods of Analysis, CBS Publishers. & Distributors, New Delhi, 7th ed.

20PEIN501C Advanced Microcontroller Techniques

Teaching Scheme:
Lectures: 3 Hrs/week

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

Prerequisites:
1. Concepts of Microprocessors and Microcontrollers
2. Logic building concepts and programming microcontrollers in C

Course Objectives:
1. To introduce the architecture and features of high-capacity microcontrollers
2. To provide an understanding of integrated peripherals and its configuration
3. To design system for specified application

Course Outcomes: The students will be able to
1. Select appropriate features of microcontroller for given application.
2. Identify detailed hardware structure and software model of the microcontroller for the given application.
3. Develop configuration of integrated peripherals.
4. Design system for given application using microcontrollers

Unit 1: Introduction to ARM Cortex (07)
Architecture, Block Diagram, Programmer's Model, Registers and Memory Management, CPU operating modes, Pipeline, Thumb instructions set, Reset circuit and Sequence. Development Tools, Tool chains, Libraries and Software for programming

Unit 2: The ARM Cortex Processor (08)
Buses, System Timing, Interrupt handling and NVIC, Power management, Clock, comparison with ARM7 and ARM10

Unit 3: Introduction to STM32 microcontrollers (08)
Overview and Features of STM32 Microcontrollers, Advantages, Drawbacks and Subfamilies, Low Power operation and reset sources

Unit 4: Integrated Peripherals of STM32 microcontrollers-I (07)
General Purpose I/O, External Interrupts, ADC and Timers, DMA

Unit 5: Integrated Peripherals of STM32 microcontrollers-II (06)

SPI, I2C, USART, CAN and USB

Unit 6: Small System Design with STM32 microcontrollers (06)

System design for specified applications using integrated peripherals and external components necessary for the same.

Books:

1. Discovering the STM32 Microcontroller, Geoffrey Brown
2. The Insider's Guide To The STM32 ARM Based Microcontroller, Trevor Martin, Published by Hitex (UK) Ltd.
3. Mastering STM32, Carmine Noviello, Lean Publishing, 2016
4. The Definitive Guide to ARM Cortex®-M0 and Cortex-M0+ Processors, Joseph Yiu, Second Edition, Elsevier

20PEIN502A Industry 4.0 and IIOT

Teaching Scheme:
Lectures: 3 Hrs/week

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

Prerequisites: Basic knowledge of Computer and Internet

Course Objectives:

1. To understand building blocks, components of IoT and concepts of Industry 4.0
2. To understand technologies used in IoT and Industry 4.0
3. To understand the role of platforms and big data in IoT

Course Outcomes: The students will be able to

1. Identify the different stages of industrial revolution & features of Industry 4.0.
2. Compare connectivity technologies & protocols used for IoT.
3. Comprehend IoT, cyber-physical systems, cloud computing and big data, smart factories and their role in Industry 4.0.
4. Select appropriate IoT technology for an application.

Description:

Industry 4.0 concerns the transformation of industrial processes through the integration of modern technologies such as sensors, communication, and computational processing. Technologies such as Cyber Physical Systems (CPS), Internet of Things (IoT), Cloud Computing, Machine Learning, and Data Analytics are considered to be the different drivers necessary for the transformation. Industrial Internet of Things (IIoT) is an application of IoT in industries to modify the various existing industrial systems. IIoT links the automation system with enterprise, planning and product lifecycle.

Suggested Swayam link:

https://onlinecourses.nptel.ac.in/noc22_cs95/preview

Reference Books:

1. S. Misra, A. Mukherjee, and A. Roy, 2020. *Introduction to IoT*. Cambridge University Press. *Availability:* https://www.amazon.in/Introduction-IoT-Sudip-Misra/dp/1108959741/ref=sr_1_1?dchild=1&keywords=sudip+misra&qid=1627359928&sr=8-1

2. S. Misra, C. Roy, and A. Mukherjee, 2020. *Introduction to Industrial Internet of Things and Industry 4.0.* CRC Press. *Availability:* https://www.amazon.in/dp/1032146753/ref=sr_1_3?dchild=1&keywords=sudip+misra&qid=1627359971&sr=8-3

3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by CRC Press.

4. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press.

20PEIN502B Biomedical

Teaching Scheme:
Lectures: 3 Hrs/week

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

Prerequisites: Basics of signals and systems and linear algebra.

Course Objectives:

1. Deduce which imaging technique is appropriate for a given application.
2. Describe their fundamental promises and limitations
3. Differentiate the imaging modalities covered in the course.

Course Outcomes: The students will be able to

1. Delineate various biomedical imaging modalities
2. Differentiate the imaging modalities covered in the course.
3. Select the appropriate imaging technique for given application
4. Identify various medical image processing algorithms

Description:

This course attempts to provide an introduction to the different commonly-used medical imaging systems. Overview of biomedical imaging systems and analysis. Examination of various imaging modalities. Although there are several courses and textbooks available from medical physics background, there are only a few materials that treat the subject from a system's perspective, which is the view point taken here.

Topics: Introduction, 2D- Signals Systems review, Image Quality metrics, Projection Radiography,:X-ray CT, Nuclear Medicine- PET/SPECT, Ultrasound Imaging, MRI

Suggested Swayam link:

https://onlinecourses.nptel.ac.in/noc22_bt56/preview

Reference Books:

1. Medical Imaging Signals and Systems by J. L. Prince and J. M. Links, Pearson Prentice Hall, 2006, ISBN 0130653535.
2. Webb's Physics of Medical Imaging, 2nd Edition, CRC press
3. Foundations of Medical Imaging , Z. H. Cho, J. P. Jones, and M. Singh , Wiley , 1993
4. Stewart C. Bushong, Radiologic Science for Technologists: Physics, Biology, and Protection, 10th ed., Mosby, 2012. (ISBN-13: 978-0323081351)

20IN501L Process Loop Components Lab

Teaching Scheme:
Practical: 2Hrs/weeks

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

Course Outcomes:

1. Calibrate various process control components like transmitter, converter etc by selecting proper test and measuring instruments
2. Find the characteristics of various process control components like transmitter, converter, control valve etc.
3. Configure, tune and test various process control components like pressure switch, transmitter, controller, control valve etc by proper analysis of given application
4. Develop and implement control circuits and PLC programs for the given application

List of Practical Assignments: (Minimum 8)

1. Plot the characteristics of the pressure switch and observe the switch output.
2. Testing of various pneumatic and hydraulic components.
3. Identify the sequence of the given Alarm Annunciator and testing of Alarm annunciator using pressure switch
4. Calibration of Temperature Transmitter
5. Calibration of Current to pneumatic Converter
6. Plot the characteristics of square root extractor
7. Calibration of Differential pressure transmitter
8. Calibration of SMART differential pressure transmitter and Flow measurement using SMART differential pressure transmitter
9. Plot the step response of electronic controllers
10. PLC programming
11. Interfacing of PLC to pneumatic circuit
12. Plotting control valve characteristics
13. Open ended assignment on PLC programming

Or similar type of practical assignments based on the course contents

20IN502L Digital Signal Processing Lab

Teaching Scheme:
Practical: 2 Hrs/Week

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

Course Outcomes: After the successful completion of the course the students will be able to:
1. Implement various DSP operations like convolution, auto correlation using Matlab.
2. Implement different transforms applied to signals using Matlab.
3. Design and implement IIR and FIR filters for bandpass, band stop, lowpass and high pass filters in Matlab.
4. Develop digital signal processing blocks for given application.

List of Practical Assignments:
Students are expected to perform at least eight experiments using MATLAB or equivalent software:
1. Write a program to generate the basic signals and implement the basic DSP operations on the given signals.
2. Write a Program to implement Linear Convolution of the two given sequences.
3. Write a Program to obtain the auto-correlation and Cross-correlations of the given sequences.
4. Write a Program to obtain the transfer function and plot is pole-zero plot
5. Write a Program to find the DFT of the given sequences. Plot its magnitude and phase plot. Also find its IDFT to obtain the original sequence.
6. Write a Program to design and implement FIR filters using difference windowing methods.
7. Write a Program to design and implement IIR filters (Using Butterworth or Chebyshev approximations).
8. Generation of signal. Generate a noise signal. Mix both the signals. Design a Filter. Recovery of original signal using filter.
9. DSP Application: design solution to any application using emerging technologies which is beyond syllabus.

Or similar type of practical assignments based on the course contents

20PEIN501LA Modern Control Theory Lab

Teaching Scheme:
Practical: 2 Hrs/Week

Examination Scheme:
In Semester: 25 marks
Oral: 25 Marks
Credit: 1

Course Outcomes: Students will be able to
1. Investigate Time and Frequency Domain Specifications.
2. Choose, Compare suitable Compensator.
3. Determine, Compare and Choose Controller Tuning Parameters.
4. Apply Modern Control Techniques in Continuous and or Continuous/Discrete Domain.

List of Practical Assignments:

1. Effect of Addition of Pole and Zero on Transient and Steady State Performance of System.
2. Design of Lag, Lead-Lag and Lead Compensator.
3. Analysis of Effect of Proportional, Integral and Derivative Control Action.
4. Design of P, PI, PID Controller using Frequency Response Approach.
5. Design of Controller using Direct synthesis Approach for System with and without Dead Time.
6. Computation of State Controllability and State Observability for a System.
7. Computation of State Feedback Controller using Pole Placement Technique.
8. Computation of Full Order State Observer.
9. Design of Optimal State Regulator for Minimising Performance Index.
10. Formation of a Control System in Discrete Domain.

Or similar type of practical assignments based on the course contents

20PEIN501LB Biomedical and Analytical Instrumentation Lab

Teaching Scheme:
Practical: 2 Hrs/Week

Examination Scheme:
In Semester: 25 marks
Oral: 25 Marks
Credit: 1

Course Outcomes:

1. Analyse the bio signals acquired by biomedical instruments.
2. Operate biomedical instruments to record bio-signals.
3. Select appropriate analytical instruments for sample analysis based on application.
4. Test samples using various analytical instruments.

List of Practical Assignments:

1. To Study principles and design concept of biosensors and their applications in biomedical field.
2. To Measure systolic and diastolic Blood Pressure Using Sphygmomanometer and automatic BP apparatus for different subjects.
3. To study 12 lead configuration and details of ECG waveform using ECG recorder and calculation of heart rate.
4. To study standard amplitude and frequency of EEG signal and to learn frequencies of alpha, beta, delta, theta waves of EEG signal.
5. To learn and record various lung capacities of Respiratory system using Power lab.
6. To Study and Check Specifications of an ECG Recorder. To record various leads of ECG using ECG machine and analysis of recorded ECG signal.
7. To record/monitor first and second heart sound using Electronic Stethoscope and Power lab and analysis of recorded heart sound.
8. To design and implement the photo-plethysmography Sensor for Pulse Rate Measurement.
9. Analysis by using photoelectric colorimeter.
10. Analysis by using Densitometer.
11. Analysis by using Double beam spectrometer.
12. Analysis by using Flame photometer.
13. Analysis by using Spectrofluorometer.

Or similar type of practical assignments based on the course contents

20PEIN501LC Advanced Microcontroller Techniques Lab

Teaching Scheme:
Practical: 2 Hrs/Week

Examination Scheme:
In Semester: 25 marks
Oral: 25 Marks
Credit: 1

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

List of Practical Assignments:
Part A: (any 5)
1. Introduction and familiarization with programming environment of ARM
2. Display interfacing and Programming using ARM
3. Wave generation using ARM
4. Introduction and familiarization with programming environment of STM32
5. Port configuration and programming for input/ output devices
6. Analog input measurement using ADC
7. Communication interface configuration and programming

Part B:
System development using STM32 microcontroller for given problem statement

Or similar type of practical assignments based on the course contents

MKSSS's Cummins College of Engineering for Women, Pune
(An Autonomous Institute Affiliated to SavitribaiPhule Pune University)

Autonomous Program Structure
Third Year B. Tech. Sixth Semester
(Instrumentation and Control)
Academic Year: 2022-2023 Onwards

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Marks	Credit
		Lecture	Tutorial	Practical	In Semester	End Semester	Oral	Practical		
20IN601	Process Instrumentation and Control	3	1	0	50	50	0	0	100	4
20IN602	Industrial Automation	3	0	0	50	50	0	0	100	3
20IN603	System Engineering and Management	3	1	0	50	50	0	0	100	4
20HS601	Management Information System (MIS)	3	0	0	50	50	0	0	100	3
20PEIN601	Programme Elective-III	3	0	0	50	50	0	0	100	3
20OE601	Open Elective-II	3	0	0	50	50	0	0	100	3
20IN602L	Industrial Automation Lab	0	0	2	25	0	0	25	50	1
20IN603L	System Engineering and Management Lab	0	0	2	25	0	25	0	50	1
20PEIN601L	Programme Elective Lab-III	0	0	2	25	0	25	0	50	1
20IN604	Mini Project	0	0	2	25	0	0	25	50	1
	Total	**18**	**2**	**8**	**400**	**300**	**50**	**50**	**800**	**24**
	Grand Total	**28**			**800**				**800**	**24**

Programme Elective-III	**Programme Elective-III Lab**
20PEIN601A Building Automation	20PEIN601LA Building Automation
20PEIN601B Embedded Product Design	20PEIN601LB Embedded Product Design

Department of Instrumentation & Control Engineering

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

CUMMINS COLLEGE OF ENGINEERING FOR WOMEN
KARVE NAGAR
PUNE-411 052

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

20PEIN601C MEMS	20PEIN601LC MEMS

20OE601 Open Elective-II			Eligible Departments				
Sr. No.	Course Code	Course Title	EnTC	Comp	IT	Mech	Instru
1	20OE601A	Automation and Control Engineering	Y	Y	Y	Y	Y
2	20OE601B	Automotive Electronics	Y	Y	Y	Y	Y
3	20OE601C	Avionics	Y	Y	Y	Y	Y
4	20OE601D	Bioinformatics	Y	Y	Y	N	Y
5	20OE601E	Computer Vision	Y	Y	Y	Y	Y
6	20OE601F	Design Thinking	Y	Y	Y	Y	Y
7	20OE601G	e-Business	Y	Y	Y	Y	Y
8	20OE601H	Electric Vehicles	Y	Y	Y	Y	Y
9	20OE601I	Gamification	Y	Y	Y	Y	Y
10	20OE601J	Geographical Information Systems	Y	Y	Y	Y	Y
11	20OE601K	Multimedia Systems	Y	Y	Y	N	Y

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

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

20IN601 Process Instrumentation and Control

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

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

Prerequisites: Principle and applications of various Sensors and Transducers, Basics of control systems, Principle of actuators and final control element and their applications.

Course Objectives:
1. To understand the principles of multi-loop controllers and nonlinear systems.
2. To equip students with knowledge of multi variable control, interaction, the pairing, decoupling and design of controllers for interacting multi variable systems.
3. Explain the control loops related to heat exchanger, Boiler, distillation column, reactor, pumps and compressors

Course outcomes: The students will be able to
1. Identify the characteristics of given process
2. Compare the features of different control strategies
3. Select appropriate control strategy for given application
4. Develop the instrumentation and control loops for various processes

Unit 1: Multi-Loop Control & Nonlinear Systems (09)

SLPC and MLPC features, Feedback, feed forward control, cascade control, ratio control, selective control, split-range control

Nonlinear Elements in Loop: Limiters, Dead Zones, Backlash, Dead Band Velocity Limiting, Negative Resistance, Improvement in nonlinear process performance through Deterministic Control Loop Calculations, Calculations of the measured variable, final control element selection, cascade control design, Real time implementation issues.

Unit 2: Multivariable Control (09)

Concept of Multivariable Control: Interactions and its effects, Modelling and transfer functions, Influence of Interaction on the possibility of feedback control, important effects on Multivariable system behaviour Relative Gain Array, effect of Interaction on stability and multiloop Control system. Multiloop control Performance through: Loop Paring, tuning, Enhancement through Decoupling, Single Loop Enhancements.

Unit 3: Heat exchanger and Boiler controls (08)

Types, gain and time constants, degrees of freedom. Basic controls in Heat exchangers, Steam Heaters, Condensers, fired heaters and vaporizers. Advanced Control Override, Feed forward Control.
Types, Components, Boiler controls like Drum level control (1,2,3,5 element), Air to fuel ratio control, Combustion controls, Steam temperature and pressure control, Safety interlocks, Burner management system, startup and shutdown procedures, boiler safety standards

Unit 4: Distillation Column control (08)
Mass and Energy balance, column feed control, column pressure control, control of overhead and bottom composition, distillate reflux flow control. Frequency response, lag in liquid and vapour flow, concentration lag, predicting the behaviour of control system

Unit 5: Reactor and pumps and compressor control (08)
Types of reactions and reactors, factors governing the conduct of reaction, stability of reactors, time constant, effects of lag, flow control, temperature control, pH control, end point detection of continuous and batch reactors. Sequential & logic control in batch process, batch production management.
Pumps: Types, Basic Controls, Multi pump system controls. Compressors: Types, Basic Controls.

Text Books:
1. Process Control Systems ‑F.G. Shinskey, TMH.
2. Instrument Engineers' Handbook: Process Control: B.G. Liptak, Chilton.
3. Optimization of Industrial Unit Processes ‑ Bela G. Liptak

Reference Books:
1. Boiler Control Systems: David Lindsey, Mc GRAW‑HILL

Tutorials:
Minimum 8 assignments based on the theory syllabus

20IN602 Industrial Automation

Teaching Scheme:
Lectures: 3Hrs/Week

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

Prerequisites: Basics of Process Loop Components

Course Objectives:

1. Understand the basic concepts of automation and its requirements.
2. To develop an automation project and its documentation.
3. To learn and apply standards and recommended practices to automation.
4. To understand the activities followed in automation projects.

Course Outcomes: The student will be able to,

1. Classify and compare the different automation tools used in industry.
2. Select suitable communication protocol for the required automation system.
3. Develop the logic and communication for any PLC/DCS system.
4. Discuss various safety methods used in automation industries.

Unit 1: Introduction to Industrial Automation (08)

Introduction to industrial automation (Automation Pyramid according to industry 4), Introduction to automation tools (PLC, HMI, SCADA, DCS, Robotics and Drives), Introduction to automation tools performance criteria, Development of URS (User Requirement Specification) for automation and FDS (Functional Design Specification) for automation tools.

Unit 2: Components and Hardware (07)

Controllers: PLC, DCS, Embedded controllers; Operator Interfaces: Text based interfaces, graphical interfaces, Touch screens; Sensors: Discrete devices (sourcing and sinking concept, limit switches, proximity switches), Analog (pressure, flow, temperature sensing), Special purpose components: Encoders(high speed counter), vision sensors, bar code, RFID; Contactors, Starters, Circuit breakers, fuses, terminal blocks; Actuators and motion control : Pneumatic and hydraulic actuators, motors. Wiring of discrete, analog input and output devices.

Unit 3: Industrial Protocols (08)

Definition of protocols, Introduction to OSI model, Communication standards (RS232, RS485), Modbus (ASCII/RTU), Foundation fieldbus (H1/HSE), Profibus, Profinet, Industrial Ethernet, CAN, DeviceNet, ControlNet and HART protocols, Introduction to third party interface. Comparison between the protocols.

Unit 4: PLC Based Automation **(07)**

IEC 61131-3 standard, Logic development(Timer, Counter, Compare, Math, Conversion and Move instructions) Analog control loop (PID) configuration in PLC, PLC to PLC communication, PLC to HMI communication, PLC to other devices communication programs(servo motor and stepper motor logic in PLC)

Unit 5: Distributed Control System **(06)**

DCS introduction, Architecture of different makes: comparison and specification, Configuration of discrete and analog IO's and programming, Development and configuration of user interface, alarm management, diagnosis, security and user access management.

Unit 6: Process Safety and Safety Management System **(06)**

Introduction to process safety, hazardous area classification, process hazard analysis, safety integrity levels (SIL), Introduction to IEC61511 standard, SIS application for safety system.

Text Books:

1. S.K.Singh, "Computer Aided Process Control", PHI.
2. Garry Dunning, "Introduction to Programmable Logic Controllers", Thomson Learning.
3. Krishna Kant, "Computer Based Process Control", PHI.
4. Frank Lamb, "Industrial Automation Hands On", Mc Graw Hill.

Reference Books:

1. Samuel Herb, "Understanding Distributed Process Systems for Control", ISA.
2. Webb & Reis, "Programmable Logic Controllers: Principles and Applications", PHI.

20IN603 System Engineering and Management

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

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

Prerequisites: -

Course Objectives:
1. To Know the basic concepts of Project Engineering and Management.
2. To Understand various engineering documents.
3. To interpret and apply national and international standards, and recommended practices.
4. To Know the activities followed in instrumentation projects.

Course Outcomes: By the end of the course, students should be able to
1. Develop documentation for, work distribution, team, planning and scheduling for any project.
2. Apply national and international standards, and recommended practices
3. Develop instrumentation detailed engineering documents as per required standards
4. Develop testing and commissioning documentation

Unit 1: Basic Concept of Project Management (08)
Definition, Types and Life cycle phases of project, Basics of Project management, Project Planning, Scheduling, Tools and techniques of project management.

Unit 2: Instrumentation Documentation and its Related Standards (07)
Detailed discussion of ISA standards, FEED documents (PFD, Material balance, P&ID etc.) and DED documents (Process data sheets, instrument index, instrument specification sheet, calculation sheets like valve sizing, thermowell design, orifice design etc.).

Unit 3: Panels and Wiring Documentation (08)
Electrical Panels: Specification, GA drawings, Instrumentation Panels (Instrument panels, Marshalling panels) Terminal Strip reports, Power requirement calculation etc. Instrument Cable: Types, specification, Cable trays, Control room engineering.

Unit 4: EPC Contracting and Procurement Activities (07)
Introduction to EPC contracting, Vendor registration, requirements for qualification documents. Tendering and bidding process, requirement and qualification documents, Bid

evaluation (Role and knowledge required as an instrumentation engineer), Purchase orders etc..

Unit 5: Installation **(06)**

Understand, design and develop instrument Installation sketches for various instruments (Hook up drawings like Thermowell, Flow transmitter, Differential pressure transmitter, orifice, pitot tube, rotameter, DPT type level transmitter installation specification etc.

Unit 6: Commissioning and testing **(06)**

Inspection and Testing: Factory Acceptance Test (FAT) Team, Planning, documentation, Customer or Site Acceptance Test (CAT or SAT), Team, Planning, documentation. Test and inspection reports. Pre-commissioning planning activities, documents required for Cold Commissioning and hot commissioning, Performance trials and final hand over, Calibration records

Text Books:

1. Applied instrumentation in process industries by Andrew & Williams (Gulf Publishing)
2. Management systems by John Bacon (ISA)
3. Process control Instrument Engineers Handbook by Liptak.

Reference Books:

1. Instrument Installation Project Management (ISA).
2. Successful Instrumentation & Control Systems Design, by Michael D. Whitt (ISA)

Tutorials:

Minimum 8 assignments based on the course contents

20HS601 HS – Management Information System

Teaching Scheme:
Lectures: 3 Hr/Week

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

Prerequisites: -

Course Objectives:
1. To introduce the students to the Management Information Systems
2. Its application in organizations and related technology
3. The course would expose the students to the managerial issues relating to information systems.
4. Help them identify and evaluate various options in Management Information Systems.

Course Outcomes:
1. Identify the functionalities and use of Management information system in industry.
2. Analyse various factors of Management Information System in organization e.g. sales, profit, digital marketing.
3. Develop various information system like ERP,CRM, data warehouse, etc
4. Analyse various parameters of technology solutions in any organization

Unit 1: Introduction to Management Information Systems (07)
Need, Purpose and Objectives - Contemporary Approaches to MIS, architecture of MIS, MIS as an instrument for the organizational change. Organizational levels, functional area. Automation pyramid, MIS in level 5 of industry 4.0.

Unit 2: Information System in Business (08)
Data and Information: Introduction, data and information- measuring data, information as a resource, information in organisational functions, types of information technology, types of information systems- transaction processing systems-management information systems

Unit 3: Management Information Systems, Technology, and Strategy (08)
Role of Information Technology in Organization, Plant Operation management and digitization. Information System and Strategy; Strategic Analysis and management. The Information Centre, Plant Operation management and digitization.

Unit 4: Systems Analysis and Design (07)
Systems Development Life Cycle (SDLC), Alternative System Building Approaches Prototyping, Rapid Development Tools, Agile, CASE Tools, Object Oriented Systems. MIS in renewable energy.

Unit 5: Decision Support Systems **(06)**

Understanding DSS- MIS and DSS-Decision making-types of decisions, Analytics and Business Intelligence- BI techniques. Group Decision Support Systems, Executive Information Systems, Executive Support Systems, Expert Systems and Knowledge Based Expert Systems, Artificial Intelligence in DSS.

Unit 6: SCM, CRM, EIS and International Systems **(06)**

Introduction, Supply Chain Management Systems, Customer Relationships Management Systems, Challenges of Enterprise Systems Implementations- Managing the implementation, International Information Systems-Outsourcing and off-shoring.

Text Books:

1. Management Information Systems, Laudon and Laudon, 7th Edition, Pearson Education Asia
2. Management Information Systems, Jawadekar, Tata McGraw Hill
3. Management Information Systems - Sadagopan, Prentice Hall
4. Analysis and Design of Information Systems, Rajaraman, Prentice Hall

Reference Books:

1. Decision Support Systems and Intelligent Systems, Turban and Aronson, Pearson Education Asia
2. Management Information Systems, Schultheiss, Tata McGraw Hill
3. Management Information Systems, Davis and Olson, Tata McGraw Hill 4. Management Information Systems - Jayant Oke

20PEIN601A Building Automation

Teaching Scheme:
Lectures: 3 Hrs/Week

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

Prerequisites: Basics of Electronics and Instrumentation

Course Objectives:
1. Enable students to understand basic concept of building automation
2. Learn to create safe, secure, comfortable, healthy, and sustainable environment in buildings
3. Learn to bring energy efficiency in building systems

Course Outcomes: The student will be able to
1. Delineate various HVAC system, fire and security system components and systems.
2. Investigate the system requirements to select HVAC system, fire and security system components.
3. Develop the HVAC air systems and water system operations and control philosophies
4. Develop the Fire Safety, Security and Access Control Systems.

Unit 1: Introduction to Building Automation Systems (08)
Intelligent buildings, its's architecture and structure - Evolution of intelligent buildings. Facilities management vs. intelligent buildings, Lifecycle of building. BAS System Hierarchy – Field level components, Direct Digital Control (DDC), Supervisory Controller, Server, Operator Workstation (OWS). Different systems in BAS which includes HVAC, security, fire, lighting systems. Importance of each system in BAS. Process of BAS design, Role of different stakeholders (Architect, contractor, consultant, application engineer and engineer) in BAS system design. BAS communication protocols and addressing concepts – BACnet and LON

Unit 2: Comfort parameters and measurement in BAS system (08)
Comfort parameters for human being - temperature, humidity, flow, pressure, clean air: Working Principle, Characteristics of different types of temperature sensors - RTD, Thermistor, Thermocouple, Bimetallic strip; Humidity, Specific Humidity, Relative Humidity, Dew point, Saturation point; Dry bulb & Wet bulb temperature, Working principle of Psychrometer; Pressure and Flow measurements in HVAC for air-side and water-side applications; Measurement of CO2 level in air, Air filtration techniques, ozonisation and UV; Other Parameters affecting building operation - Building load for Chilled water and hot water system, Working principal of BTU meter, BTU meter mounting.

Unit 3: HVAC Water Systems (07)

Chilled Water Systems: Concept of refrigeration cycle. Working, mechanical configuration of different types of components used in refrigeration cycle - evaporator, condenser, compressor, expansion valve. Difference between air-cooled chiller and water-cooled chiller. Working and mechanical configuration of different types of cooling towers. Concept and working of heat pump. Design, working of different types of chilled water system - single chiller system, series chiller system, parallel chiller system. Working of different components of chilled water system - decoupler line, bypass line, primary circuit, secondary circuit, and condenser pumps.

Hot Water Systems: Working and design of different types of boilers- fire tube, water tube, packaged boiler. Working and design of different types of heat exchanger. Design of different types of hot water system- with boilers, heat exchanger with steam input, heat exchanger with hot water input. Concept of geothermal system - Variable frequency drives: Use of VFD's for Pumps and Fans. Purpose and application of VFD.

Unit 4: HVAC Air Systems (07)

Air Handling Units and Terminal units - Concept of Air handling unit. Design, working of different components in AHU - damper, filter, cooling coil, heating coil, fan, heat recovery wheel, humidifier. Design and working of different types of AHU with combination of - 100% outdoor air, mixed air, constant volume, variable volume, dual duct, single duct. Operation of different modes in AHU - cooling, heating, humidification, dehumidification, static pressure control, volume matching, economizer mode. Heat recovery techniques - plate heat exchanger, heat recovery wheel and glycol heat recovery loop. Concept of Variable Air Volume (VAV) system - Design, working, use of different types of VAV- CAV, cooling only, with reheat, supply-exhaust VAV for critical areas (hospital and labs)

Unit 5: Introduction to Fire Alarm System & Fire Detection (06)

What is Fire? Fire alarm System-The History, FAS architecture & operation, Classification of Fire Alarm System, Conventional and Addressable Fire Alarm System, Important Codes-NFPA72, IS 2189, BS 5839, Critical fire & safety parameters in Facility Environment FAS Loops-Classification of Loops and Examples, Power Supply Requirement and its designing parameters. Battery Calculations. Network terminology for Fire Systems, Classification of Cables, Class of Cables, Types, and distance Supported specific to fire alarm system, Working Principles of Fire Alarm devices and its working Application in building safety, Components of fire detection system, SLC wiring and its classification, Concepts of Water leak detection system & Concepts of VESDA (Very early smoke detection system)

Unit 6: Introduction to Building Security – Access Control & CCTV (06)

Basic Concept of Access Control System it's benefits & architecture, Access Control System Devices –Its features and Working principles. Antipassback, Forgiveness, Two-man Rule, Time and Attendance, Guard Tour, Elevator Control, Secure and Non-Secure Concept, Card Technology Overview –Smartcard, Proximity Card, MI fare Cards, System Architecture of Access Control System, Basic of CCTV system, System Architecture of CCTV System,

Types of Camera –Fixed, PTZ, Analog, Digital, Video Analytics, Camera Connectivity, Video Management System: DVR, DVM, NVR

Text Books:

1. Robert Gagnon, Design of Special Hazards and Fire Alarm Systems.
2. Damjanovski, Vlado, CCTV, Butterworth-Heinemann , 3rd ed.
3. Benantar M., Access Control System
4. Montgomery R, Fundamentals of HVAC Control Systems , Elsevier Publications
5. Roger W. Haines "HVAC Systems Design Handbook", Fifth Edition
6. James E. Brumbaugh "HVAC Fundamentals", volume 1 to 3
7. "Basics of Air Conditioning" ISHRAE, Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0004 for online shopping)

Reference Books:

1. "All About AHU's", ISHRAE. Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0005 for online shopping)
2. "Chillers Basics", ISHRAE. Indian Society of Heating, Refrigerating & Air Conditioning Engineers
(product code: B0009 for online shopping)
3. "HVAC Handbook Part-1", Indian Society of Heating, Refrigerating & Air Conditioning Engineers
4. "Handbook – Industrial Ventilation Application", 2004, Indian Society of Heating, Refrigerating & Air Conditioning Engineers

20PEIN601B Embedded Product Design

Teaching Scheme:
Lectures: 3 Hrs/week

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

Prerequisites: Embedded system design, Knowledge of Assembly and C programming, Electronic instrumentation and system design

Course Objectives:
1. To give knowledge of interfacing analog and digital input devices to microcontrollers.
2. To give knowledge of interfacing analog and digital output devices to microcontrollers.
3. To implement different power optimization techniques for low power systems.
4. To give an overview of product design with case study.

Course Outcomes: Students will be able
1. Apply different methodologies to interface different sensors and devices to microcontrollers.
2. To apply different methodologies to interface different actuators to microcontrollers.
3. To explore and select proper power optimization techniques.
4. To design and test performance of a system.

Unit 1: Programming and interfacing analogue input devices (07)
Load cell, Temperature sensor, 2-wire transmitters, potentiometric sensors, LVDT, Linear opto IL300

Unit 2: Programming and interfacing analogue output devices (08)
Linear opto IL300, PWM based DAC, serial DAC, Voltage to current converter, Lamp/indicator, miniature DC motor,

Unit 3: Programming and interfacing digital input devices (08)
Key board, Proximity switch, incremental Encoders, Ultrasonic sensors, serial ADC, RTC-1307, Optocoupler MCT2E

Unit 4: Programming and interfacing digital output devices (08)
Alpha-numeric LCD, 7-Segment LED display, serial memories, Optocoupler MCT2E, printer, Stepper motor, relays (SSR and Electro-mechanical)

Unit 5: Power efficient system and communication design (06)

Design considerations for battery powered systems, communication based on RS-232, RS-485, Bluetooth, USB drives

Unit 6: Small system design with case study (05)

Embedded system design for Temperature data logger, Burglar alarm, Fire alarm, WSN based system, RFID based access control

Text Books:

1. Microcontrollers: Theory & Applications by Dr. A. V. Deshmukh, Tata McGraw Hill, Publications
2. Programming and Customizing the AVR Microcontroller by Dhananjay V. Gadre, Tata McGraw Hill Publishing Company Limited, 2003.
3. AVR microcontroller & Embedded System by A. Mazidi , Prentice Hall

Reference Books:

1. Internet resources for AVR:
2. Atmel AVR Page:. http://www.atmel.com/images/doc2502.pdf
3. http://www.atmel.in/Images/doc0856.pdf
4. Datasheets of ATmega 8535, ATtiny2313
5. Datasheets of IL300, RTC1307, MCT2E, serial ADCs, DACs

20PEIN601C MEMS

Teaching Scheme:
Lectures: 3 Hrs/week

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

Prerequisites: Conventional sensors and materials, application of sensors

Course Objectives:
1. To introduce emerging MEMS field and importance of micro scaling to students
2. To provide knowledge of advanced materials, sensors and actuators
3. To learn advance micro fabrication techniques
4. To know advancement in instrumentation field of bio, automotive, aerospace field

Course Outcomes: The student will be able to,
1. Compare smart material based on their characteristics.
2. Select the appropriate micro sensor, micro actuator and type of microfluidic flow for given application.
3. Identify and define various phases of micro scaling and micro fabrication process.
4. Develop applications using MEMS devices.

Unit 1: Introduction to MEMS **(06)**
Introduction to MEMS, Introduction to micro sensors, Evaluation of MEMS, Application of MEMS

Unit 2: Smart Material **(08)**
Shape memory Materials, Electrostrictive Materials, Magnetostrictive Materials, Rheological Materials, Electro chromic Materials, Self-healing Material, Conducting polymer

Unit 3: Micro Fabrication **(09)**
Study of Silicon as a Material for Micromachining, Thin-film Deposition –Evaporation, Sputtering, Chemical Vapor Deposition, Epitaxial Growth of Silicon Thermal Oxidation, Lithography, Doping the Silicon Wafer: Diffusion and Ion, Implantation of Dopants, Etching. Dry Etching, Silicon Micromachining Bulk Micromachining, Surface Micromachining

Unit 4: Micro Sensor and Micro Actuator **(07)**
Micro sensor - Silicon Capacitive Accelerometer, Conductometric Gas Sensor, Fibre-Optic Sensors, Electrostatic Comb-Drive
Micro Actuator - Magnetic Micro relay, Microsystems at Radio Frequencies, Piezoelectric Inkjet Print Head, Portable Blood Analyzer, Micro mirror Array for Video Projection

Unit 5: Microfluidics **(06)**

Droplet Microfluidics, Active Flow control, Microvalves, Electrically actuated microvalves, Micromixers, Combinational Mixers, Elastomeric Micromixers. Microfluidic for Flow cytometry, cell sorting, cell trapping, Cell culture in microenvironment.

Unit 6: MEMS –Electronics, Packaging and Applications **(05)**

Wafer Bonding & Packaging of MEMS Interface Electronics for MEMS

Text Books:

1. Micro And Smart Systems by G.K. Ananthasuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat, V.K. Atre : Wiley, India (2010).
2. Microfluidics and Microfabrication by Suman Chakraborty
3. Foundation of MEMS by Chang Liu
4. An Introduction to MEMS by Nadim Maluf and Kirt Williams

Reference Books:

1. Smart Material Systems and MEMS: Design and Development Methodologies, Vijay, K., Varadan K., Vinoy J. Gopalakrisham S. Willey 2006
2. Smart materials and new technologies, Addington, M. ,Schodek, Daniel L. Architectural Press, 2005.
3. Smart Structure and Materials, Brain Culshaw Artech House – Borton. London 1996
4. Smart Structure analysis and design, Srinivasan A.V., Michael McFarland D., Cambridge University Press, 2001
5. Fundamentals of Micro fabrication, Marc Madou

20OE601C Avionics

Teaching Scheme:
Lectures: 3 Hrs/week

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

Prerequisites: Basics of Control Systems, Basics of Communication System

Course Objectives:
1. To integrate the digital electronics with cockpit equipment
2. To understand the various principles in flight desk and cockpit panels.
3. To understand the communication techniques used in aircraft.
4. To explain the modern era of flight control system

Course Outcomes: The student will be able to
1. Identify the mechanical and electronic hardware required for aircraft.
2. Compare the communication and navigation techniques used in aircrafts.
3. Disseminate the autopilot and cockpit display related concepts.
4. Compare and identify different actuators in avionics.

Unit 1: Introduction to Avionics **(08)**
Basics of Avionics-Basics of aircraft- glider – control surfaces- Cockpits instrumentation -Need for Avionics - Integrated Avionics Architecture.

Unit 2: Digital Avionics Bus Architecture **(07)**
Avionics Bus architecture–Data buses MIL–RS 232- RS422-RS 485-STD 1553- ARINC 429–ARINC 629- Aircraft system Interface- Network topologies

Unit 3: Flight Deck and Cockpit **(07)**
Control and display technologies CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil cockpit and military cockpit: MFDS, PFDS-HUD, HMD, HMI

Unit 4: Avionics Systems **(06)**
Communication Systems – Navigation systems – Flight control systems – Radar electronic Warfare – Utility systems Reliability and maintainability Fundamentals-Certification-Military and civil aircrafts.

Unit 5: On Board Navigation Systems **(07)**

Overview of navigational aids, Flight planning, Area navigation, required time of arrival, RNAV architecture , performance aspects, approach and landing challenges, regulatory and safety aspects, black box instrumentation INS, GPS and GNSS characteristics.

Unit 6: Basics of Final Control Element **(06)**

Basics of pneumatic, hydraulic and electric actuators, Function of DC Servo motor, AC Servo motor function of pneumatic, hydraulic actuators.

Text Books:

1. R.P.G. Collinson, "Introduction to Avionics", Chapman & Hall Publications, 1996.
2. N. S. Nagaraja(1996),Elements of electronic navigation, 2 edition, Tata McGraw Hill, New Delhi.

Reference Books:

1. Cary R .Spitzer, "The Avionics Handbook", CRC Press, 2000.
2. Middleton, D.H. "Avionics Systems", Longman Scientific and Technical, Longman Group UK Ltd., England, 1989.
3. Spitzer, C.R. "Digital Avionics Systems", Prentice Hall, Englewood Cliffs, N.J., U.S.A., 1987.
4. Brain Kendal, "Manual of Avionics", The English Book House, 3rd Edition, New Delhi, 1993

20OE601D Bioinformatics

Teaching Scheme:
Lectures: 3 Hrs/week

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

Prerequisites: -

Course Objectives:
1. To understand the basics of bioinformatics and explore various databases used in bioinformatics.
2. To be familiar with a set of well-known supervised, unsupervised learning algorithms used for bioinformatics applications.
3. To understand the concepts and types of Phylogeny.

Course Outcomes: Students will be able
1. Apply basic concepts of bioinformatics to biological data analysis.
2. Classify different types of biological databases.
3. Apply various techniques, algorithms and tools to nucleic acid and protein sequence analysis.
4. Apply various techniques, algorithms and tools to be used for phylogenetic analysis.

Unit 1: Introduction to Bioinformatics (06)
Definition, applications, Protein and DNA structure, Biological Data Acquisition: The form of biological information. Retrieval methods for DNA sequence, protein sequence

Unit 2: Bioinformatics Databases (08)
Format and Annotation: Conventions for database indexing and specification of search terms, Common sequence file formats. Annotated sequence databases - primary sequence databases, protein sequence, Information on various databases and bioinformatics tools available. For eg; nucleic acid sequence database (GenBank, EMBL, DDBJ), protein sequence databases (SWISSPROT, TrEMBL, PIR, PPB)

Unit 3: Algorithms for bioinformatics (08)
Introduction to various machine learning techniques and their applications in bioinformatics. Genetic algorithm, Support Vector Machine, Neural Network and their practical applications towards the development of new models, methods and tools for bioinformatics

Unit 4: Sequence Analysis (08)

Various file formats for biomolecular sequences - genbank, fasta, gcg, msf, nbrf-pir, etc Basic concepts of sequence similarity, identity and homology, paralogues. Sequence based database searches - BLAST and FASTA algorithms

Unit 5: Sequence Alignment **(06)**

Pairwise and Multiple Sequence Alignments (MSA). Basic concept of sequence alignment, Pairwise alignment (Needleman and Wunsch, Smith and Waterman algorithms), MSA (Progressive and Hierarchical algorithms). Their use for analysis of Nucleic acid and protein sequences and interpretation of results

Unit 6: Phylogeny **(06)**

Phylogeny analysis, definition and description of phylogenetic trees and its types. Various computational methods in phylogenetic and molecular evolutionary analysis

Text Books/Reference Books:

1. Hooman Rashidi, Lukas K. Buehler, 'Bioinformatics Basics: Applications in Biological Science and Medicine' (2nd Edition) (May 2005)
2. Des Higgins (Ed),Willie Taylor (Ed), 'Bioinformatics: Sequence, Structure and Databanks - A practical approach' (1st Edition) (October 2000)
3. N.J. Chikhale and Virendra Gomase, 'Bioinformatics- Theory and Practice' (1st Edition)(July 2007)
4. Bioinformatics: Databases and Systems, by Stanley I. Letovsky
5. Bioinformatics Databases: Design, Implementation, and Usage (Chapman & Hall/ CRC
6. Mathematical Biology & Medicine), by SorinDraghici
7. Data base annotation in molecular biology, principles and practices, Arthur M.Lesk
8. Current topics in computational molecular biology, Tao, Jiang, Ying Xu, Michael Q.Zang

20IN602L Industrial Automation Lab

Teaching Scheme:
Practical: 2Hrs/Week

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

Course Outcomes: Students will be able to,
1. Develop URS and FDS documents for any automation project.
2. Develop PLC/ DCS logic for any given industrial application.
3. Simulate and test the developed logic for the given application.
4. Interface different devices with PLC/ DCS

List of Practical Assignments:(any 8)
1. Compare the applicability of different automation tools for the given application.
2. Preparing URS and FDS for any automation project.
3. Logic implementation of any automation project in PLC using ladder language.
4. Logic implementation of any automation project in PLC using FBD language.
5. Simulate digital and analog function blocks in DCS.
6. Tune PID controller for any loop using PLC/DCS.
7. Interface PLC and HMI for any automation project through OPC or suitable protocol.
8. Study the interfacing of PLC to PLC and PLC to other devices(Servo motor, stepper motor, printer, etc)
9. Develop Graphical User Interface in DCS for any control loop.
10. Study the application of different safety systems (Case study).

Or similar type of practical assignments based on the course contents

20IN603L System Engineering and Management Lab

Teaching Scheme:
Practical: 2Hrs/Week

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

Course Outcomes: By the end of the course, students should be able to
1. Develop Project Management documents
2. Apply national and international standards and recommended practices.
3. Create instrumentation detailed engineering documents as per specified standards
4. Create testing and commissioning documentation.

List of Practical Assignments:
1. Develop documents for SOW/WBS/Organization structure for any I&C Project
2. Interpret the Process flow diagram and Material Balance sheet.
3. Introduction Auto CAD like (smart sketch etc.) software.
4. Develop P&ID for given process
5. Develop Instrument Index sheet, I/O list for given P&ID
6. Develop Specification sheets for given instruments and P&ID
7. Develop GA drawings for a given panel (JB/Electrical/ PLC/DCS) .
8. Develop Hook up drawings (Control valve, Thermowell, orifice plate, rotameter etc..)
9. Create Loop Wiring Diagram/Logic diagram
10. Create documents for tests like FAT/SAT or CAT
11. Develop commissioning documents.

Or similar type of practical assignments based on the course contents

20PEIN601LA Building Automation Lab

Teaching Scheme:
Practical: 2Hrs/Week

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

Course Outcomes: Student will be able to,
1. Describe the various components of a Building Automation System.
2. Investigate the system requirements of a Building Automation System.
3. Design the various Building Automation System components.
4. Develop the various Building Automation System components.

List of Practical Assignments: (minimum eight)
1. To study Architecture of BMS & IBMS
2. To study Psychrometric chart and various parameters
3. To study different types of Air Handling Units
4. To study various terminal unit systems (CAV, VAV)
5. To study Chilled Water System and loops
6. To study Hot Water System and loops
7. To study FAS loops and classifications
8. To study SLC wiring, loops, classifications
9. To study cause and effect matrix-Fire alarm system
10. To study CCTV System Architecture and types of cameras

Or similar type of practical assignments based on the course contents

20PEIN601LB Embedded Product Design Lab

Teaching Scheme:
Practical: 2Hrs/Week

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

Course Outcomes: The student will be able to
1. Verify and compare the performance of different displays
2. Design and interface various sensors to embedded controller
3. Select appropriate output devices for given application
4. Design and test embedded controller-based systems for industrial application.

List of Practical Assignments: (minimum 5)
1. Interfacing of Keyboard and LCD
2. Interfacing of 2-wire transmitter
3. Design of up-down counter and Interfacing of 7-segment LED display
4. Design and testing of an application based on power down mode of microcontroller

(Any 1 from)
5. Temperature indicator using LM35
6. Interfacing of proximity switch and relay using MCT2E optocoupler
7. Distance measurement using ultrasonic sensor HC-SR04

(Any 1 from)
8. Speed control of miniature DC motor
9. Intensity control of Lamp/Power LED
10. Programmable voltage to current converter

Or similar type of practical assignments based on the course contents

20PEIN601LC MEMS Lab

Teaching Scheme:
Practical: 2Hrs/Week

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

Course Outcomes:
1. Simulate a sensor design through software like COMSOL
2. Selection of appropriate sensor and actuator for the specified application
3. Characterization of simulated sensor design
4. Design a MEMS system based on the specified application

List of Practical Assignments:
1. Finite element simulation of MEMS sensor – COMSOL/ANSYS
2. Design of MEMS sensor – system on a chip approach
3. Fabrication of MEMS sensor – resistive/capacitive type
4. Characterization of MEMS sensor – resistive/capacitive type
5. Microfluidics – Design, simulation, fabrication and characterisation
6. Micromixers – Design, simulation, fabrication and characterisation
7. Paper microfluidics – Simulation, fabrication and characterisation

Or similar type of practical assignments based on the course contents

20IN604 Mini Project

Teaching Scheme:
Practical: 2 Hrs/week

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

Course Outcomes: Students will be able to

1. Identify and define with proper study, problem statement related to industry, healthcare, society, laboratory.
2. Design various stages to solve the identified problem.
3. Implement and test the developed design or system or prototype
4. Prepare and present technical documentation of the developed system.

MKSSS's Cummins College of Engineering for Women, Pune
(An Autonomous Institute Affiliated to SavitribaiPhule Pune University)

Autonomous Program Structure of

Final Year B. Tech. Seventh Semester
(Instrumentation & Control Engineering)
Academic Year: 2023-2024 Onwards

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Total Marks	Credit
		Lecture	Tutorial	Practical	In Sem	End Sem	Practical	Oral		
20IN701	Internship/Project	0	0	0	200	0	0	100	300	15
20HS702	Economics and Personal Finance (EPF) (Online)	2	0	0	50	50	0	0	100	2
	Grand Total	**32**							**400**	**17**

	Credits	Marks	aching Hrs / week	luation Mode
Internship / Project =	15	300	30	Presentations + Oral
HS- EPF (Online) =	2	100	2	ISE + ESE

Duration of Internship / Project :

1. Full Internship 6 Months
2. Full Project 6 Months
3. Combination: Internship of 2 to 6 Months duration + Project from 1 to 6 Months Duration.

For Internship / Project:
In-Sem-Reviews =Two ; ESE = One Review with external (Final)

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

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Chairman Governing Body
MKSSS's Cummins College of Engineering
For Women, Pune-411052

20IN701: Internship/Project

Teaching Scheme:
Practical: 30 Hrs/week

Examination Scheme:
In Semester: 200 Marks
Oral: 100 Marks
Credit: 15

Course Outcomes: The student will be able to

1. Identify and define technical problem related to various fields.
2. Implement and test the designed stages involved in solving the defined problem statements.
3. Work in a team and abide by the norms of professional ethics.
4. Gain effective communication and documentation skills along with self-learning ability.

Autonomous Program Structure of
Final Year B. Tech. Eighth Semester
(Instrumentation & Control Engineering)
Academic Year: 2023-2024
onwards

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Marks	Credit
		Lecture	Tutorial	Practical	In Semester	End Semester	Oral	Practical		
20IN801	Process Data Analytics	3	0	0	50	50	0	0	100	3
20PEIN801	Program Elective-IV	3	0	0	50	50	0	0	100	3
20PEIN802	Program Elective-V	3	0	0	50	50	0	0	100	3
20OE801	Open Elective-III	3	0	0	50	50	0	0	100	3
20OE802	Open Elective-IV*	3	0	0	50	50	0	0	100	3
20IN801L	Process Data Analytics lab	0	0	2	25	0	25	0	50	1
20PEIN801L	Program Elective–IV Lab	0	0	2	25	0	25	0	50	1
	Total	**15**	**0**	**4**	**300**	**250**	**50**	**0**	**600**	**17**
	Grand Total	**19**			**600**				**600**	**17**

Programme Elective-IV	**Programme Elective-IV Lab**
20PEIN801A Process Modelling and Optimization 20PEIN801B Artificial Intelligence and Machine Learning 20PEIN801C Medical Device Technology	20PEIN801LA Process Modelling and Optimization 20PEIN801LB Artificial Intelligence and Machine Learning 20PEIN801LC Medical Device Technology

Programme Elective-V
20PEIN802A Safety Instrumentation Systems
20PEIN802B Computer Techniques and Operating Systems
20PEIN802C Environmental Instrumentation

APPROVED BY
Secretary Governing Body
MKSSS's Cummins College of Engineering
for Women, Pune-411052

APPROVED BY
Chairman Governing Body
MKSSS's Cummins College of Engineering
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20OE801 Open Elective-III			Eligible Departments				
Sr. No.	Course Code	Course Title	EnTC	Comp	IT	Mech	Instru
1	20OE801A	Big Data and Analytics	Y	Y	Y	Y	Y
2	20OE801B	Cyber Physical Systems	Y	Y	Y	N	Y
3	20OE801C	Digital Control	Y	N	N	Y	Y
4	20OE801D	Industrial Engineering and Management	Y	Y	Y	Y	Y
5	20OE801E	Introduction to Cyber-crime and Forensics	Y	Y	Y	Y	Y
6	20OE801F	Instrumentation in Food and Agriculture	Y	Y	Y	Y	Y
7	20OE801G	Medical IoT	Y	Y	Y	N	Y
8	20OE801H	Quantum Computing	Y	Y	Y	N	Y
9	20OE801I	Renewable Energy Sources	Y	Y	Y	Y	Y
10	20OE801J	Soft Computing	Y	Y	Y	Y	Y
11	20OE801K	Software Testing and Quality Assurance	Y	Y	Y	Y	Y

20OE802 Open Elective-IV			Eligible Departments				
Sr. No.	Course Code	Course Title	EnTC	Comp	IT	Mech	Instru
1	20OE802A	Applied statistics with R Programming	Y	N	N	Y	Y
2	20OE802B	Automobile Engineering	Y	Y	Y	N	Y
3	20OE802C	Autonomous Robots	N	Y	Y	Y	N
4	20OE802D	Building Automation and Energy Audit	Y	Y	Y	Y	N
5	20OE802E	Data Analysis and Visualization	Y	N	Y	Y	Y
6	20OE802F	Data Science using Python	Y	N	Y	Y	Y
7	20OE802G	Industrial Drives and Control	Y	Y	Y	Y	N
8	20OE802H	Smart Sensors and Systems	Y	Y	Y	Y	N
9	20OE802I	Wireless Networks	N	Y	Y	N	Y

20IN801 Process Data Analytics

Teaching Scheme:
Lectures: 3 Hrs/week

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

Prerequisites: -

Course Objectives:
1. To explore the statistical analysis techniques for various kinds of data.
2. To understand the concepts and types of Artificial Intelligence and Machine Learning Algorithms.
3. To be familiar with a set of well-known supervised, semi-supervised and unsupervised learning algorithms.

Course Outcomes: The student will be able to
1. Apply standard statistical inference procedures to draw conclusions from data analysis.
2. List and define the basic concepts of artificial intelligence and machine learning.
3. Compare and select various machine learning algorithms for solving practical problems.
4. Implement various machine learning algorithms to different domains.

Unit 1: Introduction to data analytics **(07)**

Need of data analytics in process industries, types of data analytics (Descriptive analytics, Diagnostic analytics, Preventative analytics and Prescriptive analytics), Application of each type of analytics in various process and manufacturing industries. Data types: Structured, unstructured data and challenges with unstructured data, numerical and categorical data.

Unit 2: Data Acquisition and Preprocessing **(07)**

Sources of data: internal and external. Data acquisition: data access, Data handling at different levels of data access modes, ownership of data, data security, data reliability

Data Preparation: Data restoration, Identification of tables/fields of interest, Importing into the analytical tool, Merging and splitting data files, Data cleaning, Missing values and other data preparation steps, Data integration: linking multiple databases.

Unit 3: Descriptive Statistics **(07)**

Compute measures of central tendency (mean, mode, median), measures of variability (Range, variance, standard deviation, degrees of freedom), normal distribution (Characteristics of normal distribution, skewness, kurtosis), confidence interval.

Unit 4: Inferential Statistics (07)

Hypothesis and hypothesis testing, Chi square test, t test, correlation, Linear regression, multi regression, Logistic regression, Goodness of fit, Analysis via linear models, Non-linear model: ANOVA, Test decision rules

Unit 5: Supervised and Unsupervised Learning Methods (07)

Compare supervised and unsupervised learning, Supervised learning algorithms: Neural networks, Naive Bayes, Linear regression, Logistic regression and random forest

Unsupervised learning methods: Clustering, Associative Rule Mining, Introduction to Big Data and Challenges for big data analytics. Case studies and applications of algorithms in process applications.

Unit 6:Clustering and Classification (07)

Basics of clustering and classification, classification metrics, classification via Bayes rule, Identifying clusters in your data, Clustering and classifying using nearest neighbors algorithm: Average nearest neighbor, k nearest neighbor , Decision trees. Case studies and applications of algorithms in process applications.

Text Books:

1. Montgomery, Douglas C. and Runger, George C. (2014) Applied Statistics
2. Probability for Engineers, 6 th edition, John Wiley & Sons, Inc (ISBN-978-1118539712).
3. An Introduction to R, by Venables and Smith and the R Development Core Team.
4. Data Analysis and Graphics Using R; An Example-based Approach, by John Maindonald and John Braun. Cambridge Series in Statistical and Probabilistic Mathematics, 2003.
5. Sheldon M. Ross,"Introduction to Probability and Statistics for Engineers and Scientists", 4th edition, Academic Press; 2009.

Reference Books:

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
2.Arshdeep Bahga, Vijay Madisetti, "Big Data Science & Analytics: A Hands-On Approach", VPT, 2016
3. E. Alpaydin, "Machine Learning", MIT Press, 2010.
4. K. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
5. C. Bishop, "Pattern Recognition and Machine Learning, Springer", 2006.
6. Shai Shalev-Shwartz, Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2014.
7. John Mueller and Luca Massaron, "Machine Learning For Dummies", John Wiley & Sons, 2016.

8. Chandan K. Reddy and Charu C Aggarwal, "Healthcare data analytics", Taylor & Francis, 2015
9. Hastie, Trevor, et al. "The elements of statistical learning". Vol. 2. No. 1. New York: springer, 2009.
10. Montgomery, Douglas C., and George C. Runger. "Applied statistics and probability for engineers" John Wiley & Sons, 2

20PEIN801A Process Modelling and Optimization

Teaching Scheme:
Lectures: 3 Hrs/Week

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

Prerequisites: Process Instrumentation, Automatic Control System, Control system Design

Course Objectives:
1. Understand and develop system's mathematical models.
2. Learn the use of Numerical methods in solving the model equations.
3. To learn to various optimization techniques.

Course Outcomes: The student will be able to
1. Define and list types of mathematical models.
2. Develop mathematical model of process.
3. Simulate and analyse the system performance.
4. Apply the optimization techniques and analyse the results.

Unit 1: Modelling Aspects & Mathematical Models (07)
Definition of process model, physical and mathematical modelling, deterministic and stochastic process. Introduction, uses of mathematical models, classification of mathematical methods, scope of coverage, principles of formulation, fundamental laws, continuity equations, energy equations, equation of motion, transport equation, equation of state, equilibrium, kinetics

Unit 2: Mathematical Modelling of Mechanical & Chemical Engineering Systems (08)
Process models of some typical systems in differential equations form, , dead time, first and second order models, higher order models, Behaviour of first order and second order system

Unit 3: Mathematical Models (08)
Mathematical Models of Tanks in series, Tanks in parallel Reaction dynamics, Modelling the chemical reactions, CSTR models, Plug flow reactor model, modelling of flash drum, distillation columns, evaporators, dryers, heat exchangers.

Unit 4: Basic concept of Optimization (07)

Optimization: Concept, need, Essential features of optimization Problem, Concepts of objective functions, Equality and Inequality Constraints, Payback period, Return of Investment, Net present Value, Internal Rate of Return. Classification of optimization problem, Continuity of functions, convex and concave functions, Convex Region, Extremum of the objective functions, quadratic approximation, Feasible region.

Unit 5: Optimization of Unconstrained Functions & Linear Programming (06)

One-Dimensional search numerical methods for optimizing a function of one variable , scanning and bracketing procedures, Newton, Quasi Newton and Secant methods, Runge Kutta method.

Unit 6: Unconstrained Multivariable Optimization (06)

Simplex method, Direct Methods, Indirect Methods, Steepest Descent method. Linear Programming: Basics of Linear Programming, Simplex Algorithm

Text Books:

1. W. L. Luyben, Process, Modelling, Simulation and Control for Chemical Engineers• by McGraw Hill, 1973.
2. Thomas Edgar, David Himmelblau, Optimization of Chemical Processes• Second edition, McGraw Hill, 2001.

Reference Books:

1. W. F. Stoecker, Design of Thermal Systems International Education, McGraw hill 1989.
2. J. Malley, Practical Process Instrumentation and Control • McGraw Hill.
3. Deo Narsingh ,System Simulation with digital Computer • Prentice Hall India, New Delhi.
4. Singiresu S.Rao,Engineering Optimization (Therory & Practice),third Edition,New Age International(p) Ltd,Publishers.

20PEIN801B Artificial Intelligence and Machine Learning

Teaching Scheme:
Lectures: 3 Hrs/Week

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

Prerequisites: Basics of Mathematics, Computational Techniques.

Course Objectives:
1. To explore the statistical analysis techniques for various kinds of data.
2. To understand the concepts and types of Artificial Intelligence and Machine Learning Algorithms.
3. To be familiar with a set of well-known supervised, semi-supervised and unsupervised learning algorithms.

Course Outcomes: The students will be able to
1. Explore Machine Learning Methodology
2. Analyse research-based problems using Machine Learning Techniques.
3. Formalize a given problem in the different AI methods.
4. Implement basic AI algorithms.

Unit 1: Machine Learning **(08)**
Machine learning -examples of machine learning applications
Types of Learning: Supervised, Unsupervised, Issues in machine learning. Hypothesis, Target Function, Cost Function, Gradient, Training, Testing, Cross-validation, Evaluating hypothesis accuracy.

Unit 2: ML Algorithms **(09)**
Classification Algorithms , Regression Algorithms, Clustering Algorithms,
Deep Learning,

Unit 3: Fundamentals of Artificial Intelligence **(08)**
Introduction, What is AI, Applications of AI, Types of AI, A.I. Representation, Non-AI & AI Techniques, Representation of Knowledge, Knowledge Base Systems, Production Systems, Problem Characteristics, Types of production systems.

Unit 4: State Space Search **(09)**
Search Algorithms: Depth Bounded DFS, Heuristic Search: Heuristic Functions, Best First Search, Hill Climbing, Optimal Search: A* algorithm, Iterative Deepening A*, AO* search.

Unit 5: Applications of AIML **(08)**
Case Study: Uber Alternative routing, Credit card fraud analysis, Sentiment Analysis, Camera Age Analysis, etc

Text Books:

1. Elaine Rich and Kevin Knight: "Artificial Intelligence." Tata McGraw Hil
2. Stuart Russell & Peter Norvig : "Artificial Intelligence : A Modern Approach", Pearson Education, 2nd Edition.
3. T. Mitchell, Machine Learning,", McGraw-Hill, 1997.
4. Anup Kumar Srivastava, Soft Computing, Alpha Science International limited. 2009.

20PEIN801C Medical Device Technology

Teaching Scheme:
Lectures: 3 Hrs/week

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

Prerequisites: Physiology of human body organs

Course Objectives:
1. To study diagnostic and operating instruments
2. To study life saving devices
3. Get the knowledge of laser technology
4. To learn various instruments used for checking performance of sensory organs

Course Outcomes:
1. Suggest the use of life saving devices for cardiovascular diseases
2. Justify the need and working of continuous monitoring devices
3. Describe use of lasers for various medical applications
4. Summarise use of diagnostic instruments

Unit 1: Cardiac Assistive and Coronary Care Devices: (06)
Pacemaker, Types of pacemakers: External and Internal, Programmable Pacemaker, Defibrillators: AC and DC Defibrillator, Implantable defibrillator, Heart Lung Machine.

Unit 2: Clinical Lab Instrumentation (06)
Blood and its composition and function, Blood Cell Counters, Electrophoresis, Pulse Oximetry- principle, Invitro and In vivo Oximeter, Telemetry- Time division and Frequency division multiplexing, Telemedicine.

Unit 3: Respiratory and Kidney Therapy Equipment (06)
Spiro meters, Ventilators, Dialysis System- Haemodialysis and Peritoneal dialysis Artificial Kidney-types (Coil type, parallel plate type), Lithotripsy

Unit 4: Laser Applications and Rehabilitation Engineering (06)
Types of lasers, Properties of laser, Basic Endoscopes system and its characteristics ,Laser applications in ophthalmology- Diabetic Retinopathy, glaucoma and Retinal hole and detachment treatment , Dermatology- Tattoo, port wine treatment.
Orthotics & Prosthetic devices, overview of various orthotics and prosthetic devices along with its materials. Wheelchair types, material used in wheelchair.

Motor Rehabilitation: Functional Electrical Stimulation - Robotics in rehabilitation - Sports, stroke and geriatric Rehabilitation - Assistive technology for dyslexia - Computer & internet access for challenged people - Neural engineering in rehabilitation engineering -

Unit 5: ICU Operating Room Instrumentation, Electrical & Fire Safety: (06)

Drug Delivery System, ICU layout: organization, bedside monitor. Operating room instrumentation: Electro surgical Unit, Anaesthesia Machine. Sources of Shocks, Macro and Micro Shocks, monitoring and Interrupting the operation from leakage current-Elements of Fire, causes of fire and protection.

Unit 6: Sensory Assist Devices (06)

Basic Audiometer; Pure tone audiometer; Audiometer system Bekesy; Evoked response Audiometer system, Hearing Aids, Visual acuity, Slit Lamp, Tonometer, Ophthalmoscope, Perimeter.

Assistive Devices for Visual and hearing Impairments, application of DSP in hearing aids - Cochlear implants - Voice synthesizer, speech trainer - Ultra sonic, Infrared and LASER canes - Intra ocular lens - Braille Reader - Tactile devices for visually challenged - Text voice converter - Screen readers.

Text Books:

1. Medicine and Clinical Engineering by Jacobsons& Webster, PHI
2. Introduction to Biomedical Equipment Technology ByCarr& Brown
3. Biomedical Instrumentation and Measurements by Cromwell, PHI
4. Handbook of Biomedical Instrumentation by R. S. Khandpur, TMH

Reference Books:

1. The Biomedical Engineering Handbook, Bronzino, IEEE Press
2. Applied Chemical Engineering Feenberg,
3. Principles of Medical Imaging.-By: K. Kirk Shung, Michael B. Smith, BenjaminTsui.-Pub: Academic Press.
4. Medical Laser Applications -By Carruth
5 .Biomedical Instrumentation and Measurement, R.Anandanatarajan

20PEIN802A Safety Instrumentation Systems

Teaching scheme:
Lectures: 3Hrs /week

Examination scheme:
In semester: 50 Marks
End Semester: 50 Marks
Credit: 3

Prerequisites: -

Course Objectives:
1. To make the students aware of basic concepts of safety instrumented system,
2. To make the students aware of standards
3. To make the students aware of risk analysis techniques.

Course Outcomes: The student will be able to
1. Differentiate between process control and safety control and identify the role of safety instrumented systems in the industry.
2. Identify and analyse the process hazards.
3. Select the Safety integrity level.
4. Analyse the performance of different logic system technologies and field devices with optimum risk levels.

Unit 1: Introduction **(07)**
Safety Instrumented System (SIS) - need, features, components, difference between basic process control system and SIS, Risk: how to measure risk, risk tolerance, Safety integrity level, safety instrumented functions, review of Standards and Regulations related to Safety,

Unit 2: Safety Life Cycle **(08)**
Hazard and risk analysis, allocation of safety functions to protective layers, develop safety requirements specification, SIS design & engineering, installation commissioning and validation, operations and maintenance, modifications, decommissioning.

Unit 3: Determining the Safety Integrity Level (SIL) **(07)**
Evaluating Risk, Safety Integrity Levels, SIL Determination Method: As Low As Reasonably Practical (ALARP), Risk matrix, Risk Graph, Layers of Protection Analysis (LOPA)

Unit 4: Technology Selection **(08)**
Covers the safety requirements specification (SRS) and the pros and cons of pneumatic, relay and microprocessor logic systems, PLC systems for safety system development. Issues

Relating to Field Devices: importance of field devices: impact of field devices such as sensors, final elements on system performance.

Unit 5: Reliability of SIS **(06)**

Covers reliability issues and helps make sense of the minimum hardware fault tolerance requirement, Likelihood analysis: estimation and statistical analysis, fault propagation, event tree analysis and fault tree analysis, Quantitative layer of protection analysis: multiple initiating events, estimating initiating event frequencies and IPL failure probabilities

Unit 6: Case Study **(06)**

The safety life cycle and its importance, furnace/fired heater safety shutdown system, scope of analysis, define target SILs, develop safety requirement specification (SRS), SIS conceptual design, life cycle cost analysis, verification of SIL satisfaction, detailed design, installation, commissioning and pre-start-up tests, operation and maintenance procedures.

Reference Books:

1. Paul Gruhn and H Jarry L. Cheddie, "Safety Instrumented systems: Design, Analysis and Justification", ISA, 2 nd edition, 2006.
2. Dr. Eric W Scharpf, Heidi J Hartmann, Harlod W Thomas, "Practical SIL target selection: Risk Analysis per the IEC 61511 Safety Lifecycle", exida, 2012.
3. Ed Marszal, Eric W Scharpf, "Safety Integrity Level Selection", ISA.

20PEIN802B Computer Techniques and Operating Systems

Teaching Scheme:
Lectures: 3 Hrs/week

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

Prerequisites: -

Course Objectives:
1. To understand the functions of operating systems
2. To understand the software development cycle and its blocks
3. To learn the current trends in software engineering

Course Outcomes: The students will be able to
1. Illustrate functionalities of operating system
2. Compare parallel computer architecture and functions
3. Identify methods in software engineering
4. Compare trends and techniques used in software engineering

Unit 1: Operating System Overview **(07)**
Concepts of Operating System and its services, Types of operating systems
Process Management: Concept, scheduling, operations on process
CPU scheduling: Basic concepts, CPU scheduling algorithms
Deadlocks: Characterization, Handling, Recovery Disk scheduling algorithms

Unit 2: Memory and File Management **(08)**
Memory Management: Address Binding, Overlays, Swapping, Contiguous memory allocation, Paging, Segmentation
Virtual memory: Concept, Demand paging, Preparing, Page size considerations, Page replacement algorithms, Thrashing
File system management: Concept, file access methods, directory structures, file allocation methods

Unit 3: RTOS, Parallel Computers **(07)**
Real Time & embedded System OS: Concepts, Types, their differences, Handheld Operating Systems. Interrupt Routines in RTOS environment, RTOS Tasks and their Scheduling models, Strategy for synchronization between the processes,
Parallel Computers: Basic concepts, Types of parallelism, Intertask dependencies, classification of parallel computers, vector computers, Array processors, Systolic Arrays
Introduction to Tensor Processing Units

Data Compression, Encryption and decryption

Unit 4: Introduction to Software Engineering (08)

Nature of Software, software process model, Application domains, web applications, mobile applications Preliminaries: Discipline, layers, process, practice and myths

Process models: Generic, Process assessment and improvement, prescriptive models, specialized models

Software Development Life Cycle and its models:

a. Linear Sequential

b. Rapid development

c. Incremental

Component based Software Analysis, Software Design, Software Implementation

Unit 5: Software Testing (06)

Software Testing: fundamentals, white box, black box testing, control structure testing, specific environment testing, comparison testing, orthogonal testing, strategic approach to testing, unit testing, integrated testing, validation testing, system testing

Software debugging: Standard guidelines, debugging techniques use of break points, test macros, output files for sampled inputs, instruction set simulation, laboratory tools

Software maintenance: Preventive, Corrective, Adaptive, Enhancement, System Re engineering

Unit 6: Trends in Software Engineering (06)

CASE, Risk Management, Software Configuration Management Tools like GitHub

Agile Development Process, SCRUM, Cleanroom methodology

Project Management trends such as ERP, SAP, Global Software Development, Test-driven development

Text books:

1. Operating System Concepts by Silberschatz, Galvin, Gagne
2. Parallel Computer architecture and programming by V. Rajaraman, C. SivaRam Murthy, PHI
3. Introduction to Data Compression by Khalid Sayood, Morgan Kaufmann Publishers, Inc.
4. Software Engineering by Ian Somerville, 4th edition, Addison Wesley publication

Reference Books:

1. Computer Architecture and Parallel processing by Kai Hwang, Faye Briggs, McGraw Hill International Editions.

2. Operating Systems: Internals and Design Principles by William Stallings
3. Modern Operating Systems by Andrew S. Tanenbaum
4. Software Engineering: A practitioner's approach by Ian Somerville
5. A Gentle Introduction to Agile and Lean Software Development by Stephen Haunts

20PEIN802C Environmental Instrumentation

Teaching Scheme:
Lectures: 3 Hrs/week

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

Prerequisites: Sensor & Transducer, Analytical Instrumentation

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

Course Outcomes: The student will be able to
1. Identify the Instrumentation related to Environment.
2. Analyse various aspects of disaster management and ecosystem
3. Select various sensors and instruments for measurement of weather parameters.
4. Select various sensors and instruments for measurement of air and water quality parameters

Unit 1: Sensors, Detectors, Analysers for Environmental Instrumentation (08)
Necessity of instrumentation & control for environment, sensor requirement for environment, Instrumentation methodologies: Detectors & Analyzer

Unit 2: ICT- Automatic Weather Station (08)
Instruments in Weather stations like Barometer, Rain gauge, Ceilometer etc. Global environmental analysis, Virtual Instruments in Environmental Engineering Laboratory, Rover Environmental Monitoring Station (REMS).

Unit 3: Water Quality Parameters and Water Treatment (09)
Standards of raw & treated water, sources of water & their natural quality, effects of water quality, Water quality parameters & their application, conductivity analysers & their application, Water treatment

Unit 4: Air Pollution and Sound Monitoring Systems (09)
Definitions, energy environment relationship, importance of air pollution, Air sampling methods & equipment, analytical methods for air pollution studies. Control of air pollution, Instruments used for air pollution control. Sound pollution: basics of sound pollution, its effect to environment. Acoustic noise measurement & monitoring, control methods

Unit 5: Geoinformatics **(08)**

Introduction to Geo-informatics, Role of Geo-informatics in Environmental Monitoring and Control

Text Books:

1. Water treatment technology by Walter J. Weber.
2. Air pollution engineering by M. N. Rao & H. V. N. Rao.
3. Air pollution control technology by Wark & Warner.
4. 'Environmental Engineering' by Peany Howard S, Donal R Rowe and George TachoBanoylous Teddy

Reference Books:

1. Environmental Instrumentation & Analysis Handbook by Randy D. Down.
2. Environmental Instrumentation & Analysis Handbook, by Randy D. Down & Jay H. Lehr, Wiley.
3. Environmental noise pollution by Patrick F. Cunniff, Wiley, May 1977
4. Environmental Engineering and Science by Gilber M Masters, Pearson Education (1997)

20OE801C Digital Control

Teaching Scheme:
Lectures: 3 Hrs/Week

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

Prerequisites: Basics of Control Systems

Course Objectives: To
1. Understand the basic components of a digital control system.
2. Design various Digital Controllers and Study response of those controllers.
3. Learn and understand the stability of the system in the Z plane.
4. Introduce Optimal Control Design and Its need.

Course Outcomes: Students will be able to
1. Analyse system design in various planes S-W-Z and its mapping.
2. Analyse system stability in the S and Z plane.
3. Design and analyse systems using classical methods and State Space.
4. Design Optimal Control for a Discrete System.

Unit 1: Introduction to Discrete Time Control System (08)
Basic building blocks of Discrete Time Control System, Sampling Theorem, Choice of Sampling Rate, Z Transform and Inverse Z Transform for applications of solving Differential Equations, Impulse Sampling, Reconstruction – Zero Order Hold

Unit 2: Pulse Transfer Function and Digital Controllers (08)
Pulse Transfer Function, Pulse Transfer Function of Open Loop and Closed Loop System, Pulse Transfer Function of Digital PID Controller, Design of Deadbeat Controller

Unit 3: Stability Analysis of Discrete Control System (08)
Stability regions in S plane W plane and Z plane, Mapping between three planes, Stability Tests for Discrete Systems

Unit 4: Design of Discrete Control System by State Space Approach (07)
Different Canonical Forms, Relation between Pulse Transfer Function and State Equation, Solution of Discrete Time State Space Equations, Eigen Values, Eigen Vectors

Unit 5: Pole Placement and Observer Design (07)
Concept of Controllability and Observability, Pole Placement Design by State Feedback, Design of Feedback Gain Matrix by Ackerman's Formula, State Observer Types.

Unit 6: Introduction to Optimal Control **(05)**

Basics of Optimal Control, Quadratic Optimal Control, Performance Index.

Text Books:

1. K. Ogata, "Discrete Time Control Systems", Prentice Hall, Second Edition.
2. M. Gopal, "Discrete Control and State Variable Methods", Tata McGraw Hill.
3. Kannan Moudgalya, "Digital Control", John Wiley and Sons.

Reference Books:

1. G. F. Franklin, J. David Powell, Michael Workman, "Digital Control of Dynamic Systems", Addison Wesley, Third Edition.
2. M. Gopal, "Digital Control Engineering", Wiley Eastern LTD.
3. Forsytheand W, Goodall R, "Digital Control".
4. Contantine H. Houpis, Gary B. Lamount, "Digital Control Systems", McGraw Hill International, Second Edition.

20OE801F Instrumentation in Food and Agriculture

Teaching Scheme:
Lectures: 3 Hrs/Week

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

Prerequisites: Basics of sensors and transducers, knowledge of Unit operations and basics of process control, PLC and pneumatic and hydraulic instrumentation

Course Objectives:
1. To know the scope of Instrumentation in agriculture field
2. To know greenhouse, food packaging automation schemes
3. Understand sensors used in agriculture field and weather monitoring stations
4. To get acquainted with food quality standards

Course Outcomes: The student will be able to
1. Identify the different unit operations, process control equipments involved in different types of process industries
2. Select appropriate measurement techniques for measurement of various process parameters related to soil, green house, Dam and agro-metrology
3. Analyse and develop various control loops for processes involved in various food processing plants
4. Assess various automation tools to develop automation strategy to Dam, Green house, food processing and packaging in accordance to various food standards

Unit 1: Process Control in Agriculture and Food Industries (08)
Sensors in Agriculture (Hygrometers, Anemometers, fine wire thermocouple, etc), Sensors in Food (ph, temperature sensor for pasteurization, brix sensor, etc), Flow diagram of some continuous processes like sugar plant, dairy, juice extraction, etc & batch process (Fermentation)

Unit 2: Instrumentation in Irrigation and Green House (09)
SCADA for DAM parameters & control, irrigation canal management systems, Auto drip & sprinkler irrigation systems
Green House Automation: Construction of green houses, Sensors for greenhouse, Control of ventilation, cooling & heating, wind speed, temperature & humidity

Unit 3: Instrumentation in Farm equipments, Food Safety and Sanitation (09)

Instrumentation for farm equipment: Implementation of hydraulic, pneumatic and electronic control circuits in harvesters cotton pickers, tractors, etc; Classification of pumps, pump characteristics, selection and installation.

Food safety standards (Food safety and standards bill 2005, Agmark, Bureau of Indian Standards, Codex Standards, recommended international code of hygiene for various products)

Sanitation regulatory requirements: Sanitation standards operating procedure (SSOP's), Sanitation performance standards (SPS), 11 principles of sanitary facility design, Sanitation best practices.

Unit 4: Automation in Food Packaging (08)

Ware house management, Cold Storage Units, PLC and SCADA in food packaging

Unit 5: Smart Instrumentation in Agriculture and Food Industries (08)

Wireless sensors, Application of IOT in agriculture and food industries, application of Image processing in agriculture and food industries, application of robots in agriculture and food industries, Case studies.

Text Books:

1. D. Patranabis, "Principles of Industrial instrumentation", TMH (2010), ISBN-13: 978-0070699717
2. Michael. A.M, " Irrigation : Theory and Practice" , Vikas Publishing House Pvt Ltd, Second edition (2008), ISBN-13: 978-8125918677
3. Curtis D. Johnson, " Process control and instrumentation technology", , 8th Edition, 2015,Person, ISBN: 9789332549456, 9332549451
4. Akalank Kumar Jain , Vidhi Jain "Food Safety and Standards Act, Rules & Regulations", Akalank Publications; 13th Edition edition (2015), ISBN-13: 978-8176393584

Reference books:

1. Rosana G. Moreira, "Automatic Control for Food Processing Systems (Food Engineering Series)", Springer; 2001 edition (28 February 2001), ISBN-13: 978-0834217812
2. Bela G. Liptak , "Instrument Engineers' Handbook, Process Control and Optimization", CRC Press; 4 edition (29 September 2005), ISBN-13: 978-0849310812.
3. Robert H. Brown, " CRC Handbook of Engineering in Agriculture, Volume II: Volume 1 (C R C SERIES IN AGRICULTURE)", CRC Press; 1 edition (30 June 1988), ISBN-13: 978-084933862

20OE801G Medical IoT

Teaching Scheme:
Lectures: 3 Hrs/week

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

Prerequisites: -

Course Objectives:
1. To understand smart Objects and IoT Architecture
2. To learn sensor Interfacing
3. To learn IoT Protocols
4. To build simple IoT based Health care system

Course Outcomes:
1. Ascent the basic concepts of IOT in healthcare
2. Relate the existing hardware platforms and sensor interfaces for various healthcare-based Applications
3. Comprehend the ways of communication between the client and the server in IOT
4. Build various applications in healthcare using IOT based approach with appropriate case studies.

Unit 1: Medical Measurements (06)
Cardiovascular system, respiratory system, nervous system etc. Measurement of Heart, Brain and Muscle activity using wearable sensors. Monitor health parameters like Blood Pressure, ECG, EMG, EEG, HR, RR, SPO2 etc.

Unit 2: Sensors & Smart Patient Devices (08)
Role of Wearables, Challenges and Opportunities, Future of Wearables, Social Aspects, Wearable Haptics, Intelligent Clothing, Industry Sectors' Overview – Sports, Healthcare, Military, Environment Monitoring, Mining Industry, Public Sector and Safety.

Unit 3: Wearable mechatronics device (08)
Accelerometers, Gyroscopic Sensors; In – Shoe Force and Pressure Measurement its applications. Physical Activity Monitoring: Human Kinetics, Cardiac Activity.
Cuffless Blood Pressure Monitor, Study of Flexible and Wearable Piezo resistive Sensors for Cuffless Blood Pressure Measurement, Wearable Pulse Oximeter, Wearable Sweat Analysis, Wearable Heart Rate Measurement.

Unit 4: Device Connectivity and Security / Biomedical Sensors with Internet connectivity (08)
Gateway, Embedded Systems for devices like RPi, Arduino, etc, Protocols as applied to medical devices.

Sensor interface: Temperature sensor, pressure sensor, optical sensor etc. Wireless body area network. IoT Privacy and Security.

Unit 5: Data Analytics for Medical Applications (06)

Real Time Data Analytics, Continuous IoT Monitoring, Approach to Predict and Diagnosis of Heart and Chest diseases, Alzheimer, Diabetic Retinopathy etc. through data analytics.

Unit 6: IoT in Biomedical Applications - Case Studies (06)

Secured architecture for IoT enabled Personalized Healthcare Systems, Healthcare Application development in mobile and cloud Environments.

Case Study1: Wireless Patient Monitor system; Design an IoT System for Vital Sign Monitors, Weight measuring device, Blood pressure measuring device, ECG, Blood glucose measuring, Heart rates measuring devices and Pulse Oximeters etc.

Case Study2: Wearable Fitness & Activity Monitor; Walking time measuring device ii. Step counting device iii. Speed measuring device iv. Calorie spent measuring device v. Time spent in rest or sleeping measuring device.

Text Books:

1. Joseph D. Bronzino, "Handbook of Biomedical Engineering", 2nd edition –Volume II, CRC press, 2010.
2. Edward Sazonov and Michael R. Neuman, "Wearable Sensors -Fundamentals, Implementation and Applications", Elsevier Inc., 2014.
3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by CRC Press.
4. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press.

Reference Books:

1. Subhas Chandra Mukhopadhyay and Tarikul Islam, "Wearable Sensors - Applications, design and implementation" IOP Publishing Ltd 2017.
2. Shantanu Bhattacharya, A K Agarwal, Nripen Chanda, Ashok Pandey and Ashis Kumar Sen, "Environmental, Chemical and Medical Sensors", Springer Nature Singapore Pte Ltd. 2018.
3. Dieter Uckelmann, Mark Harrison, Florian, "Architecting the Internet of Things", Springer.
4. "The Internet of Things: Key Applications and Protocols", by, Wiley
5. Olivier Hersent, David Boswarthick, Elloumi, Daniel Kellmereit, Daniel Obodovski, "The
6. Silent Intelligence: The Internet of Things", Publisher: Lightning Source Inc; 1st Edition (15 April 2014). ISBN-10: 0989973700, ISBN-13: 978- 0989973700.

20OE802D Building Automation and Energy Audit

Teaching Scheme:
Lectures: 3 Hrs/Week

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

Prerequisites: Basics of Electronics and Instrumentation

Course Objectives:
1. To understand Need and Applications Building automation systems.
2. To understand the working of various Building automation components.
3. To Select and Implement Building automation with various applications.

Course Outcomes: The student will be able to
1. Investigate the system requirements for developing building automation systems.
2. Compare and choose the suitable building automation systems for the applications
3. Design building automation system for required application.
4. Evaluate the performance of the designed building automation system.

Unit 1: Fire Alarm Systems I **(08)**
Introduction: to BAS, Need and Applications of BAS, Block diagram of BAS.FAS: Need and Applications of FAS, Types of FAS, Block diagram of FAS, Fire, Fire Development Stages, Fire Signatures, Initiation Devices, Notification Appliances, IDC Placements, NAC Placements, Fire Suppression: Fire Extinguishers & Its Classification, Fire Suppression Systems.

Unit 2: Fire Alarm Systems II **(08)**
IDC, NAC, SLC, FAS Wiring Standards, FAS Communication Protocols, Voltage Drop Analysis, Battery Capacity Analysis, Cause & Effect Matrix.

Unit 3: Access Control Systems **(06)**
Introduction to Security Systems, Types of Security systems, Access Control Systems: Introduction, Applications, Concept, Generic Model, Components, Card Technologies, Communication Protocols for ACS, Biometrics for ACS, CCTV System Types: CCTV Components, Digital Video Management System

Unit 4: HVAC- Air Systems **(06)**
Human Comfort Parameters and Air Properties Need of HVAC System, HVAC Block Diagram. AHU: Concept, Working, AHU Functions, AHU Components: Dampers, Filters, Cooling coil, Heating coil, etc., AHU Configurations, AHU Locations, AHU Terminal Units: CAV, VAV, Measurement and Control Loops for Air Systems.

Unit 5: HVAC- Water Systems **(07)**

Cold Water System: Refrigeration Cycles, Chillers, Cooling Towers, Types of chilled water system, Concept of Free Cooling : Direct Waterside, Series Waterside, Parallel Waterside. Hot Water Systems: Heating Circuits, Boilers, Types of Boilers, Heat Exchangers: Steam Input and Hot Water Input, Solar Hot Water System, Measurement and Control Loops for Water Systems.

Unit 6: Building Energy Management System **(07)**

Overview of Building Energy Management Systems, BEMS Control systems overview, Benefits of BEMS, Energy System Monitoring, Application of Energy Efficient Strategies, Effective Energy management, Computerized Energy Management Systems.

Text Books:

1. Robert Gagnon, Design of Special Hazards and Fire Alarm Systems.
2. Damjanovski, Vlado, CCTV, Butterworth-Heinemann, 3rd ed.
3. Benantar M., Access Control System
4. Montgomery R, Fundamentals of HVAC Control Systems, Elsevier Publications
5. Roger W. Haines "HVAC Systems Design Handbook", Fifth Edition
6. James E. Brumbaugh "HVAC Fundamentals", volume 1 to 3
7. "Basics of Air Conditioning" ISHRAE, Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0004 for online shopping)

Reference Books:

1. "All About AHU's", ISHRAE. Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0005 for online shopping)
2. "Chillers Basics", ISHRAE. Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0009 for online shopping)
3. "HVAC Handbook Part-1", Indian Society of Heating, Refrigerating & Air Conditioning Engineers
4. "Handbook – Industrial Ventilation Application", 2004, Indian Society of Heating, Refrigerating & Air Conditioning Engineers

20OE802G Industrial Drives and Control

Teaching Scheme:
Lectures: 3 Hrs/Week

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

Prerequisites: -

Course Objectives:
1. To evaluate and select a suitable drive for a particular application.
2. To analyse the basic drive system dynamics
3. To develop the basic design of an electric drive system.

Course Outcomes:
1. Selection of appropriate drive for the given application
2. Selection of suitable control system scheme along with the interlocking for given application
3. Analysis of the control drive dynamics for the desired drive system
4. Design of the total electric drive system based on desired application

Unit 1: Introduction to Industrial Drives (07)
Concept of electric drive, Power modulators, Motors used in drives, types of loads choice of drives, classification of drives Multi quadrant operation of Drives.

Unit 2: Introduction to Control Systems (07)
Open and closed loop systems with examples, automatic control, speed control of motors

Unit 3: Electrical Control of Machines (08)
Manual control – Magnetic control – Semi-automatic and Automatic control of Modern machinery – Development of Control circuits–Two wire and Three wire control – Remote control –

Unit 4: Interlocking of drives (08)
Control circuit components –Symbols for control components–Fuses, Switches and Fuse Switch units.

Unit 5: Dynamics and Control of Electric Drives (06)
D.C. motor drives, Induction motor drives, Synchronous and Brushless D.C. motor drives.

Unit 6: Industrial process and drives **(06)**

Process flow diagram of paper mill, cement mill, sugar mill, steel mill, Hoists and cranes, centrifugal pumps and compressors, solar powered pump drives, selection of drives for the above processes

Text Books:

1. Electrical Motor Drives, R. Krishnan [PHI-2003]
2. Electric Drives, Vedam Subrahmaniam [TMH-1994]
3. Industrial Drives and Control, Sandeep M. Chaudhari, Nilesh R. Ahire [Nirali Prakashan]

Reference Books:

1. Control of Electric Drives,W. Leonard, [Springer- 2001]
2. Electrical Drives, Second Edition, S.A. Nasar, Boldea [CRC Press - 2006]

20OE802I Smart Sensors and Systems

Teaching Scheme:
Lectures: 3 Hrs/Week

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

Prerequisites: -

Course Objectives:

1. Theoretical understanding of various physical phenomena behind the operation of different types of sensors and microsystems
2. Overview of micro/nano fabrication process
3. Develop a complete sensor or sensor system, MEMS device or microsystem

Course Outcomes:

1. Selection of suitable sensor along with the associated electronics and fabrication process for given application
2. Selection of appropriate smart sensors for the desired application in the field of Automobile, Biomedical, Military, Space and Défense.
3. Design of application-based sensors in the field of Military, Défense, Spacecraft and environment
4. Analysis of the system designed for applications in the field of Biomedical and Automobile

Unit 1: Introduction to Smart Sensors and Systems (07)

Principles of Sensing, Classification and Terminology of Sensors. Introduction to micromachining - Fabrication and miniaturization techniques
Digital Signal Controllers (Microcontrollers and Digital Signal Processors) for Smart sensors
Key features, Certain case studies - for eg: temperature, fingerprint recognition

Unit 2: Microfabrication process (08)

Fabrication and miniaturization techniques, Steps involved in fabrication

Unit 3: Smart sensors in Biomedical field (08)

Bio-analytical [sample preparation and detection of compound] sensors & systems, Transduction modes & classifications,
Hall Effect sensors and associated signal conditioning circuits, Sensors for displacement (linear and angular), velocity, acceleration, force, torque, vibration and shock measurements. Sensor measurements for conductivity and viscosity. Electrochemical transducer in Biology

and medicine Biochemical Transducer, Enzyme-based electrochemical biosensors, electronic tongue, few related Case studies

Unit 4: Smart sensors in Automobile industry (07)

Introduction to Modern Automotive Systems and need for electronics in Automobiles, Sensors for vehicle body management, Sensors for automotive vehicle convenience and security systems, Sensors for chassis management, Powertrain sensors, Air Bag and Seat Belt Pre tensioner Systems, Case studies explaining the Modern Trends and Technical Solutions, Related communication systems

Unit 5: Smart sensors related to Environment and in Spacecraft (06)

Human Toxicology Ecotoxicology, Water and air pollution sources

E nose for Sensitive and Selective Chemical Sensing, Chemical sensors, Ocean environment Smart sensors in spacecraft - in monitoring applications, Smart Instrumentation Point Bus (SIP), Solid state micro-gyroscopes, related Case studies

Unit 6: Smart sensors in Military and Defence (06)

Types of sensors (Accelerometers, Inertial Sensors, Pressure Sensors, Force Sensors, Motion Sensors, Gyroscopes, Temperature Sensor and Others), Device-based Sensor, Clothing-based Sensor, Application based sensors - Wrist Wear, Foot Wear, Eye Wear, Body Wear and Neck Wear, intelligent sensor technology for surveillance and electronic intelligence, Case studies, related communication systems

Text Books:

1. Understanding Smart Sensors, Randy Frank [Artech House, Boston London]
2. Smart Sensors for Environmental and Medical Applications, Hamida Halilil, Hadi Heidari [Wiley]
3. Smart Sensors and MEMS: Intelligent Devices and Microsystems for Industrial Applications, S Nihtianov, Antonio Luque [Science Direct]

Reference Books:

1. Smart Sensors and Systems, Lin, Y.-L., Kyung, C.-M., Yasuura, H., Liu, Y. [Springer]
2. Smart Sensor Systems, Gerard Miejer [Wiley]

20IN801L Process Data Analytics Lab

Teaching Scheme:
Practical: 2 Hrs/week

Examination Scheme:
In Semester: 25 Marks
Oral: 25 marks
Credit: 1

Course Outcomes: The student will be able to
1. Apply standard statistical inference procedures to draw conclusions from data analysis.
2. Analysis of data using various statistical methods.
3. Develop programming logic for various machine learning algorithms.
4. Implement various machine learning algorithms to process industries.

List of Practical Assignments:
1. Introduction to linear and multiple regression function in MATLAB
2. Applying linear & multiple regression to process data from a typical process plant
3. Implement ANOVA for a database
4. Data Analysis using K nearest neighbour Regression
5. Introduction to programming in R
6. Linear regression in R
7. Implementation of Neural Networks for standard data set
8. Implementation of Fuzzy logic for classification of standard data set

Or similar type of practical assignments based on the course contents

20PEIN801LA Process Modelling and Optimization Lab

Teaching Scheme:
Practical: 2 Hrs/Week

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

Course Outcomes: The student will be able to
1. Analyze the system model.
2. Identify mathematical models of processes.
3. Analyze the system performance.
4. Apply the optimization techniques and analyze the results.

List of Practical Assignments:
Students are expected to perform Minimum 8 Experiments
1. Analysis of first/second order systems by using step and ramp input.
2. Simulation of mathematical modeling of electrical/ mechanical systems by first principle.
3. Simulation of mathematical modeling of liquid level systems.
4. Study of distillation columns.
5. Study of Heat Exchanger.
6. Identification of second order process by prediction error method and compare it with modeling by first principle.
7. Obtaining unknown parameters of second order process by least square technique.
8. Obtaining Relative gain array of any MIMO physical system.
9. Obtaining inverse Nyquist array of any Physical system.
10. Design of optimal control system by using quadratic approximation.
11. Analysis and comparisons of Quasi Newton and secant methods.
12. Finding optimal solution using Simplex Method system

Or similar type of practical assignments based on the course contents

20PEIN801LB Artificial Intelligence and Machine Learning Lab

Teaching Scheme:
Practical: 2 Hrs/Week

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

Course Outcomes: The students will be able to
1. Formalize a given problem in the different AI methods.
2. Implement basic AI algorithms.
3. Evaluate decision tree learning algorithms.
4. Analyse research-based problems using Machine Learning Techniques.

List of Practical Assignments:
Any Software/Programming Language: PROLOG/Matlab/Python etc
1. Write a program to implement simple Chat-bot.
2. Implement Tic-Tac-Toe using A* algorithm.
3. Implement alpha-beta pruning graphically with proper example and justify the pruning.
4. Write a python program to implement Water Jug Problem.
5. Use Heuristic Search Techniques to Implement Best first search (Best-Solution but not always optimal) and A* algorithm (Always gives optimal solution).
6. Use Heuristic Search Techniques to Implement Hill-Climbing Algorithm.
7. Write a program to implement Hangman game.
8. Write a program to solve the Monkey Banana problem.
9. Write a program to implement Simple Calculator program.
10. Write a program to POS (Parts of Speech) tagging for the given sentence using NLTK
11. Solve 8-puzzle problem using best first search.
12. Solve Robot (traversal) problem using means End Analysis.
13. Implementation of Image features Processing
14. Write a program to implement Naïve Bayes Algorithm
15. Implement Support Vector Machine algorithms on a dataset.
16. Implement Genetic algorithm algorithms on a dataset.
17. Implement K-means algorithms on a dataset.
18. Implement PCA algorithms on a dataset.

Or similar type of practical assignments based on the course contents

20PEIN801LC Medical Device Technology Lab

Teaching Scheme:
Practical: 2 Hrs/Week

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

Course Outcomes: The students will be able to
1. Identify various biomedical Instruments Involved in diagnosis, treatment and surgery.
2. Identify various controls of Instruments.
3. Record the response of the sensory organ.
4. Analyze and interpret the recorded data.

List of Practical Assignments:
1. Record and Monitor parameters using BSM.
2. Implementation of various modes using electrosurgical machine.
3. Design ECG telemetry system.
4. Recording and analysis of audiogram for different subjects using audiometer.
5. Design a signal conditioning to monitor and to remove the leakage current.
6. Develop an algorithm for Text to Voice Conversion in MATLAB/Suitable Language.
7. Develop an algorithm for Voice to Text Conversion in MATLAB/Suitable Language.
8. Design/Develop Ultrasonic Cane for Navigational Aid.
9. Pressure Measurement using In Shoe Pressure Sensor.
10. Fall Detection using Accelerometer and Flex Sensor
11. Hospital visit Report

Autonomous Program Structure of

Third and Final Year B. Tech.
Academic Year: 2022-2023 Onwards

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Total Marks	Credit
		Lecture	Tutorial	Practical	In Sem	End Sem	Oral	Practical		
20OEHS 501	Open HS Elective –I	3	0	0	50	50	0	0	100	3
20OE 601	Open Elective-II	3	0	0	50	50	0	0	100	3
20OE 801	Open Elective-III	3	0	0	50	50	0	0	100	3
20OE 802	Open Elective-IV*	3	0	0	50	50	0	0	100	3

* **Inter-disciplinary Course**

20OEHS 501 Open Elective I (Humanities)

Sr. No.	Course Code	Course Title
1	20OEHS501A	Entrepreneurship Development
2	20OEHS501B	Intellectual Property Rights
3	20OEHS501C	Introduction to Digital Marketing
4	20OEHS501D	Law for Engineers
5	20OEHS501E	Organizational Behaviour
6	20OEHS501F	Project Management

20OE601 Open Elective-II

20OE601 Open Elective-II			**Eligible Departments**				
Sr. No.	**Course Code**	**Course Title**	**EnTC**	**Comp**	**IT**	**Mech**	**Instru**
1	20OE601A	Automation and Control Engineering	Y	Y	Y	Y	Y
2	20OE601B	Automotive Electronics	Y	Y	Y	Y	Y
3	20OE601C	Avionics	Y	Y	Y	Y	Y
4	20OE601D	Bioinformatics	Y	Y	Y	N	Y
5	20OE601E	Computer Vision	Y	Y	Y	Y	Y
6	20OE601F	Design Thinking	Y	Y	Y	Y	Y
7	20OE601G	e-Business	Y	Y	Y	Y	Y
8	20OE601H	Electric Vehicles	Y	Y	Y	Y	Y
9	20OE601I	Gamification	Y	Y	Y	Y	Y
10	20OE601J	Geographical Information Systems	Y	Y	Y	Y	Y
11	20OE601K	Multimedia Systems	Y	Y	Y	N	Y

20OE801 Open Elective-III

20OE801 Open Elective-III			**Eligible Departments**				
Sr. No.	**Course Code**	**Course Title**	**EnTC**	**Comp**	**IT**	**Mech**	**Instru**
1	20OE801A	Big Data and Analytics	Y	Y	Y	Y	Y
2	20OE801B	Cyber Physical Systems	Y	Y	Y	N	Y
3	20OE801C	Digital Control	Y	N	N	Y	Y
4	20OE801D	Industrial Engineering and Management	Y	Y	Y	Y	Y
5	20OE801E	Introduction to Cyber-crime and Forensics	Y	Y	Y	Y	Y
6	20OE801F	Instrumentation in Food and Agriculture	Y	Y	Y	Y	Y
7	20OE801G	Medical IoT	Y	Y	Y	N	Y
8	20OE801H	Quantum Computing	Y	Y	Y	N	Y
9	20OE801I	Renewable Energy Sources	Y	Y	Y	Y	Y
10	20OE801J	Soft Computing	Y	Y	Y	Y	Y
11	20OE801K	Software Testing and Quality Assurance	Y	Y	Y	Y	Y

20OE802 Open Elective-IV

20OE802 Open Elective-IV			**Eligible Departments**				
Sr. No.	**Course Code**	**Course Title**	**EnTC**	**Comp**	**IT**	**Mech**	**Instru**
1	20OE802A	Applied statistics with R Programming	Y	N	N	Y	Y
2	20OE802B	Automobile Engineering	Y	Y	Y	N	Y
3	20OE802C	Autonomous Robots	N	Y	Y	Y	N
4	20OE802D	Building Automation and Energy Audit	Y	Y	Y	Y	N
5	20OE802E	Data Analysis and Visualization	Y	N	N	Y	Y
6	20OE802F	Data Science using Python	Y	N	N	Y	Y
7	20OE802G	Industrial Drives and Control	Y	Y	Y	Y	N
8	20OE802H	Smart Sensors and Structures	Y	Y	Y	Y	N
9	20OE802I	Wireless Networks	N	Y	Y	N	Y

20OEHS501A ENTREPRENEURSHIP DEVELOPMENT

Teaching Scheme
Lectures: 3 Hours / Week

Examination scheme:
ISE: 50 Marks
ESE: 50 Marks
Credits: 3

Prerequisite: NA

Course Objectives:

1. Understand the fit between individual entrepreneurial ambitions
2. Select a problem worth solving
3. Identify customers
4. Develop a solution for your customers' problems and problem solution
5. Build and demonstrate an MVP (Minimum Viable product)
6. Structure a business model around the problem, customer, and solution and present Business Model Canvas

Course Outcomes:

After completion of the course, students will be able to

CO1	Describe what it takes to be an entrepreneur
CO2	Analyze business opportunities and the basics to create, launch and manage new businesses
CO3	Develop Business Model for their Idea/Problem
CO4	Create MVP (Minimum Viable Product)

Module 1: Introduction (03)

Discover yourself, Principles of Effectuation, Identify your entrepreneurial style

Module 2: Problem Identification and Idea generation (04)

Identify Problems worth Solving, Introduction to Design Thinking, Generate ideas that are potential solutions to the problem identified

Module 3: Customer Segmentation (07)

Customer identification, Market, Creative solution, Unique Value proposition

Module 4: Business Model Canvas (04)

Types of business models, Business Plan documentation, Risk identification

Module 5: Validation (09)
Identification of MVP, Solution development, Building products/services, Build-measure-learn loop for development, Market fit of solution

Module 6: Money (05)
Revenue streams, Pricing and cost, Venture financing, Investor expectations

Module 7: Team building (03)
Shared leadership, role of good team, Collaboration tools and techniques

Module 8: Marketing and sales (03)
Positioning, Channels and strategies, Sales planning

Module 9: Support (04)
Project management, Planning and tracking, Business Regulation

Text Books:

1. Course contents available at: https://staging.learnwise.org/ - Through a Cloud Technology Platform – WF Learn Wise Platform
2. PDF documents can be downloaded from the website for the distribution to students.

Sample References:

1. Effectuation: https://necrophone.com/2014/01/20/effectuation-the-best-theory-ofentrepreneurship-you-actually-follow-whethe
2. Value Proposition: https://www.youtube.com/watch?v=jZN6CUieuOQ&list=PLw540Wq5kay866m6A6xI7KOwE_Ah7is4m
3. The Lean BMC: https://www.youtube.com/watch?v=FjB_e7UO1hc
4. Define your MVP: https://startups.fb.com/en-in/categories/development/
5. Designing Experiments: https://www.youtube.com/watch?v=WiMZWCg1Hu8&t=111s
6. Beating the Competition: https://www.youtube.com/watch?v=46uP6vOj5G
7. Google : Think branding: https://www.youtube.com/watch?v=1l2CUjkg0ug

20OEHS501B Intellectual Property Rights

Teaching Scheme
Lectures: 3 Hours / Week

Examination scheme:
ISE: 50 Marks
ESE: 50 Marks
Credits: 3

Prerequisite: No pre-requisite

Course Objectives:
To facilitate learners
to,

1 Overview of Intellectual Properties (IP) regime in India and International arrangements
2 Introduce the types of IP as Patents, Copyrights, Trade Secrets etc.
3 Understand the process and steps involved in filing Intellectual Properties
4 Understand intricacies involved in drafting patent applications

Course Outcomes:
After completion of the course, students will be able to

CO 1 Demonstrate the concepts of Intellectual Property Rights, patents and other forms of IP
CO2 Apply appropriate type of IP for the Intellectual property
CO3 Analyze the patentability of inventive step by searching patents
CO4 Construct patent drafts for given Patent specification
CO5 Understand the advances in patent law, in national and international scenario

Unit 1: Introduction (06)

Intellectual Property (IP) Vs. Physical property, History of IP in India, Importance of IP, Patentable inventions / art, types of IPR-Patents, Copyright, Industrial Design, Trade Marks etc., Basic principles of IPR, Economic Importance of Intellectual Property Rights, IPR-ownership, morality, public order, traditional knowledge

Unit II: Patents (08)

Introduction to Patents, Patentable Inventions as per the Indian Patent Act, Patent searching, types of Patent applications, Procedure for filing application (National and International), Patents offices, Register of Patents, Rights and obligations of patentee, Term of patent, Patent of Addition

Unit III: Drafting of patent applications (08)

Fundamentals of drafting, structure of the patent specification-Field of invention, prior art, patent classifiations, technical advance, Invention Disclosure Form, problem solution statement, claims, preamble, body, summary

Unit IV: Transfer and Infringement of Patent Rights (06)

Working of patents, compulsory licensing, Revocation of patents, Transfer of Patent Rights- Assignment, License; Concept of infringement, Infringement of Patents Rights, Infringement of Patents rights

Unit V: Introduction to other types of IPs (08)

Copyright, Trade Marks, Geographical Indications, Industrial Designs, Trade Secrets, Layout designs of Integrated Circuits : Introduction, Work protected by, ownership and infringement, Application process

Unit VI : Advances in IPR (06)

International Patenting, Patent Co-operation Treaty (PCT), Commercialization of Patents, Advances in IPR

Text Books:

1 Niraja Pandey, Khushdeep Dharni, "Intellectual Property Rights", PHI
2 N. S. Rathore, "Intellectual Propoerty Rights: Drafting,Interpretation of Patents Specification and Claims" , New India Publishing Agency

Reference Books:

1 Venkataraman M., "An introduction to Intellectual property Rights", Venkataraman M.
2 Mishra, "An introduction to Intellectual property Rights", Central Law Publications
3 R Anita, V. Bhanoji Rao, "Intellectual property Rights, - A Primer", Eastern book Company
4 R Puri, "Practical approach to intellectual propert Rights"
5 P Ganguly, "IPR unlisting the knowlege economy"

Online Resources:

1 NPTEL course material on "Patent Drafting for Biginners" - https://onlinecourses.nptel.ac.in/noc18_hs17/preview
2 IP India : www.ipindia.nic.in/
3 WIPO, World Intellectual property Organization - www.wipo.int/
4 Intellectual Property (IP) Policy | USPTO - https://www.uspto.gov/intellectualproperty-ip-policy

20OEHS501C Introduction to Digital Marketing

Teaching Scheme
Lectures: 3

Examination scheme:
In Semester: 50 marks
End Semester: 50 marks
Credits: 3

Prerequisite:

Course Objectives:

1 Interpret Digital marketing campaign strategy
2 Explain social media and its role in marketing strategy through various channels which it operates
3 Explore search engine optimization
4 Explain concepts related to mobile marketing

Course Outcomes:
After successfully completing the course students will be able to
1 Explore methods to illustrate website and webhosting concepts
2 Develop a marketing plan for product or service by integrating social media platforms to generate leads
3 Examine mobile marketing strategies to connect with customers
4 Demonstrate importance of organic ranking through SEO

Unit I: Overview of Digital Marketing (08)
Introduction to Digital Marketing,Understand customer needs, Benefits of Digital marketing, Digital marketing platforms and Strategies, Comparing Digital with Traditional Marketing,Latest Digital marketing trends, What is Domain Name, Types of Domain, Web Hosting Concepts, Domain/Hosting Business,introduction to wordpress

Unit II: Digital Advertising with Google AdWords (08)
Introduction to Paid Marketing, Google Account setup, Account Structure, Campaigns settings, AdGroup setup, Keyword Match Types, Keyword Research Tools, Understanding Ad Auction, What is Quality Score, My Client Centre, Google AdWords Editor Tool,
Interface Tour and BillingSettings

Unit III: Social Media Marketing (08)
Introduction to Social Media, Integrating Social Media with Other Disciplines, Facebook Marketing, Facebook account setup, Personal account properties, Facebook marketing strategy, Facebook business page setup, Types of Business pages, Cover photo designing, Page management options, twitter and Instagram marketing

Unit IV: Mobile Marketing (06)

Introduction to Mobile Marketing and m-commerce, create mobile app,case study:market potential of mobile commerce.

Unit V: Search Engine Optimization (06)

Introduction to Search Engines, On-Page Optimization, Off-Site Optimization, Social media monitoring Tool

Unit VI : Case study and Future Trends in Digital marketing (06)

Digital marketing Scenario in india and world, Digital Strategies Influence r marketing, AI in Digital Marketing

Text Books:

1 Seema Gupta, **"Digital Marketing**", *McGraw-Hill Publication*, (1st Edition), (2018).
2 Benjamin Mangold, **"Google Adwords and Google Analytics"**, *loves data* , (1st Edition), (2018).
3 Richard stokes, **"Pay per click",** *Entrepreneur Press*,(2nd Edition), (2014).
4 Suraj Bandyopadhyay **"Models for Social Networks with Statistical Applications"**, *Sage Publications*, (1st Edition), (2011).

Reference Books:

1 Ian Dodson, "**The Art of Digital Marketing",** *Wiley,* (1st Edition), (2016).
2 Sira. R Bowden , "**Beginners Guide Digital Marketing Part 2:** *Mobile Marketing", BookRix,* (1st Edition), (2016).

Online Resources:

NPTEL:Marketing Management: *https://nptel.ac.in/courses/110/104/110104070/*

websites:

1 https://www.searchenginejournal.com/seo-guide/panda-penguin-hummingbird/
2 https://www.lynda.com/Analytics-tutorials/Online-Marketing-Fundamentals/188429-2.html

20HS501D - LAW FOR ENGINEERS

Teaching Scheme
Lectures: 3 Hours / Week

Examination scheme:
ISE: 50 Marks
ESE: 50 Marks
Credits: 3

Course Objectives:

1 To acquaint the students with legacies of constitutional development in India and help them to understand the most diversified legal document of India and philosophy behind it
2 To make students aware of the theoretical and functional aspects of the Indian Parliamentary System
3 To channelize students' thinking towards basic understanding of the legal concepts and its implications for engineers
4 To acquaint students with latest intellectual property rights and innovation environment with related regulatory framework
5 To make students learn about role of engineering in business organizations and e- governance

Course Outcomes:
After completion of the course, students will be able to

CO 1 Identify and explore the basic features and modalities about Indian constitution
CO2 Differentiate and relate the functioning of Indian parliamentary system at the center and state level
CO3 Differentiate different aspects of Indian Legal System and its related bodies
CO4 Correlate and apply different laws and regulations related to engineering practices
CO5 Correlate role of engineers with different organizations and governance models

Unit 1: Legal Structure and Constitutional Law (06)

Legal Structure **:** Court System in India (District court, District Consumer court, Tribunals, High courts, Supreme Court), Arbitration, Constitutional Law: The Preamble, Fundamental Rights, Fundamental Duties, Emergency provisions: Kinds, Legal requirements and Legal effects.

Unit II: RTI and Contract Law (06)

Right to Information Act, 2005: Evolution and concept, Practice and procedures, Contract Law : General Principles of Contract under Indian Contract Act, Kinds of government contracts and dispute settlement, Standard form contracts : Nature, Advantages, Unilateral character, Principles of protection against possibility of exploitation, Clash between two standard forms contract.

Unit III: Sale of Goods Law and Consumer Protection Act (06)

Sale of Goods Law **:** Goods- movable property, Warranty, Guarantee, Consumer Protection Act **:** Consumer Rights and Legislative framework on Consumer protection.

Unit IV: Environment Law and Labour Laws (08)

Environment Law**:** Laws relating to industrial pollution, environmental protection, Labour Laws**:** Industrial Disputes Act, Collective bargaining; Industrial Employment, Health and safety at work, Accidents, PoSH Act 2013 **:** Laws relating to Equality and Empowerment of Women, The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013

Unit V: Patent and Cyber Law (08)

Law relating to Patents : Patents Act, 1970, Law relating to Intellectual property, Law relating to Copyright, Law relating to Trademarks, Cyber law Act 2000 : The Information Technology Act, 2000 (also known as ITA-2000, or the IT Act) - dealing with cybercrime and electronic commerce.

Unit VI : Corporate Law and Land Law (08)

Corporate Law**:** Meaning of corporation; Law relating to companies, public and private (Companies Act, 1956) general provisions, Corporate liability, civil and criminal, Code of Business Conduct (COBC) provides the ethical guidelines and expectations for conducting business, Land Law: Transfer of Property Act, Land disputes.

Text Books:

1 D.D. Basu, "**Shorter Constitution of India"**, Prentice Hall of India, December 2017
2 S.K. Awasthi & R.P. Kataria, "**Law relating to Protection of Human Rights"**, Orient Publishing, 2000
3 Wadhera , "**Intellectual Property Rights"**, Universal Law Publishing Co, 5th edition
4 O.P. Malhotra, "**Law of Industrial Disputes"**, N.M. Tripathi Publishers, 1968

Reference Books:

1 M.P. Jain, "**Indian Constitutional Law"**, Wadhwa & Co., 2018
2 S.K. Kapur, "**Human Rights under International Law and Indian Law"**, Central Law Agency, 7th edition
3 Avtarsingh, "**Law of Contract"**, Eastern Book Co, 2020
4 T. Ramappa, "**Intellectual Property Rights Law in India"**, Asia Law House, 2016

Online Resources:

1 **Companies Act, 2013 Key highlights and analysis by PWC.**
https://www.pwc.in/assets/pdfs/publications/2013/companies-act-2013-key-highlightsandanalysis.pdf

20OEHS501E ORGANIZATIONAL BEHAVIOR

Teaching Scheme
Lectures: 3 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Course Objectives:
To facilitate the learner to
1 Develop familiarity with the concepts related to organizational behavior.
2 Gain knowledge about personality traits and individual behavior.
3 Study group dynamics.
4 Get exposure to the recent trends in Organizational behavior.

Course Outcomes:
After completion of the course, students will be able to
1 Explain concepts of organizational behavior, its importance and culture.
2 Outline meaning of personality and how individual behavior impact organization.
3 Relate with ideas of group dynamics and influence of groups in work place.
4 Recall latest trends in Organizational behavior.

Unit 1: Introduction (07)
Management and Organizational Behavior (OB), Organizational behavior in historical perspective, Developing an OB model, Challenges and Opportunities for OB, Foundation of individual behavior.

Unit II: Individual (08)
Personality, personality frameworks, big five model, perception, individual decision making, attitudes, components of attitudes, attitudes and behavior, Job attitudes, values

Unit III: Diversity and Ethics (06)
Environmental context : diversity and ethics, Communication, Case studies

Unit IV: Trends (07)
International organizational behavior, emotional intelligence, strategic organizational behavior, Intra-preneurship, flat organization,Gig economy

Unit V: Group Dynamics (08)
Foundation of group behavior, stages of group development, group decision making, team building, organizational conflicts and negotiation, power and politics,employee engagement

Unit VI : Dynamic Environment and Culture (06)

Information technology and globalization, Human resource policies and practices, OKR (Objective and Key results)framework, Learning

Text Books:

1 Stephen P. Robbins, Timothi A.Judge, **'Organisational Behavior'**, 18th Global Edition, Pearson Education(2017),ISBN: 978-0-13-410398-3
2 Dr. S. S. Khanka, **'Organisational Behaviour (Text and Cases)',** S.Chand & Company Pvt.Ltd. (2018), ISBN 978-81-219-2014-8
3 Fred Luthans, **'Organizational Behavior '**, 12th Edition, McGraw Hill Publication (2017), ISBN-978-1-25-909743-0

Reference Books:

1 Moorhead, Griffin, 'Introduction to Organizational Behavior', India Edition (2010), Cengage Learning, ISBN: 978-81-315-1242-5
2 P. Subba Rao, 'Organisational Behaviour (Text , Cases and Games)' Himalaya Publishing House (2017), ISBN 978-93-5024-673-3
3 K. Aswathappa, 'Organisational Behavior : Text, Cases & Games', 12th Revised Edition,Himalaya Publishing House(2017), ISBN 978-93-5051-588-4

Online Resources:

1 NPTEL on "Organizational Behavior": https://nptel.ac.in/downloads/110105034/#

20OEHS501F PROJECT MANAGEMENT

Teaching Scheme
Lectures**:** 3 Hours / Week
Tutorial : 1 Hour/ Week

Examination scheme:
ISE**:** 50 Marks
ESE**:** 50 Marks
Credits: 3

Course Objectives:

1 To introduce concepts of Project management
2 To discuss life cycle of real life projects and activities involved in projects
3 To understand risks involved in a project

Course Outcomes:
After completion of the course, students will be able to

CO 1	Identify scope of a project and lifecycle of a project
CO2	Develop a plan for a project
CO3	Determine schedule of a project
CO4	Assess risks involved in a project
CO5	Estimate budget of a project
CO6	Adapt project management tools and techniques

Unit 1: Introduction (07)
Definition of project, Objectives of Project Management, Classification of projects, Life cycle phases of the project. Project management and Project manager, Role and responsibilities of the project manager, Stakeholder Identification, team building

Unit II: Project Planning (07)
Project Planning: Introduction and basic requirements, establishing project objectives, Statement of work (SOW), project specifications, Work Breakdown structure (WBS).

Unit III: Project Scheduling (07)
Project scheduling: Introduction and basic requirements, milestone scheduling, Network Scheduling techniques: PERT(Program Evaluation Review Technique), CPM(Critical Path Method), GANNT chart, Schedule control

Unit IV: Risk Assessment and Management: (07)
Risk Management Planning, Risk identification, Qualitative Risk analysis, Quantitative Risk analysis, Risk response planning, Risk monitoring and controlling

Unit V: Project Cost Estimation (07)

Resource Planning, Cost Estimating, Cost Budgeting, Budget control, Earned Value Analysis, Project Audits, Project closure

Unit VI : Tools and Techniques for Project Management (07)

Project Management tools, International Project Management, Collaborative development, Planning Quality Management, Quality metrics, Techniques for Quality Control (statistical control, six sigma, ISO)

Text Books:

1 1. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), PMI.
2 PROJECT MANAGEMENT A Managerial Approach, Jack R. Meredith, John Wiley & Sons

Reference Books:

1 Morris, P. W. G., Pinto, J. K., The Wiley Guide to Managing Projects, 2004, John Wiley & Sons
2 Phillips, J.PMP Project Management Professional Study Guide, McGraw-Hill, 2003.

Online Resources:

1 http://www.pmi.org
2 https://www.ipma.world

20OEHS601A Automation and Control Engineering [ACE – OE-II]

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
ISE**:** 50 Marks
ESE**:** 50 Marks
Credits: 3

Pre-requisite: Engineering Mechanics, Fluid Mechanics, Basic Mathematics

Course Objectives:

Course prepares students to

1 To familiarize with the basic concepts of Industrial Automation
2 To acquaint with the concept of low cost automation with Hydraulic and Pneumatic systems.
3 To acquaint with the basic concepts of the Industrial Fluid Power and Factory Automation.
4 To familiarize with the working of different types of controllers and control actions.

Course Outcomes:

Students will be able to

1 Identify the elements of automation systems, levels of automation and types of automation.
2 Describe assembly line automation, Transfer system, and its components.
3 Analyze different hydraulics and pneumatics circuits for Industrial applications.
4 Study of control system and its types.
5 Develop the basic ladder logic using PLC for different industrial applications.

Unit/Module: 1 Introduction to Automation 4 hours CO: 1

Definition, Automation in Production system, Need of automation, Societal issues of automation, Automation strategies, levels of automation, types of automation, Architecture of an Industrial automation system.

Unit/Module: 2 Hydraulics and Pneumatics devices 6 hours CO: 2

Different types of Hydraulics and Pneumatics devices,

DCV: All possible configuration and valve designation for Single acting and double acting actuators

FCV, PCV, Actuator and auxiliary elements in hydraulic and pneumatic system, Industrial applications and Case studies.

Unit/Module: 3 Hydraulic Systems 8 hours CO: 3

ISO symbols for Hydraulics, Basics of Hydraulic system, Hydraulic Power Pack, Actuators, Circuits using Sequencing and cascading method, Design of Electro-Hydraulic circuits, Case studies and Industrial Applications. Digital and Servo hydraulic control circuits.

Unit/Module: 4 Pneumatic Systems 6 hours CO: 4

ISO symbols for Pneumatics, Basic circuits using linear and rotary pneumatic actuators, Circuits using Cascade method and shift register method, Design of Electro-pneumatic circuits using solenoids to operate single acting and double acting actuators.

Unit/Module: 5 Assembly line Automation and control 6 hours CO: 5

Automated Material handling systems, automated inspection, transfer lines, part placing and part escapement, AGV's and conveyors

Control System: Open loop, Close Loop, Mathematical Modelling of basic systems :Hydraulic, Pneumatic, Thermal and Fluid systems, Case Studies

Unit/Module: 6 Controllers 6 hours CO: 6

Programmable Logic Controller: Basics of PLC, PLC operating cycle, Architecture of PLC, PLC Ladder Programming, Logic Gates, Timers, Counters, Concept of Latching and Interlocking, Selection of PLC for different industrial applications.

Control Actions: On-Off controller, Proportional controller (P),Integral Controller(I) ,Derivative Controller(D),Compound Controller actions: PI,PD,PID

Total Lecture hours: 36 hours

Text Books:

1 Anthony Esposito, "Fluid Power with Applications",7th Edition, 2008,PHI Publication.
2 M.P.Groover, "Automation, Production System and Computer Aided Manufacturing",3rd Edition,PHI Publication,New Delhi.
3 M.P.Groover, "Industrial Robotics: Technology, Programming and Applications
4 Ogata, "Modern Control Engineering"
5 Nagrath and Gopal "Mathematical Modelling, Simulation and Analysis", MGH Pub
6 Gary Dunning, "Introduction to Programmable Logic controller", Thomas Learning, edition, 2001.
7 Handbook of design, manufacturing and Automation: R.C. Dorf, John Wiley and Sons.

Reference Books:

1 C D Johnson, "Process Control Instrumentation Technology", Prentice Hall of India, New Delhi. ISBN: 8120309871
2 Vickers "Industrial Hydraulics" Manual, 3rd Edition, Vickers Inc.

20OE601B AUTOMOTIVE ELECTRONICS

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisite: 20ES01: Basic Electrical and Electronics Engineering

Course Objectives:

1 To explain the operation of basic automotive System components
2 To discuss sensors and actuators in automotive applications
3 To describe the system view of automotive control systems and In-vehicle Communication Protocols
4 To introduce diagnostic methodologies and safety aspects in automotive system

Course Outcomes:

After completion of the course, students will be able to

CO 1 Explain the functioning of automotive systems
CO2 Identify key components of automotive control systems and represent in terms of block diagram
CO3 Develop a model for simple systems using model based development.
CO4 Compare communication protocols, safety systems and diagnostic systems Estimate

Unit 1: Fundamentals of Automotive Systems (10)

Overview of an Automotive System, Basics of Spark Ignition, Compression Ignition Engines, Need of Electronics in Automobiles, Ignition systems, Transmission systems, Suspension system, Braking system, Steering system, Fuel Delivery system, Alternator and battery charging circuit, Basics of Hybrid Electric Vehicles.

Unit II: Automotive Sensors, Actuators, Control Systems (08)

Systems approach to Control and Instrumentation: Concept of a system, Analog and Digital system, Basic Measurement system, Types of Control Systems, Sensor Characteristics, In-vehicle Sensors: Air flow sensing, Crankshaft Angular Position sensing, Throttle angle sensing, Temperature sensing, EGO sensor, Vibration sensing (in Air Bags), Actuators: Fuel injector, EGR actuator, Ignition system, Variable Valve Timing (VVT), BLDC motor, Electronic Engine Control, Engine Management System strategies for improving engine performance and efficiency.

Unit III: Microcontrollers / Microprocessors in Automotive Domain, Model Based Development (09)

Critical review of Microcontroller / Microprocessor (Architecture of 8-bit /16-bit Microcontrollers with emphasis on Ports, Timers/Counters, Interrupts, Watchdog Timer and PWM), Criteria to choose the appropriate microcontroller for automotive applications, Automotive grade processors, Fuel Maps and Ignition Maps, Introduction to Model Based Development.

Unit IV: Automotive Communication Protocols (07)

Overview of Automotive Communication Protocols, CAN, LIN, FLEXRAY, MOST, Communication Interface with ECUs, Interfacing with infotainment gadgets, Application of telematics in automotive domain: GPS and GPRS, Relevance of Protocols such as TCP/IP, Bluetooth, IEEE 802.11x standard, in automotive applications.

Unit V: Safety Systems in Automobiles, Diagnostics, Standards (08)

Active Safety Systems: Anti-lock Braking System (ABS), Traction Control System, Electronic Stability Program, Passive Safety systems: Airbag System, Advanced Driver Assistance System (ADAS), Anti-theft systems, Fundamentals of Diagnostics, Self Diagnostic System, On-Board Diagnostics and Off-Board Diagnostics, Importance of Reliability in Automotive Electronics, Reliability Testing with example, Environmental and EMC Testing for Automotive Electronic Components, ISO, IEC and SAE Standards.

Text Books:

1 Williams B. Ribbens**, "Understanding Automotive Electronics**", *Newnes*, (7th Edition), (2003).
2 Robert Bosch**, "Automotive Electronics Handbook"**, *John Wiley and Sons*, (1st Edition), (2004).

Reference Books:

1 Ronald K Jurgen, **"Automotive Electronics Handbook",** *McGraw-Hill*, (2nd Edition), (1999).
2 James D Halderman, **"Automotive Electricity and Electronics",** *PHI Publication* , (1st Edition), (2005).
3 Tom Denton, **"Automobile Electrical & Electronic Systems",** *Routledge*, (4th Edition), (2002).
4 Tom Denton**, "Advanced Automotive Diagnosis",** *Elsevier*,(2"d Edition), (2006).
5 V.A.W. Hillier, **"Fundamentals Automotive Electronics",** *Oxford University Press*, (6th Edition), (2014).
6 Mehrdad Ehsani, Ali Emadi, Yimin Gao, **"Modern Electronic, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory and Design"**, *CRC Press*, (2nd Edition), (2009).
7 Terence Rybak, Mark Steffka, **"Automotive Electromagnetic Compatibility (EMC)"**, *Springer*, (2004).

Online Resources:

1 **NPTEL Course "Fundamentals of Automotive Systems"** https://onlinecourses.nptel.ac.in › noc20_de06 › preview

20OE601C Avionics

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisites: Basics of Control Systems, Basics of Communication System

Course Objectives:
1 To integrate the digital electronics with cockpit equipment
2 To understand the various principles in flight desk and cockpit panels.
3 To understand the communication techniques used in aircraft.
4 To explain the modern era of flight control system

Course Outcomes: The student will be able to
1 Identify the mechanical and electronic hardware required for aircraft.
2 Compare the communication and navigation techniques used in aircrafts.
3 Disseminate the autopilot and cockpit display related concepts.
4 Compare and identify different actuators in avionics.

Unit 1: Introduction to Avionics (08)
Basics of Avionics-Basics of aircraft- glider – control surfaces- Cockpits instrumentation -Need for Avionics - Integrated Avionics Architecture.

Unit 2: Digital Avionics Bus Architecture (07)
Avionics Bus architecture–Data buses MIL–RS 232- RS422-RS 485-STD 1553- ARINC 429–ARINC 629- Aircraft system Interface- Network topologies.

Unit 3: Flight Deck and Cockpit (07)
Control and display technologies CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil cockpit and military cockpit: MFDS, PFDS-HUD, HMD, HMI

Unit 4: Avionics Systems (06)
Communication Systems – Navigation systems – Flight control systems – Radar electronic Warfare – Utility systems Reliability and maintainability Fundamentals- Certification-Military and civil aircrafts.

Unit 5: On Board Navigation Systems (07)
Overview of navigational aids, Flight planning, Area navigation, required time of arrival, RNAV architecture , performance aspects, approach and landing challenges, regulatory and safety aspects, black box instrumentation INS, GPS and GNSS characteristics.

Unit 6: Basics of Final Control Element (06)

Basics of pneumatic, hydraulic and electric actuators, Function of DC Servo motor, AC Servo motor function of pneumatic, hydraulic actuators.

Text Books:

1 R.P.G. Collinson, "Introduction to Avionics", Chapman & Hall Publications, 1996.

2 N. S. Nagaraja(1996),Elements of electronic navigation, 2 edition, Tata McGraw Hill, New Delhi.

Reference Books:

1 Cary R .Spitzer, "The Avionics Handbook", CRC Press, 2000.
2 Middleton, D.H. "Avionics Systems", Longman Scientific and Technical, Longman Group UK Ltd., England, 1989.
3 Spitzer, C.R. "Digital Avionics Systems", Prentice Hall, Englewood Cliffs, N.J., U.S.A., 1987.
4 Brain Kendal, "Manual of Avionics", The English Book House, 3rd Edition, New Delhi, 1993

20OE601D Bioinformatics

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisites:

Course Objectives:

1 To understand the basics of bioinformatics and explore various databases used in bioinformatics.
2 To be familiar with a set of well-known supervised, unsupervised learning algorithms used for bioinformatics applications.
3 To understand the concepts and types of Phylogeny.

Course Outcomes: Students will be able

1 Apply basic concepts of bioinformatics to biological data analysis.
2 Classify different types of biological databases.
3 Apply various techniques, algorithms and tools to nucleic acid and protein sequence analysis.
4 Apply various techniques, algorithms and tools to be used for phylogenetic analysis.

Unit 1: Introduction to Bioinformatics (06)

Definition, applications, Protein and DNA structure, Biological Data Acquisition: The form of biological information. Retrieval methods for DNA sequence, protein sequence

Unit 2: Bioinformatics Databases (08)

Format and Annotation: Conventions for database indexing and specification of search terms, Common sequence file formats. Annotated sequence databases - primary sequence databases, protein sequence, Information on various databases and bioinformatics tools available. For eg; nucleic acid sequence database (GenBank, EMBL, DDBJ), protein sequence databases (SWISSPROT, TrEMBL, PIR, PPB)

Unit 3: Algorithms for bioinformatics (08)

Introduction to various machine learning techniques and their applications in bioinformatics. Genetic algorithm, Support Vector Machine, Neural Network and their practical applications towards the development of new models, methods and tools for bioinformatics

Unit 4: Sequence Analysis (08)

Various file formats for biomolecular sequences - genbank, fasta, gcg, msf, nbrf-pir, etc Basic concepts of sequence similarity, identity and homology, paralogues. Sequence based database searches - BLAST and FASTA algorithms

Unit 5: Sequence Alignment (06)

Pairwise and Multiple Sequence Alignments (MSA). Basic concept of sequence alignment, Pairwise alignment (Needleman and Wunsch, Smith and Waterman algorithms), MSA (Progressive and Hierarchical algorithms). Their use for analysis of Nucleic acid and protein sequences and interpretation of results

Unit 6: Phylogeny (06)

Phylogeny analysis, definition and description of phylogenetic trees and its types. Various computational methods in phylogenetic and molecular evolutionary analysis

Text Books/Reference Books:

1 Hooman Rashidi, Lukas K. Buehler, 'Bioinformatics Basics: Applications in Biological Science and Medicine' (2nd Edition) (May 2005)
2 Des Higgins (Ed),Willie Taylor (Ed), 'Bioinformatics: Sequence, Structure and Databanks - A practical approach' (1st Edition) (October 2000)
3 N.J. Chikhale and Virendra Gomase, 'Bioinformatics- Theory and Practice' (1st Edition)(July 2007)
4 Bioinformatics: Databases and Systems, by Stanley I. Letovsky
5 Bioinformatics Databases: Design, Implementation, and Usage (Chapman & Hall/ CRC
6 Mathematical Biology & Medicine), by SorinDraghici
7 Data base annotation in molecular biology, principles and practices, Arthur M.Lesk
8 Current topics in computational molecular biology, Tao, Jiang, Ying Xu, Michael Q.Zang

20OE601E COMPUTER VISION

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisite:20EC501 Digital Signal Processing

Course Objectives:

1 To introduce major ideas, methods and techniques of Computer Vision algorithms
2 To introduce fundamentals of Image formation
3 To explain concepts of Camera Calibration and Stereo Imaging
4 To explain different Background Subtraction techniques and Motion tracking algorithms

Course Outcomes:

After completion of the course, students will be able to

CO1 Explain the fundamentals of Image formation, Camera calibration parameters and Stereo Imaging
CO2 Apply camera calibration concepts to calculate intrinsic and extrinsic parameters of camera
CO3 Explain different Background Subtraction techniques and Calculate the Performance measures of it.
CO4 Select the appropriate feature extraction techniques according to the requirement of the applications
CO5 Analyze the appropriate Background Subtraction techniques and Object tracking algorithms according to the requirement of the applications

Unit I: Camera Calibration (07)

Geometrical primitives and transformations, 3D to 2D projections, Image Formation, Capture and Representation, Camera Calibration and parameters, Digital camera.

Unit II: Stereo Imaging (08)

Stereo Vision: Epipolar geometry, Rectification, Correspondence, triangulation, RANSAC algorithm, Dynamic programming.

Unit III: Visual Features and Representations (09)

Edge, Blobs, Corner Detection, SIFT, SURF, HoG.

Unit IV: Background Subtraction Techniques for Moving Object Detection (09)

Frame differencing, Mean and Median filtering, Gaussian Mixture Model (GMM), Kernel density estimation, Applications.

Unit V: Motion Tracking (09)

Motion tracking using Optical flow, blob tracking, Colour feature based mean shift, Kalman tracking, Applications.

Text Books:

1 D. Forsyth, J. Ponce**, "Computer Vision, A Modern Approach"**, *Prentice Hall*, (2nd Edition), (2003).
2 R. Szeliski, **"Computer vision algorithms and applications",** *Springer-Verlag*, (2nd Edition), (2010).

Reference Books:

1 L. G. Shapiro, George C. Stockman**, "Computer Vision"**, *Prentice Hall*, (1st Edition), (2001
2 E. Trucco, A. Verri, **"Introductory Techniques for 3-D Computer Vision"**, *Prentice Hall*, (1st Edition), (1998)
3 D. H. Ballard, C. M. Brown, **"Computer Vision"**, Prentice Hall, (1st Edition), (1982).
4 M. Sonka, V. Hlavac, R. Boyle, **"Image Processing, Analysis, and Machine Vision",** *Thomson Press*, (3rd Edition), (2011).

Online Resources:

NPTEL Course **"Computer Vision"**

1 https://nptel.ac.in/courses/106/105/106105216/
2 http://www.ai.mit.edu/projects/vsam/Publications/stauffer_cvpr98_track.pdf
3 https://people.cs.rutgers.edu/~elgammal/pub/ieeeproc-paper-final.pdf
4 http://www.cs.cmu.edu/~16385/s15/lectures/Lecture24.pdf

20OE 601F Design Thinking

Teaching Scheme
Lectures**:** 3 Hours / Week
Tutorial: -

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisite:

Course Objectives:

Familiarize students with

1 Design thinking process
2 User centric approach for designing a solution
3 Problem analysis with various methods
4 Applications of Design Thinking

Course Outcomes:

Students should be able to

1 Analyze problems with various methods
2 Recommend a solution based on empathy, ideation, prototyping, and playful testing
3 Apply design thinking methods to generate innovative and user centric solutions
4 Test designed prototypes to reduce risks and accelerate organizational learning

Unit I: Design and Design Problems **8 Hours**

What is Design? The components of design problems; measurement, criteria and judgement in design

A model of design problems – Defining problems: Selecting goals and diverse teams, creating a unified vision and scope, mapping stakeholders and personas; Analysing design problems, generators of design problems, roles of generators, design constraints

Unit II: Design Solutions **8 Hours**

Solutions to Design Problems: Designer's response: procrastination, non-committal design and throw away design, design problems and solutions

Design Process: define, search, ideate, prototype, select, implement, learn, Refresher and restate the challenge, getting inspiration, understanding innovation ambition, Solution ideation, Narrowing solution choice, Solution evaluation, Road map

Unit III: Design Thinking **9 Hours**

Types and Styles of Thinking – theories of design, types of thinking; creative thinking - what is creativity? creativity in design, Principles of design thinking

Unit IV: Design Philosophies and Strategies **9 Hours**

Theory and practice, three early phases of working on the same problem
Prototype Creation: Choosing a prototype approach, user interface prototypes, applications vs custom build, reference architectures, prototype and solution evaluation

Unit V: Design Tactics and Traps **8 Hours**

Methods and Tactics, understanding the problem, the model of problems, One or many solutions? Common traps and ways of avoiding them

Text Books:

1 Bryan Lawson, "How designers think: The design process demystified", 2nd Edition, Butterworth Architecture
2 Nigel Cross, "Design Thinking", Berg Publishers - 2011

Reference Books:

1 Ben Crothers, "Design Thinking Fundamentals", O'Reily
2 Tim Brown, "Change by Design: How Design Thinking Transforms Organizations", HarperCollins – 2009
3 Susan Weins Chenk, "Hundred things every designer needs to know about people", New Riders Publication
4 Vijay Kumar, "101 Design Methods: A Structured Approach for Driving Innovation in Your Organization", Wiley Publication
5 Roger L. Martin, "Design of Business: Why Design Thinking is the Next Competitive Advantage" Harvard Business Press
6 Karl Ulrich, "Design: Creation of Artifacts in Society" - 2011
7 Bala Ramadurai, "Karmic Design Thinking"
8 T. Amabile, "How to kill creativity", SAGE Publication - 2006
9 William Lidwell, Kritina Holden, Jill Butler, "Universal principles of Design ", Rockport Publishers
10 Bella Martin, Bruce Hanignton, Bruce M Hanington "Universal methods of design", Rockport Publishers - 2012
11 Roman Kizanie, "Empathy: Why it matters, how to get it", TarcherPerigee Publishers
12 Karla McLaren, "The Art of Empathy: A complete Guide to life's most essential skill", Sounds True Publishers

20OE601G e-Business

Teaching Scheme
Lectures: 3 Hours / Week

Examination scheme:
In Semester**:** 50 Marks
End Semester**:** 50 Marks
Credits: 3

Prerequisite: No Prerequisites

Course Objectives:
To facilitate the learners to-

1. Understand the technological, economic and social phenomena behind rapid changes in the e-businesses.
2. Have a good working knowledge of e-business concepts, applications and technologies.
3. Understand the e-business models and infrastructure.
4. Learn how e-business concepts are applied to different fields, such as: education, banking, tourism and so on.
5. Inspire with online business ideas and motivate them to apply in the real life.
6. Study the new trends in e-business, e-commerce

Course Outcomes:
By the end of this course, students will be able to

CO1	Explain the concepts of e-business and e-business models
CO2	Apply suitable principles and practices of designing and developing e-business website
CO3	Apply necessary back end system components required for successful e-business implementations
CO4	Outline the meaning of e-business security and how it impacts the business
CO5	Relate e-business, BI and KM to fulfil modern e-business trends

Unit I: Introduction (07)
E-commerce and e-business, advantages of e-business in growth of a business, Transition from traditional business to e-business, features of e-business technology, e-business models, IT Infrastructure requirements of e-business Case Study : Various e-business models

Unit II: Building e-business Websites (07)
Issues involved in designing a website, designing in-house websites, steps involved in website development, e-business and website development solutions, Advantages of using an e-business solution, selection of a suitable e-business solution, security issues involved in websites, tracking and analysing website traffic data. Digital Marketing Case Study

Unit III: e-Business Infrastruture / Back end Systems (07)
Back end system support requirements - security, scalability, availability, adaptability, manageability, maintainability, assurance, interoperability, load balancing; internet technology, World Wide Web, Internet software; Content management, Case Study

Unit IV: e-security & online payment systems (07)

e-Business security policy, risks and risk assessment, practice guidelines to e-security, legal framework and enforcement, ethical, social and political issues in e-business

Performance characteristics of online payment systems, online payment methods, security and risk handling in online payments, fraud detection in online payments, IT Act 2000, digital signatures, digital certificates, and PKI; Case Study

Unit V: Knowledge management & BI for strategic e-business (08)

From information processing to knowledge world, aligning knowledge with business, knowledge management platforms, state of knowledge and measuring parameters; knowledge industry, knowledge strategy, and knowledge workers

Business and Intelligence - applications and importance of business intelligence, implementation of intelligence, building BI systems, selecting BI tools, integrating BI and KM, decision-making and BI, Case Study

Unit V: Launching an e-Business and e-business trends (06)

Launching a successful e-business – requirement analysis, managing Web site development, search engine optimization, Evaluate Web sites on design criteria.

Future and next generation of enterprise e-business, challenges and new trends, ethical and regulatory issues

Text Books:

1. Papazoglou, Michael and Pieter Ribbers, "E-Business : Organizational and Technical Foundations", John Wiley, 2nd Edition (Sept 2011).
2. Parag Kulkarni, Sunita Jahirabadkar, Pradeep Chande, "E-Business", Oxford University Press (May 2012)

Reference Book:

1. Daniel Amor, "The E-business (R)evolution", Prentice Hall PTR (2000)
2. Kenneth Laudon, Carol Guercio, "E-commerce : Business, Technology, Society", Prentice Hall, 4th Edition (January 2008).
3. Kalakota Ravi, Marcia Robinson, "E-Business 2.0 – Roadmap for Success", Pearson Education, 2nd Edition (2004).

20OE601H - Electric Vehicles

Teaching Scheme
Lectures**:** 3 Hours / Week
Tutorial: -

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Course Objectives:

1 Understand and identify and integrate EV subsystems
2 Learn and find energy storage requirements for vehicle application
3 Comprehend design of battery thermal management system
4 Undestand calculations of motor power ratings for an EV application
5 Study suitable type of sensors for EV applications
6 Study appropriate control strategy for EV

Course Outcomes:
Students should be able to

1 To identify and integrate EV subsystems
2 To calculate energy storage requirements for vehicle application
3 To select and design battery thermal management system
4 To calculate motor power ratings for an EV application
5 To select a suitable type of sensors for EV applications
6 To select appropriate control strategy for EV

Unit 1: Introduction to hybrid and electric vehicles: (6)

Engineering case, legislative push, incentives, market pull. EV : micro to mild to PHEV to HEV to REEV to EV - Hybrid-Electric Vehicle Power trains, Vehicle Energy Storage System Design, System and sub-systems, Modelling and design of EVs as a system, Motors & motive power spilting concepts, and interface within power train system

Unit 2: Power train architecture: (6)

Parallel, Series and Combined, Types of EVs, Vehicle layout and packaging options, Duty Cycles in Indian cities; performance, Components of Power Train**,** Auxiliary Inverter, HV-LV DC-DC converter, Traction Inverter, Gear Trains, Integration of power train components, regenerative brakes

Unit 3: Introduction to Energy Storage (6)

Energy storage requirements for vehicle applications, Storage technologies and metrics for comparison, Distribution of Energy, Storage Form of Energy, Intermediary Conversion, Control and Diagnostic, Ragone Chart, Theory of Ragone Plots. Ragone Plot of a Battery

Unit 4: BMS, Packing and Charging: (6)

Battery Management Systems (BMS), Lithium-Ion Batteries Aging Effects. Battery characterization and testing systems, Thermal management & Battery life cycle, Modular battery packs, packaging, thermal control, Changing Systems and Infrastructure

Unit 5: Electric Drives (6)

DC motors, induction motors and synchronous motors, permanent magnet motors, BLDC, switched reluctance motors, Switched Reluctance Motors (SRM),Permanent Magnet Synchronous Motor (PMSM)

Unit 6: Sensors in Electric Vehicles: (6)

MEMS Sensors for Engine Management, Battery Monitoring Sensors, State of the Charge Sensing, Sensors for Passenger Safety, Sensors for Skidding and Rollover Detection, Tire Pressure Sensors, Electronic Stability Control of Vehicles, Sensors for Antitheft, Vehicle Navigation Sensors. EV sensors of Texas Instruments, STM, NXP, etc.

Books:

1 Mehrdad Ehsani, Yimin Gao, Sebastian E.Gsay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Celll vehicles-Fundamentals - Theory and Design", CRC Press
2 Energy Storage by Robert A. Huggins, Springer Publication
3 Chang Liang Xia,Permanent Magnet Brushless Dc Motor Drives and Controls, Wiley 2012.
4 Katsuhiko Ogata, "Modern Control Engineering" 5th edition, Prentice Hall of India Private Ltd., New Delhi, 2010.
5 Cooper W.D & Hlefrick A.D., Electronic Instrumentation Measurement Technique, III Edition, Prentice Hall of India – 1999

20OE 601I Gamification

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Course Objectives:
To facilitate the learner to
1 To develop problem solving abilities using gamification.
2 To identify the various methods of gamification.
3 To apply gamification mechanics to solve a problem.
4 To make use of gamification tools to solve a problem.

Course Outcomes:
After completion of the course, students will be able to
1 To apply steps of problem solving using gamification.
2 To analyze player motivation and counter gamification.
3 To develop game using game mechanics.
4 To apply tools of gamification to real life applications.

Gamification is about applying game concepts, driving engagement into non game environments/contexts like a website designing, online community for interactive discussion, a fun way of learning management system for engagement of stakeholders etc.

Gamification is NOT about designing fancy games, video games, virtual reality games etc. Therefore this course does NOT cover games and game design aspects. Course will also discuss the negative impact and influence of games (when played in excess) on young minds like addiction to video games, over spending time for games.

Unit I: Gaming Foundations (6)
Introduction, Resetting Behavior, Replaying History, Gaming foundations: Fun Quotient, Evolution by loyalty, status at the wheel, the House always wins.

Unit II: Player Motivation (7)
Powerful Human Motivators, Why People Play, Player types, Social Games, Intrinsic verses Extrinsic Motivation, Progression to Mastery, Case studies for Thinking: Tower of Hanoi,Concepts Applied to Video games and Gamification.

Unit III: Counter Moves in Gamification (8)
Reclaiming Opposition: Counter gamification, Gamed Agencies: Affectively Modulating Our Screen-and App-Based Digital Futures, Remodeling design, Designing for Engagement, Case study of Maze Problem.

Unit IV: Game Design (8)

Game Mechanics and Dynamics: Feedback and Re-enforcement, Game Mechanics in depth, Putting it together, Case study of 8 queens problem.

Unit V: Game Mechanics and Applications (7)

Gamification case Studies, Coding basic game Mechanics,Gamification Applications : Education,Healthcare,Marketing,Gamification for Machine Learning.

Unit VI: Gamification Platforms (6)

Instant Gamification Platforms, Mambo.io(Ref:http://mambi.io), Installation and use of BigDoor (Open Source http://bigdoor.com),ngageoint/gamification-server
(ref: https://github.com/ngageoint/gamification-server).

Text Books:

1 Mathias Fuchs, Sonia Fizek,Paolo Ruffino, Niklas Schrape, Rethinking Gamification, Meson Press,2014, ISBN: 978-3-95796-000.
2 Gabe Zechermann, Christopher Cunningham, Gamification by Design, Oreilly,August 2015, ISBN: 978-1-449-397678.

Reference Books:

1 B. Burke, Gamify: How Gamification Motivates People to Do Extraordinary Things, Gartner 2014,ISBN:1937134857.
2 **Stieglitz**, S.**Lattemann**, C.**Robra-Bissantz**, S.**Zarnekow**, R.**Brockmann**,Gamification :Using Game Elements in Serious Contexts,2016,ISBN: 978-3-319-45557.

20OE 601J Geographical Information Systems

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Course Objectives:
To facilitate the learner to
1 Learn basics of GIS
2 Understand representation of GIS models
3 Relate GIS and DBMS for various applications, analyze and visualize the spatial data
4 apply GIS to supply chain management

Course Outcomes:
After completion of the course, students will be able to
1 Apply basics of GIS to database design
2 Make use of various data models to given data
3 Apply data editing techniques to spatial data
4 Apply spatial data analysis to GIS data
5 Create maps using ArcGIS
6 Apply GIS in supply chain management

Unit I: Introduction to GIS (05)
Define GIS, GISystems, GIScience, Spatial and Geoinformation, Components of GIS, Recent trends and applications of GIS; Data structure and formats, Spatial data models – Raster and vector, Database design- editing and topology creation in GIS, Linkage between spatial and non-spatial data, Data inputting in GIS. Rectification, Transformation Methods; Root Mean Square (RMS) Error

Unit II: Data Types and data models (05)
Data Types; Spatial Data; Non-Spatial Data, Data Input; Existing GIS Data, Metadata; Conversion of Existing Data, Creating New Data, Data Models; Vector Data Model; Raster Data Model; Integration and Comparison of Vector and Raster Data Models.

Unit III: Data Exploration and spatial data editing (08)
Attribute Data in GIS, Attribute Data Entry, Manipulation of Fields and Attribute Data, Data Exploration; Attribute Data Query, Raster Data Query, Map- Based Data Manipulation, Types of of Digitizing Errors, Causes for Digitizing Errors; Topological Editing and Non-topological Editing; Other Editing Operations; Editing Using Topological Rules.

Unit IV: Spatial data Analysis (08)

Spatial Data: Definition, Analysis, Processes & Steps, Software and Tools, Geodatabase Model, Role of Databases in GIS, Creating, Editing and Managing, Classification scheme of Vector-Based and Raster- Based GIS Operation Raster- Based Techniques: Methods of reclassification, overlay analysis, Digital Terrain Analysis and Modeling- TIN and DEM, Surface representation and analysis, Slope and Aspect, Geographic Visualization Data Classification

Unit V: ArcGIS (08)

Introduction, Geographical terms, ArcMap main window, Coordinate system, Georeferencing, Generation of vector referencing, Table administration, Geoprocessing tools, spatial analysis, Design and publication, API for ArcGIS

Unit VI: Trends and applications (08)

Need for GIS network analysis in SCM, data for GIS logistic service, understanding logistic management, types of GIS services, supply chain audit, ISRO-Bhuvan, Web GIS

Text Books:

1 "Fundamentals of GIS", Franz Pucha et al, 2018
2 "Principles of Geographic Information Systems",Kang-tsung chang, 2017

Reference Books:

1 "Essentials of Geographic Information Systems",Jonathan E. Campbell Michael Shin, 2018
2 "Introduction to GIS",Víctor Olaya

20OE601K MULTIMEDIA SYSTEMS

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisite:20EC402 Analog and Digital Communication
Course Objectives:

1 To introduce basic concepts and design of Colour TV and Digital TV
2 To explain advanced TV technologies like HDTV, CATV, CCTV, DTH, CAS and case study for live telecast
3 To introduce multimedia compression techniques, standards and multimedia over the internet
4 To familiarize the students with digital recording and playback systems, acoustic design, microphones and loudspeakers

Course Outcomes:
After completion of the course, students will be able to

CO1 Explain the concepts of colour TV design, systems and Digital TV
CO2 Discuss and compare advanced TV systems like CATV, CCTV, DTH, HDTV, CAS, Wi-fi TV, 3DTV and different display technologies
CO3 Apply and analyze multimedia compression standards for text, audio, image and video and explain multimedia over the internet
CO4 Compare optical recording techniques, microphones and loudspeakers
CO5 Design acoustics and PA system for auditorium, public meeting, debating hall, football stadium and college classrooms

Unit I: Colour and Digital TV (11)

Resolution, interlaced scanning, BW, CVS, Color TV systems, frequency interleaving, colour difference signals, colour TV receiver, NTSC, PAL, SECAM encoders and decoders, Introduction to Digital TV, Digital TV signals and parameters, Digital TV Transmitters and receivers.

Unit II: Advanced TV Systems (10)

HDTV standards and systems, HDTV transmitter and receiver, CCTV, CATV, Direct to Home TV (DTH), Set top box, Conditional Access System (CAS), 3D TV systems, Case study (Cricket match, Marathon, Football match), Wi-Fi TV, Video door phone systems, Display devices: LED, LCD, Plasma.

Unit III: Multimedia Compression and Multimedia over Internet (11)

Introduction, Overview, Concept of Multimedia, Multimedia Applications, Text: Types, Compression, Hypertext, Image Compression techniques: JPEG, Multimedia Audio: MIDI, MP3, Video: MPEG, Animation: Introduction, types, 3D animation, Virtual reality, Multimedia over Internet**:** Introduction to Multimedia Services, Transmission of Multimedia over the Internet, IP Multicasting, Explaining VOIP

Unit IV: Acoustics and Digital Audio Video (10)

Optical recording, noise, CD, DVD, dual layer DVD, rewritable DVD, Blu Ray DVD, Studio acoustics and reverberation, acoustic chambers, PA system for : auditorium, public meeting, debating hall, football stadium, college hall, Advanced PA systems, Different types of speakers and microphones.

Text Books:

1 R. R. Gulati, **"Modern Television Practice",** *New Age International*, (5th Edition), (2015).
2 Ralf Steinmetz, Klara Nahrstedt, **"Multimedia: Computing, Communication and Applications"**, *Pearson Publication*, (8th Edition), (2011).
3 R.G. Gupta, **"Audio and Video Systems"**, *Tata Mcgraw Hills*, (2nd Edition), (2020).
4 Robert D. Finch, **"Introduction To Acoustics",** *PHI*, (2nd Edition), (2007).
5 Dayanand Ambawade, Dr. Deven shah, Prof. Mahendra Mehra, "**Advance Computer Network"**, *Wiley*, (2nd Edition), (2014).

Reference Books:

1 A. M. Dhake, "**Television and Video Engineering**", *Tata Mcgraw Hills*, (2nd Edition), (2003).
2 Ranjan Parekh, **"Principles of Multimedia**", *Tata Mcgraw Hills*, (2nd Edition), (2013).
3 Alec Nisbett , "**The Sound Studio**", *Focal Press*, (5th Edition) , (1993).

Online Resources:

NPTEL Course " Multimedia Systems"

1 https://nptel.ac.in/courses/117/105/117105083/

20OE 801A Big Data And Analytics

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Course Objectives:
To facilitate the learner to
1 Understand the concepts, challenges and techniques of Big data and Big data analytics
2 Understand the concepts of Hadoop, Map Reduce framework , Spark for Big data analytics
3 Apply skills and tools to manage and analyze the big data
4 Understand latest big data trends and applications.

Course Outcomes:
After completion of the course, students will be able to
1 Apply basic concepts of big data for the various applications.
2 Apply data analytics life cycle to real-world big data applications
3 Choose Hadoop ecosystem components based on requirement of application
4 Compare Spark and Hadoop architecture
5 Compare various methods used in data Analytics and big data trends.

Unit I: Introduction (6)
Database Management Systems, Structured Data, SQL. Unstructured data, NOSQL, Advantages of NOSQL, Comparative study of SQL and NOSQL. Big data overview, characteristics of Big Data, Case study- SAP HANA.

Unit II: Data Analytic Life Cycle (6)
Data Analytical Architecture, drivers of Big Data, Emerging Big Data Ecosystem and new approach. Data Analytic Life Cycle: Discovery, Data preparation, Model Planning, Model Building, Communicate Results, Opearationalize. Case Study: GINA

Unit III: Big Data Architectures, Hadoop (8)
Introduction to Big Data and Hadoop, Building blocks of hadoop: Ecosystem, HDFS, HBASE, YARN, Map Reduce working.

Unit IV: Introduction to Spark (7)
Spark Framework, Architecture of Spark, Resilient Distributed Datasets, Data Sharing using Spark RDD, Operations in Spark;
Introduction to Kafka: need, use cases, components.

Unit V: Machine learning (8)

Supervised, unsupervised learning; Classification, Clustering; Time series analysis, basic data analysis using python: libraries,functions.

Text Analysis: Text Pre-processing, Topic modelling algorithms, Text Similarity measure.

Unit VI: Big Data Trends and applications (7)

Exploratory data analysis, Big data Visualization using python;

IoT and big data, Edge computing, Hybrid cloud.

Applications of Big data, Case study: E-commerce, healthcare.

Text Books:

1 "Data Science and Big Data Analytics", Wiley, 1stEdition (January 2015)
2 "Big Data, Black Book" ,Dreamtech Press (27 May 2015),ISBN-13-978-9351197577

Reference Books:

1 Arvind Sathi, "Big Data Analytics: Disruptive Technologies for Changing the Game",MC Press(November 2012)
2 J.Hurwitz, Alan Nugent, Fern Halper, Marcia Kaufman, "Big Data for Dummies", 1st Edition (April 2013)
3 Tom White, "Hadoop: The Definitive Guide", O′Reilly, 3rdedition (June 2012)
4 Abraham Silberschatz, Henry Korth, S. Sudarshan, "Database System concepts",McGraw Hill Education, 6thEdition (December 2013).
5 Vignesh Prajapati, "Big Data Analytics with R and Hadoop", Packt Publishing (November 2013)
6 Shiva Achari ,"Hadoop Essentials - Tackling the Challenges of Big Data with Hadoop" ,Packt Publishing(April 2015), ISBN:978-1-78439-668-8

Online/Web/Other References:

1 https://nptel.ac.in/courses/106/104/106104189/
2 https://hadoop.apache.org/docs/stable/
3 https://kafka.apache.org/documentation/
4 https://spark.apache.org/

20OE801B Cyber Physical System

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisite: 20EC404 Embedded System, 20EC603 Control Systems

Course Objectives:

1 To introduce modeling of the Cyber Physical System (CPS).
2 To analyze the CPS.
3 To explain the software modules.

Course Outcomes:

After completion of the course, students will be able to

1 Categorize the essential modeling formalism of CPS
2 Analyze the functional behavior of CPS based on standard modeling formalisms
3 Apply specific software for the CPS using existing synthesis tools
4 Design CPS requirements based on operating system and hardware architecture constraints

Unit I: Cyber Physical Systems (CPS) applications and Characteristics (07)

CPS in the real world, Basic principles of design and validation of CPS, CPS: From features to software components, Mapping software components to Electronic Control Unit (ECU), CPS Performance Analysis: effect of scheduling, bus latency, sense and actuation faults on control performance, network congestion, Formal methods for Safety Assurance of CPS.

Unit II: CPS physical systems modeling (07)

Stability Analysis: CLF (Common Lyapunov function), MLF (Multiple Lyapunov function), stability under slow switching, Performance under Packet drop and Noise.

Unit III: CPS computer systems modeling (07)

CPS SW Verification: Frama-C, C Bounded Model Checker (CBMC), Secure Deployment of CPS: Attack models, Secure Task mapping and Partitioning, State estimation for attack detection, Hybrid Automata Modelling: Flow pipe construction using Flowstar (Flow*), Polyhedral Hybrid Automaton Verifier (Phaver) tools (Reliability testing).

Unit IV: Operating systems and hardware architecture support for CPS (07)

CPS SW stack RTOS, Scheduling Real Time control tasks. Principles of Automated Control Design: Dynamical Systems and Stability, Controller Design Techniques, CPS HW platforms: Processors, Sensors, Actuators, CPS Network.

Unit V: Analysis and verification of CPS (07)

Advanced Automata based modeling and analysis: Basic introduction and examples, Timed and Hybrid Automata, Definition of trajectories, Formal Analysis: Flow pipe construction, Reachability analysis, Analysis of CPS Software, Weakest Preconditions, Bounded Model checking.

Unit VI: CPS case studies (07)

Automotive Case study: Vehicle ABS hacking, Power Distribution Case study: Attacks on Smart grid.

Text Books:

1 Lee, Edward Ashford, and SanjitArunkumarSeshia, "Introduction to embedded systems: A cyber physical systems approach", MIT Press, (2nd Edition), (2017).
2 Rajeev Alur, "Principles of Cyber-Physical Systems". MIT Press, (1st Edition), (2015).
3 Wolf, Marilyn, "High-Performance Embedded Computing: Applications in Cyber-Physical Systems and Mobile Computing". Elsevier, (1st Edition), (2014).

Reference Books:

1 P. Tabuada, "Verification and control of hybrid systems: a symbolic approach", Springer-Verlag, (1st Edition), (2009).
2 Raj Rajkumar, Dionisio De Niz , and Mark Klein, "Cyber-Physical Systems", *SEI Series in Software Engineering*, (1st Edition), (2018).
3 André Platzer, "Logical Analysis of Hybrid Systems: Proving Theorems for Complex Dynamics", *Springer*, (1st Edition), (2010).
4 Jean J. Labrosse, "Embedded Systems Building Blocks: Complete and Ready-To-Use Modules in C", *CRC Press*, (2nd edition), (2011).

Online/Web/Other References:

1 Coursera course, Cyber Physical system modelling
https://www.coursera.org/learn/cyber-physical-systems

20OE801C Digital Control

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisites: Basics of Control Systems

Course Objectives: To
1 Understand the basic components of a digital control system.
2 Design various Digital Controllers and Study response of those controllers.
3 Learn and understand the stability of the system in the Z plane.
4 Introduce Optimal Control Design and Its need.

Course Outcomes: Students will be able to

1 Analyse system design in various planes S-W-Z and its mapping.
2 Analyse system stability in the S and Z plane.
3 Design and analyse systems using classical methods and State Space.
4 Design Optimal Control for a Discrete System.

Unit 1: Introduction to Discrete Time Control System (08)
Basic building blocks of Discrete Time Control System, Sampling Theorem, Choice of Sampling Rate, Z Transform and Inverse Z Transform for applications of solving Differential Equations, Impulse Sampling, Reconstruction – Zero Order Hold

Unit 2: Pulse Transfer Function and Digital Controllers (08)
Pulse Transfer Function, Pulse Transfer Function of Open Loop and Closed Loop System, Pulse Transfer Function of Digital PID Controller, Design of Deadbeat Controller

Unit 3: Stability Analysis of Discrete Control System (08)
Stability regions in S plane W plane and Z plane, Mapping between three planes, Stability Tests for Discrete Systems

Unit 4: Design of Discrete Control System by State Space Approach (07)
Different Canonical Forms, Relation between Pulse Transfer Function and State Equation, Solution of Discrete Time State Space Equations, Eigen Values, Eigen Vectors

Unit 5: Pole Placement and Observer Design (07)

Concept of Controllability and Observability, Pole Placement Design by State Feedback, Design of Feedback Gain Matrix by Ackerman's Formula, State Observer Types.

Unit 6: Introduction to Optimal Control (05)

Basics of Optimal Control, Quadratic Optimal Control, Performance Index.

Text Books:

1 K. Ogata, "Discrete Time Control Systems", Prentice Hall, Second Edition.
2 M. Gopal, "Discrete Control and State Variable Methods", Tata McGraw Hill.
3 Kannan Moudgalya, "Digital Control", John Wiley and Sons.

Reference Books:

1 G. F. Franklin, J. David Powell, Michael Workman, "Digital Control of Dynamic Systems", Addison Wesley, Third Edition.
2 M. Gopal, "Digital Control Engineering", Wiley Eastern LTD.
3 Forsytheand W, Goodall R, "Digital Control".
4 Contantine H. Houpis, Gary B. Lamount, "Digital Control Systems", McGraw Hill International, Second Edition.

20OE801D Industrial Engineering and Management

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Course Objectives:
The Industrial Engineering course prepares students to…
1 Understand type of organisation and calculate partial and total productivity
2 Learn the fundamental knowledge, skills, tools and techniques of methods study and work measurement.
3 Understand type of production environments, resource planning and control methods.
4 Learn basic resource scheduling techniques, human resource management and industrial safety norms.

Course Outcomes:
Students will be able to
1 Identify type of organisation and analyze partial and total productivity
2 Manage and implement different techniques of methods study and work measurement of process under consideration for improvement.
3 Analyze production environment under consideration w.r.to its resource planning and control.
4 Apply basic resource scheduling and human resource management techniques.

1 Introduction to Industrial Management and Productivity Analysis 6

1 Industrial management: Functions and principles of management; Organisation: Concept, characteristics, structures and types of organisation- (formal line, military, functional, line and staff organisation);
2 Productivity analysis: Definition, measurement of productivity: productivity models and index (numerical); factors affecting the productivity; productivity improvement techniques;
3 Definition and scope of Industrial Engineering.

2 Method Study 7

1 Work Study: Definition, objective and scope of work-study.
2 Method Study : Definition, objective and scope of method study, activity recording and exam aids, Charts to record moments in shop - operation process charts, flow process charts, travel chart, two handed chart and multiple activity charts. Charts to record movement at work place - principles of motion economy, classification of moments, SIMO chart, and micro motion study. Definition and installation of the improved method;
3 Human factors in Work-Study;
4 Value Engineering and Value Analysis.

3 Work Measurements 6

1 Introduction: Definition, objectives and uses; Work measurement techniques:

2 Time study: Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information. Rating and standard rating, standard performance, scales of rating, factors affecting rate of working, allowances and standard time determination(numerical);

3 Work sampling: Need and procedure, sample size determinations (numerical);

4 Synthetic motion studies: PMTS and MTM. Introduction to MOST (numerical).

4 Production Management 7

1 Production Planning and Control: Types of production systems, functions of PPC, Aggregate production planning; Master Production Schedule; ERP

2 Forecasting techniques: Causal and time series models, moving average, exponential smoothing, trend and seasonality; (Numerical).

3 Supply Chain Management: Concept, Strategies, Supply Chain Network, Push and Pull Systems, Logistics, Distribution; Order Control strategies: MTO, MTA, MTS.

5 Facility Management 6

1 Facility Layout: Factors affecting facility location; Types of Plant Layout; Computer Aided Layout Design Techniques; Assembly Line Balancing (Numerical);

2 Material Handling and Inventory Control: Principles, Types of Material Handling Devices; Stores Management, Inventory costs, Types of inventory models - Deterministic and Probabilistic, Concept of EOQ, purchase model without shortages (Numerical); ABC and VED Analysis (Numerical).

6 Project Scheduling, Human Resource and Industrial Safety 6

1 Scheduling Techniques: CPM and PERT(Numerical);

2 Human Resource Development: Functions: Manpower Planning, Recruitment, Selection, Training; Concept of KRA (Key Result Areas); Performance Appraisal (Self, Superior, Peer, 360^0);

Text Books:

1 Industrial Engineering and Production Management, M Mahajan, Dhanpat Rai and Co.
2 Industrial engineering and management by O. P. Khanna, Dhanpatrai publication
3 Industrial Engineering , Martend Telsang, S. Chand Publication.
4 Industrial Organisation & Engineering Economics by Banga and Sharma, Khanna publication.
5 Prem Kumar Gupta, D. S. Hira, Problems in Operations Research: Principles and Solutions, S. Chand, 1991
6 J. K. Sharma, Operations Research : Theory And Application, Laxmi pub. India.

Reference Books:

1 Introduction to Work Study by ILO, ISBN 978-81-204-1718-2, Oxford & IBH Publishing Company, New Delhi, Second Indian Adaptation, 2008
2 Maynard's Industrial Engineering Hand Book By H.B. Maynard, KJell, McGraw Hill Education, 2001
3 Zandin K.B. - Most Work Measurement Systems, ISBN 0824709535, CRC Press, 2002.

Assignment based evaluations are designed. **This evaluation is treated as T1-Marks**. Marks will be calculated (at the end of semester) on the basis of successful completion / submission of assignments explained to you time to time on the basis of syllabus content. [Note: these assignments are part of activity based learning. Hence, students are to work in a group to complete following assignments].

Assignment Details	Mapped COs
1. Case study based Assignment on Method Study. [Data may be collected from: 1) Day to day activity : Workshop, Library, Admin area, Canteen, Parking 2) Students visiting industrial area for project 3) Quality concept Assignments in a Group.]	**CO1**
2. Hands on Assignment on application of Work Measurement technique(s). [1) Using stopwatch work measurement can be completed. (E.g. in workshop)]	**CO1, CO1**
3. Simulation / Assignment on Routing & Scheduling Model. [Open Source Softwares 1) Flexsim (Videos are available online) 2) Arena - Student Version 3) Pro model – Student Version 4) Excel templates available online. Note: Backward / Forward Scheduling concepts are to be included.]	**CO1, CO4**
4. Assignment on simulation of Manufacturing System / Service System Operations for demand forecasting of the given product using any two methods. [1) Data from shops malls, manufacturing company, etc.]	**CO1, CO4**
5. Assignment on simulation determination of EOQ and plot the graphs. [1) Use of any freeware available.]	**CO1, CO4**
6. Assignment on analysis of Manufacturing / Service Operation for Capacity Planning. [1) Define capacity term for the real life environment you are working for (e.g. foundry= tons of casting, hospital = no. of bed, etc.) 2) Study and collect the data of Variation in demand and capacity planning. 3) Analysis the pattern of data set and report… how they manage the change in capacity.]	**CO1, CO4**
7. Case study based assignment on supply chain model. [1) Select any real life supply chain (any engineering product processing, vendors for vegetable grocery, etc.) 2) Identify all major supply chain elements and prepare supply chain diagram and report.]	**CO1, CO4**
8. Assignment on analysis of (selected) plant layout modeling / Simulation for bottleneck / line balancing. [Plant layout with its detail (with Scale) and identify the type.]	**CO1, CO4**
9. Assignment on analysis of material handling system - for the selected plant layout. [This assignment must be completed with the help of plant layout visited in earlier assignment.]	**CO1, CO4**
10. Case study based assignment on identification of Key Result Areas for performance appraisal for selected company (3600 feedback). [Real life case studies.]	**CO1, CO4**
11. Assignment on industrial safety audit of selected work environment. [Download standard questionnaire and visit any work environment and submit it as assignment.]	**CO1, CO4**
Note: If student groups working with industry for their project, they are advised to collect data related to above mentioned assignments for submission.	

20OE 801E Introduction to Cyber Crime and Forensics

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Course Objectives:
To facilitate the learners to-

1 Learn fundamental concepts of cyber security
2 Understand Security challenges presented by mobile devices and information system access in cybercrime world
3 Learn tools used in Computer forensics and Cyber Applications
4 Understand risks associated with social media networking

Course Outcomes:
By taking this course the learner will be able to-

1 Classify Cyber Crimes
2 Identify threats and risks within context of Cyber Security
3 Outline Relevant laws and Acts in Cyber Security
4 Appraise various roles and tools used in Cyber Security/ Digital forensics

Unit I: Introduction to Cybercrime: (7)
Introduction, Cybercrime, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, Ethical dimensions of cybercrime,Ethics and Morality,Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes

Unit II: Cyber Offenses: **(7)**
How Criminals Plan Them: Introduction, How Criminals plan the Attacks, Typical Cyber Crimes like Social Engineering, Cyber stalking, Cyber Defamation, Intellectual property Infringement Botnets: The Fuel for Cybercrime, Dark net

Unit III: Cybercrime:Mobile and Wireless Devices : **(8)**
Introduction, Trends in Mobility, Financial Frauds in Mobile and Wireless Computing, Security Challenges Posed by Mobile Devices, structure of Sim card, Sim card forensics, Sim card cloning, Organizational Measures for Handling Mobile,Mobile Apps and cybercrime, Whats app forward frauds, End point detection systems, End point detection systems in devices in organisation

Unit IV: Methods Used in Cybercrime: (8)

Introduction, Proxy Servers and Anonymizers,Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow

Unit V: Digital Forensics- (6)

Introduction to Digital Forensics, Forensics Software and Hardware, Evaluating computer forensic tools , Software tools and Hardware Tools, New Trends, Mobile forensics for android, Sample Case studies.

Unit VI: Cyber Security Tools- (6)

wireshark, Nmap, Nessus, Ncat, Burp Suite, Snort, Nikto Carer Opprtunities and trends in Cyber Security.

Text Books:

1 Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunil Belapure, Wiley INDIA. ISBN 978-81-265-2179-1
2 Information Security & Cyber Laws By Sarika Gupta, Gaurav Gupta,Khanna Publication ISBN: 978-93-810-6824-3 2019
3 Computer Forensics and Investigations Bill Nelson, Amelia Phillips and Christopher Stuart Cengage learning. ISBN 978-81-315-1946-2

Reference Books:

1 Intoduction to Cyber Security , Chwan-Hwa(john) Wu,J.David Irwin.CRC Press T&F Group
2 Eoghan Casey,"Digital evidence and computer crime Forensic Science,Computers and the Internet , ELSVIER,2011 ISBN 978-0-12-374268-1

20OE801F Instrumentation in Food and Agriculture

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisites: Basics of sensors and transducers, knowledge of Unit operations and basics of process control, PLC and pneumatic and hydraulic instrumentation

Course Objectives:
1 To know the scope of Instrumentation in agriculture field
2 To know greenhouse, food packaging automation schemes
3 Understand sensors used in agriculture field and weather monitoring stations
4 To get acquainted with food quality standards

Course Outcomes: The student will be able to
1 Identify the different unit operations, process control equipments involved in different types of process industries
2 Select appropriate measurement techniques for measurement of various process parameters related to soil, green house, Dam and agro-metrology
3 Analyse and develop various control loops for processes involved in various food processing plants
4 Assess various automation tools to develop automation strategy to Dam, Green house, food processing and packaging in accordance to various food standards

Unit 1: Process Control in Agriculture and Food Industries (08)
Sensors in Agriculture (Hygrometers, Anemometers, fine wire thermocouple, etc), Sensors in Food (ph, temperature sensor for pasteurization, brix sensor, etc), Flow diagram of some continuous processes like sugar plant, dairy, juice extraction, etc & batch process (Fermentation)

Unit 2: Instrumentation in Irrigation and Green House (09)
SCADA for DAM parameters & control, irrigation canal management systems, Auto drip & sprinkler irrigation systems
Green House Automation: Construction of green houses, Sensors for greenhouse, Control of ventilation, cooling & heating, wind speed, temperature & humidity

Unit 3: Instrumentation in Farm equipments, Food Safety and Sanitation (09)
Instrumentation for farm equipment: Implementation of hydraulic, pneumatic and electronic control circuits in harvesters cotton pickers, tractors, etc; Classification of pumps, pump characteristics, selection and installation.
Food safety standards (Food safety and standards bill 2005, Agmark, Bureau of Indian Standards, Codex Standards, recommended international code of hygiene for various products)
Sanitation regulatory requirements: Sanitation standards operating procedure (SSOP's), Sanitation performance standards (SPS), 11 principles of sanitary facility design, Sanitation best practices.

Unit 4: Automation in Food Packaging (08)

Ware house management, Cold Storage Units, PLC and SCADA in food packaging

Unit 5: Smart Instrumentation in Agriculture and Food Industries (08)

Wireless sensors, Application of IOT in agriculture and food industries, application of Image processing in agriculture and food industries, application of robots in agriculture and food industries, Case studies.

Text Books:

1 D. Patranabis, "Principles of Industrial instrumentation", TMH (2010), ISBN-13: 978-0070699717
2 Michael. A.M, " Irrigation : Theory and Practice" , Vikas Publishing House Pvt Ltd, Second edition (2008), ISBN-13: 978-8125918677
3 Curtis D. Johnson, " Process control and instrumentation technology", , 8th Edition, 2015,Person, ISBN: 9789332549456, 9332549451
4 Akalank Kumar Jain , Vidhi Jain "Food Safety and Standards Act, Rules & Regulations", Akalank Publications; 13th Edition edition (2015), ISBN-13: 978-8176393584

Reference Books:

1 Rosana G. Moreira, "Automatic Control for Food Processing Systems (Food Engineering Series)", Springer; 2001 edition (28 February 2001), ISBN-13: 978-0834217812
2 Bela G. Liptak , "Instrument Engineers' Handbook, Process Control and Optimization", CRC Press; 4 edition (29 September 2005), ISBN-13: 978-0849310812.
3 Robert H. Brown, " CRC Handbook of Engineering in Agriculture, Volume II: Volume 1 (C R C SERIES IN AGRICULTURE)", CRC Press; 1 edition (30 June 1988), ISBN-13: 978-084933862

20OE801G Medical IoT

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisites:

Course Objectives:
1 To understand smart Objects and IoT Architecture
2 To learn sensor Interfacing
3 To learn IoT Protocols
4 To build simple IoT based Health care system

Course Outcomes:
1 Ascent the basic concepts of IOT in healthcare
2 Relate the existing hardware platforms and sensor interfaces for various healthcare-based Applications
3 Comprehend the ways of communication between the client and the server in IOT
4 Build various applications in healthcare using IOT based approach with appropriate case studies.

Unit 1: Medical Measurements (06)

Cardiovascular system, respiratory system, nervous system etc. Measurement of Heart, Brain and Muscle activity using wearable sensors. Monitor health parameters like Blood Pressure, ECG, EMG, EEG, HR, RR, SPO2 etc.

Unit 2: Sensors & Smart Patient Devices (08)

Role of Wearables, Challenges and Opportunities, Future of Wearables, Social Aspects, Wearable Haptics, Intelligent Clothing, Industry Sectors' Overview – Sports, Healthcare, Military, Environment Monitoring, Mining Industry, Public Sector and Safety.

Unit 3: Wearable mechatronics device (08)

Accelerometers, Gyroscopic Sensors; In – Shoe Force and Pressure Measurement its applications. Physical Activity Monitoring: Human Kinetics, Cardiac Activity.
Cuffless Blood Pressure Monitor, Study of Flexible and Wearable Piezo resistive Sensors for Cuffless Blood Pressure Measurement, Wearable Pulse Oximeter, Wearable Sweat Analysis, Wearable Heart Rate Measurement**.**

Unit 4: Device Connectivity and Security / Biomedical Sensors with Internet connectivity (08)

Gateway, Embedded Systems for devices like RPi, Arduino, etc, Protocols as applied to medical devices.
Sensor interface: Temperature sensor, pressure sensor, optical sensor etc. Wireless body area network. IoT Privacy and Security.

Unit 5: Data Analytics for Medical Applications (06)

Real Time Data Analytics, Continuous IoT Monitoring, Approach to Predict and Diagnosis of Heart and Chest diseases, Alzheimer, Diabetic Retinopathy etc. through data analytics.

Unit 6: IoT in Biomedical Applications - Case Studies (06)

Secured architecture for IoT enabled Personalized Healthcare Systems, Healthcare Applicatio development in mobile and cloud Environments.

Case Study1: Wireless Patient Monitor system; Design an IoT System for Vital Sign Monitors Weight measuring device, Blood pressure measuring device, ECG, Blood glucose measuring Heart rates measuring devices and Pulse Oximeters etc.

Case Study2: Wearable Fitness & Activity Monitor; Walking time measuring device ii. Ste counting device iii. Speed measuring device iv. Calorie spent measuring device v. Time spent i rest or sleeping measuring device.

Text Books:

1 Joseph D. Bronzino, "Handbook of Biomedical Engineering", 2nd edition –Volume II, CRC press, 2010.
2 Edward Sazonov and Michael R. Neuman, "Wearable Sensors -Fundamentals, Implementation and Applications", Elsevier Inc., 2014.
3 Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by CRC Press.
4 Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press.

Reference Books:

1 Subhas Chandra Mukhopadhyay and Tarikul Islam, "Wearable Sensors - Applications, design and implementation" IOP Publishing Ltd 2017.
2 Shantanu Bhattacharya, A K Agarwal, Nripen Chanda, Ashok Pandey and Ashis Kumar Sen, "Environmental, Chemical and Medical Sensors", Springer Nature Singapore Pte Ltd. 2018.
3 Dieter Uckelmann, Mark Harrison, Florian, "Architecting the Internet of Things", Springer.
4 "The Internet of Things: Key Applications and Protocols", by, Wiley
5 Olivier Hersent, David Boswarthick, Elloumi, Daniel Kellmereit, Daniel Obodovski, "The Silent Intelligence: The Internet of Things", Publisher: Lightning Source Inc; 1st Edition (15 April 2014). ISBN-10: 0989973700, ISBN-13: 978- 0989973700.

20OE801H QUANTUM COMPUTING

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisite: 20BS04 Physics, 20BS01 Linear Algebra & Univariate Calculus,20BS03 Multivariate Calculus

Course Objectives:

1 To give an introduction to quantum computation
2 To explain the basics of quantum mechanics
3 To analyze quantum circuits using qubit gates
4 To elaborate difference between classical and quantum information theory
5 To explain quantum algorithms
6 To explain noise and error correction

Course Outcomes:

After completion of the course, students will be able to

CO1 Describe the basics of quantum computation
CO2 Apply the concepts of quantum mechanics
CO3 Design of quantum circuits using qubit gates
CO4 Comparison between classical and quantum information theory
CO5 Utilize quantum algorithms
CO6 Apply noise and quantum error correction

Unit I: Introduction to Quantum Computation (03)

Quantum bits, Bloch sphere representation of a qubit, multiple qubits.

Unit II: Background Mathematics and Physics (08)

Hilbert space, Probabilities and measurements, Entanglement, Density operators and correlation, Basics of quantum mechanics, Measurements in bases other than computational basis.

Unit III: Quantum Circuits (08)

Single qubit gates, Multiple qubit gates, Design of quantum circuits.

Unit IV: Quantum Information and Cryptography

Comparison between classical and quantum information theory, Bell states, Quantum teleportation, Quantum Cryptography, No cloning theorem.

Unit V: Quantum Algorithms

Real Time Data Analytics, Continuous IoT Monitoring, Approach to Predict and Diagnosis of Heart and Chest diseases, Alzheimer, Diabetic Retinopathy etc. through data analytics.

Unit VI: Noise and error correction

Graph states and codes, Quantum error correction, fault-tolerant computation.

Text Books:

1 Michael Nielsen and Isaac Chuang, **"Quantum Computation and Quantum Information"**, *CambridgeUniversity Press, UK*, (10th Edition), (2012).
2 Phillip Kaye, Raymond Laflamme and Michele Mosca,**"An Introduction to Quantum Computing"**, *Oxford University Press, UK*, (1st Edition), (2007).

Reference Books:

1 N. David Mermin, **"Quantum Computer Science An Introduction"**,*Cambridge University Press*, UK, (1st Edition), (2007).
2 NosonYanofsky and MircoMannucci, **"Quantum Computing for Computer Scientists"**, *Cambridge University Press*, (1st edition), (2008).

Online Resources:

1 NPTEL Course **"Quantum Computing"**
https://onlinecourses.nptel.ac.in/noc19_cy31/

20OE801I RENEWABLE ENERGY SOURCES

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
ISE**:** 50 Marks
ESE**:** 50 Marks
Credits: 3

Course Objectives:
To make students

1 Understanding basic characteristics of renewable sources of energy and technologies for their utilization.
2 Learning engineering approach for renewable energy projects.
3 For analyze energy potential of renewable sources of energy.

Course Outcomes:
Students will be able to

1 Understand of different renewable sources of energy and technologies for their utilization.
2 Select engineering approach to problem solving when implementing the projects on renewable sources of energy.
3 Undertake simple analysis of energy potential of renewable sources of energy.
4 Describe main elements of technical systems designed for utilisation of renewable sources of energy.

Unit/Module: 1 Solar Energy 8 hours CO: 1

Solar potential, Solar radiation geometry, Solar radiation data, radiation measurement, Types of Solar Collectors, Collection efficiency, Applications of Solar Energy, Solar Desalination system, Solar dryer, Solar Energy storage. Solar PV Principle, Photo-cell materials, Applications.

Unit/Module: 2 Wind Energy 7 hours CO: 2,3

Wind parameters and wind data, Power from wind, Site selection, selection of components, Blade material, Wind energy conversion systems and their classification, Construction and working of typical wind mill, wind farms, present status.

Unit/Module: 3 Biomass Technology 7 hours CO: 2,3

Introduction to biomass technology, Combustion and fermentation, Biomass gasification, types of gasifire, Pyrolysis, various applications of Biomass energy, Bio-fuel types, and applications.

Unit/Module: 4 Ocean – Tidal – Geothermal Energy 6 hours CO: 3

Introduction to OTEC, open and closed cycle OTEC systems, Energy through waves and tides. Geothermal Energy, Energy generation through geothermal system, types of geothermal resources, Introduction of tidal systems, Environmental impact.

Unit/Module: 5 Hydrogen - Fuel Cell – Hybrid Energy System 7 hours CO: 4

Introduction to hydrogen and fuel cell technology, applications of hydrogen and fuel cell technology. Need for hybrid energy systems, Case studies of hybrid energy system such as Solar-PV, Wind-PV, Micro hydel- PV, Biomass-Diesel systems.

Total Theory hours: 35 hours

Text Books:

1 Solar Energy by Dr. S.P.Sukhatme Tata McGraw Hill.
2 Non Conventional Energy Sources by G.D.Rai.- Khanna Publishers.
3 Energy Technology by S. Rao, Dr. B.B.Parulekar Khanna Publishers.

Reference Books:

1 Fan Lin You,Hong ye (2012), Renewable Energy Systems, Advanced conversion technologies and applications, CRC Press
2 John. A. Duffie, William A.Beckman (2013) Solar Engineering of Thermal processes, Wiley
3 Godfrey Boyle (2017), Renewable Energy, power for sustainable future, Oxford University Press.
4 A.R.Jha (2010), Wind turbine technology, CRC Press.

20OE 801J Soft Computing

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Course Objectives:

1. To understand basics in soft computing
2. To understand concepts of fuzzy logic and fuzzy sets
3. To understand supervised neural network architecture, training and testing algorithms and tools for the same
4. To understand unsupervised neural network architecture, training and testing algorithms
5. To understand concept for optimization, evolutionary programming and genetic algorithm and tools for the same
6. To understand concept swarm intelligent systems and tools for the same

Course Outcomes:
After completion of the course, students will be able to

1 Identify various soft computing and artificial neural network constituents to solve the problems in engineering domain
2 Experiment with fuzzy logic principles
3 Apply Supervised learning algorithms in artificial neural networks to simple real life problems
4 Apply Unsupervised learning algorithms in artificial neural networks to simple real life problems
5 Apply principles of genetic algorithm in solving engineering optimization problems
6 Apply principles of swarm intelligence in solving engineering optimization problems

Unit I: Introduction to Intelligent systems, soft tools and Artificial Neural network (07)

Soft computing constituents and conventional Artificial Intelligence, Artificial Neural network: definition, advantages of artificial neural network, Fuzzy Set Theory, Genetic algorithm, hybrid systems: neuro fuzzy, neuro genetic, fuzzy genetic, soft computing, Introduction to Artificial Neural Network: Fundamental concepts, basic models of artificial neural network, important terminologies of ANNs, McCulloch- Pitts Neuron, linear separability.

Unit II: Fuzzy logic and fuzzy sets (07)

Introduction to fuzzy logic, fuzzy sets, fuzzy set operations, properties of fuzzy sets, classical relation, fuzzy relation, membership function, fuzzification, Methods of membership value assignments, lambda-cuts for fuzzy set, lambda-cuts for fuzzy relations, defuzzification.
Introduction to tools for fuzzy logic using MATLAB/ Python

Unit III: Supervised Learning Networks (07)

Introduction, Perceptron Networks: Perceptron learning rule, Architecture, perceptron training algorithm for single output classes, perceptron training algorithm for multiple output classes, perceptron network testing algorithm, Back Propagation Network: flowchart for training process, training algorithm, linear factors of back- propagation networks, number of training data, number of hidden layer nodes, testing algorithm of back- propagation networks. Introduction to tools for Supervised Learning Networks using MATLAB/ Python

Unit IV: Associative Memory Networks and Unsupervised Learning Networks (07)

Associative Memory Networks: Introduction, Training algorithm for pattern association: Hebb rule, Auto-associative Memory networks, Bidirectional associative memory: architecture, discrete bidirectional associative memory, Unsupervised Learning Networks: Introduction, Fixed wright competitive nets: max net, Kohonen Self organizing feature maps

Unit V: Genetic Algorithm (07)

Introduction, Traditional Optimization and Search Techniques, biological background, genetic algorithms and search space, genetic algorithm vs. traditional algorithms, basic terminologies in in genetic algorithm, simple GA, operations in genetic algorithm: encoding- binary, octal, selection- Roulette wheel selection, random selection, crossover- single point cross over, two point crossover, mutation- flipping, interchanging, stopping condition for genetic algorithm flow, constraints in genetic algorithm. Introduction to tools for Genetic Algorithm using MATLAB/ Python

Unit VI: Swarm Intelligent Systems (07)

Introduction, background of Ant Intelligent systems, Importance of the Ant Colony Paradigm, Ant colony systems, Development of Ant colony systems, Applications of Ant Colony Intelligence, the working of ant colony systems, practical swarm intelligent systems: The basic of PSO method, Characteristic features. Introduction to tools for Swarm Intelligent Systems using MATLAB/ Python

Text Books:

1 S.N. Sivanandam- **"Principles of Soft Computing",** Third Edition, Wiley India- ISBN 9788126577132, 20018
2 B K Tripathy, J Anuradha, "Soft Computing- Advances and Applications", Cengage India, ISBN: 78-8131526194, 1st, 2018
3 P.Padhy, **"Artificial Intelligence and Intelligent Systems"** Oxford University Press, ISBN 10: 0195671546, 2005

Reference Books:

1 De Jong, **"Evolutionary Computation: A Unified Approach",** Cambridge (Massachusetts): MIT Press. ISBN: 0-262-04194-4. 2006

2 J. S. R. Jang, CT Sun and E.Mizutani, **"Neuro-Fuzzy and Soft Computing" ,** PHI PVT LTD, ISBN 0-13-261066-3. 2015

3 S. Rajsekaran and G.A. Vijayalakshmi Pai, **"Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications"** , Prentice Hall of India, ISBN: 0451211243, 2003

4 1. Sinha N.K., **" Soft Computing And Intelligent Systems: Theory And Applications"**, ISBN-13: 978-0126464900, Elsevier. 2007.

20OE 801K Software Testing and Quality Assurance

Teaching Scheme:
Lectures : 3 hours/week
Tutorial : --

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

Prerequisites:

Course Objectives:
Familiarize students with
1. Testing strategies in projects.
2. Levels of testing strategies
3. Various quality assurance models
4. Automated Testing Tools

Course Outcomes:
Students should be able to
1. Explain different terminologies in software testing.
2. Apply appropriate testing technique based on the project scenario
3. Choose quality assurance models for the project
4. Make use of modern testing tools suitable for the project

Unit – I Fundamentals **7 Hours**
Testing as a Process, Software testing principles, The tester's role in a software development organization, Origins of defects, Defect classes, Testing fundamentals, the defect repository and test design, Defect examples, Developer /Tester support for developing a defect repository. Process model to represent Different phases, Lifecycle models

Unit – II Levels of testing **7 Hours**
Need for levels of testing, Unit testing, Integration testing, System Testing - Usability and Accessibility Testing, Configuration Testing, Compatibility Testing, Stress testing, Regression testing, Alpha, Beta and Acceptance testing.

Unit – III Testing techniques **7 Hours**
Using White Box Approach to Test design - Static Testing, Structural Testing, Unit Functional Testing, Challenges in White box testing, Using Black Box Approaches to Test Case Design, Random Testing, Requirements based testing, Decision tables, State-based testing, Cause-effect graphing, Error guessing, Compatibility testing.

Unit – IV Fundamentals of software quality assurance **7 Hours**
SQA basics, Components of the Software Quality Assurance System, software quality in business context, planning for software quality assurance, product quality and process quality, software process models, 7 QC Tools and Modern Tools.

Unit – V Quality assurance models **7 Hours**
Models for Quality Assurance, ISO-9000 series, CMM, CMMI, Test Maturity Models, SPICE, Malcolm Baldrige Model- P-CMM, Clean-room software engineering, Defect Injection and prevention, Inspections & Walkthroughs, Case Tools and their effect on Software Quality.

Unit – VI Software test automation **7 Hours**

Software Test Automation, Skills needed for Automation, Scope of Automation, Design and Architecture for Automation, Requirements for a Test Tool, Challenges in Automation Tracking the Bug. Combining Manual and Automated Testing

Text Books

1. Srinivasan Desikan, Gopalaswamy Ramesh, "Software Testing: Principles and Practices", Pearson
2. Ilene Burnstein, "Practical Software Testing", Springer International edition

Reference Books

1. Paul C. Jorgensen, "Software Testing: A Craftsman's Approach", Auerbach Publications
2. William Perry, "Effective Methods of Software Testing", Wiley Publishing, Third Edition
3. Stephen Kan, "Metrics and Models in Software Quality", Addison – Wesley, Second Edition
4. Watts S Humphrey, "Managing the Software Process", Pearson Education Inc.

20OE 802A Applied Statistics with R programming

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisites: Mathematics

Course Objectives:

Familiarize students with

1 Fundamentals in Statistics
2 Evaluation and Interpretation of applied statistics
3 Hypothesis Test
4 R programming used in statistical analysis

Course Outcomes:

Students should be able to

1 Apply probability for statistical analysis.
2 Draw inferences from statistical analysis of data
3 Apply statistical methods and hypothesis tests on data
4 Explain Multivariate Analysis

Unit I: Probability **7 Hours**

Introduction, conditional probability, Bayes Theorem and independence, random variable and Probability distribution, normal distribution.

Unit II: Basic statistical measures **9 Hours**

Introduction to statistics, type of data, processing the data, classification, graphical representation. Introduction Measures of central Tendency: Arithmetic Mean, Weighted Arithmetic Mean, Median, mode, Measurement of variation: Quartile, Average and Standard Deviations, Coefficient Variation, Measurement of skewness
Case Study with R programming

Unit III: Analysis of Variance **8 Hours**

Normal distribution, evaluating normal distribution, Binomial distribution, confidence Intervals, central limit Theorem, ANOVA, Completely randomized design, Latin square Design, Duncan's Multiple Range Test
Case Study with R programming

Unit IV: Types of hypothesis **9 Hours**

Introduction , types of hypothesis, Tests of hypothesis concerning means, hypothesis concerning proportions, Hypothesis concerning variations (Chi-square and F-tests), Chi square test for checking independence of categorized data, goodness of Fit Test
Case Study with R programming

Unit V: Multivariate Analysis 9 Hours

Correlation: Introduction , types of correlations, Correlation Analysis, correlation coefficients,
Regression: Introduction, Linear Regression, Regression analysis, regression coefficients.
MANOVA, Discrimination Analysis, Factor Analysis, Principle Component Analysis and Independent Component Analysis
Case Study with R programming

Text Books:

1 S.P. Gupta, "Statistical Methods", Sultan Chand and sons Publication, 41st Edition.
2 B.L. Agarwal, "Basic Statistics", New Age Publication, 9th Edition
3 A. Papoulis, S.U. Pillai, "Probability Random Variables and Stochastic Processes", Tata McGraw Hill, (4th Edition)

Reference Books:

1 S. M.Ross, "Introduction to Probability and Statistics for Engineers and Scientists", Elsevier Publication, 5th Edition
2 Piegorsch W.W, "Statistical Data Analytics", Wiley Publication.
3 E. Rukmangadchari, E.K.Reddy, "Probability and Statistics", Pearson India Pvt.Ltd.,1st Edition
4 Rohatgi A.K. Md e. Saleh, "Introduction to Probability and Statistics", Wiley Publication Pvt. Ltd. 3rd Edition.

Web References

1 NPTEL NOC: Descriptive Statistics with R software, Prof. Shalabh, IIT Kanpur,
2 NPTEL NOC: Applied Statistics and Econometrics, Prof. Mukherjee, IIT Kanpur

20OE802-B Automobile Engineering (AE)

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
ISE**:** 50 Marks
ESE**:** 50 Marks
Credits: 3

Course Objectives:
To make students

1 To study layout of the vehicles.
2 To understand function of various components of automotive systems
3 To understand use of alternative fuels for vehicle.

Course Outcomes:
Students will be able to

1 Identify different layouts of automobile vehicle and engine auxiliary systems.
2 Explain latest transmission, steering, braking and suspension systems in vehicle.
3 Explain EV, HEV, latest trends in AI technologies
4 Understand energy sources, current emission norms and emission control systems.

Unit/Module: 1 Vehicle Structure and Engine auxiliary systems 6 hours CO: 1
Vehicle construction and different layouts, chassis, frame and body, components of engine. Electronically controlled gasoline injection system for SI engines. Electronically controlled diesel injection system, electronic ignition system. Introduction to Vehicle Maintenance and Servicing.

Unit/Module: 2 Transmission Systems 6 hours CO: 2
Introduction to transmission system, Automatic transmission system (fluid coupling, clutch less drive, fluid flywheel – torque converter), Semi-automatic transmission, continuously variable transmission (CVT), dual clutch hybrid transmission

Unit/Module: 3 Steering, Brakes and Suspension Systems 6 hours CO: 2
Introduction to Steering geometry and its function, Power Steering. Introduction to suspension system, Active and passive Suspension. Introduction to Braking Systems, Regenerative breaking, Anti-lock Braking System (ABS), EBS and Traction Control.

Unit/Module: 4 Electric and hybrid vehicles 6 hours CO: 3

Concept of electric and hybrid vehicle, EV and HEV fundamentals, architecture of EV and HEV power train, drives and energy sources in EV and HEV, Artificial intelligence technologies such as Autonomous Vehicles, computer vision assist drivers to improve safety, improve services such as vehicle inspection or insurance. Role of IoT to secure communication between vehicles as well as vehicles and infrastructure components

Unit/Module: 5 Modern Energy Sources and optimizing supply chain 6 hours CO: 4

Compressed Natural Gas (CNG), Liquefied Petroleum Gas (LNG), Bio-fuels, lithium-ion battery, hydrogen fuel cell in Automobiles, Introduction to Optimization of Supply Chain in Automotive Industry

Unit/Module: 6 Emission control in automobiles 6 hours CO: 4

Emission and Fuel Roadmap Euro 6 / BS V norms (proposed 2020-21), Effect of car emissions on human health and the environment. Exhaust gas re-circulation (EGR) and Engine emission control (three-way catalytic converter system SCR and particulate filter).

Text Books:

1 Kirpal Singh, Automobile Engineering Vol 1 and 2, Standard Publishers, 7th Edition, 1997
2 M. Chris and M. A. Masrur, Hybrid Electric Vehicles, Wiley Publications, 2nd Edition, 2017
3 Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press

Reference Books:

1 K. K. Jain and R. B. Asthana, Automobile Engineering, Tata McGraw Hill Publishers, New Delhi, 1999.
2 Barry Hollembeak, "Automotive Electricity and Electronics" Cengage Learning, Cliftorn Park, USA 2007.
3 Dr. K. R. Govindan, Automobile Engineering, Anuradha Publications, Chennai, 2013.
4 Joseph Heiner, Automotive Mechanics, Litton Education Publishing Ins., New York, 1999.
5 Angelin, Automotive Mechanics, Tata McGraw Hill Pub. Comp. Ltd., 10th Edition, 2004.
6 Josep Aulinas, Hanky Sjafrie, AI for Cars, Chapman and Hall/CRC Press, 1st Edition.

20OE802C AUTONOMOUS ROBOTS

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisite: 20BS01Linear Algebra and Univariate Calculus, 20ES01: Basic Electrical and Electronics Engineering

Course Objectives:

1 To explain fundamentals of robotic system
2 To introduce kinematics, dynamics and control for robotics systems
3 To introduce trajectory planning for motion
4 To describe application of robots in automation

Course Outcomes:
After completion of the course, students will be able to

CO 1	Explain and classify different components used in developing autonomous robot
CO2	Select sensors, actuators and grippers for autonomous robot
CO3	Apply formulations to obtain kinematics, dynamics and trajectory planning of autonomous robot
CO4	Develop path planning and navigation algorithm for autonomous robot
CO5	Design robot for automation

Unit I: Introduction to Robotics (10)
Definition of robotics, Types of robots, Components of Robot system, Classification of robots , Robot architecture, Robot locomotion, Specification of robot, Robot sensors for position, Acceleration sensors, Proximity, Velocity sensors, Force sensors, Tactile sensor, Camera and robot vision, Actuators and end effectors.

Unit II: Introduction to Mechanics of Robotic Arm (10)
Position and orientation description, Coordinate transforms, Homogeneous transform, Denavit and Hartenberg (DH) parameters, Forward and inverse kinematic analysis, Dynamics and inverse Dynamics of robots, Newton–Eller formulation, Trajectory and Path planning, Application of robotic arm.

Unit III: Mobile robot Kinematics and Dynamics (08)
Forward and inverse kinematics, holonomic and nonholonomic constraints, Kinematic models of simple car and legged robots, Dynamic simulation of mobile robots.

Unit IV: Localization (06)

Odometric position estimation, Belief representation, Probabilistic mapping, Markov localization, Bayesian localization, Kalman localization, Positioning beacon systems.

Unit V: Introduction to Planning and Navigation (08)

Path planning algorithms based on Simultaneous Localization and Mapping (SLAM) algorithm, A-star, D-star, Voronoi diagrams, Probabilistic Road Maps (PRM), Rapidly exploring Random Trees (RRT), Markov Decision Processes (MDP), Stochastic Dynamic Programming (SDP).

Text Books:

1 R. Siegwart, I. R. Nourbakhsh, **"Introduction to Autonomous Mobile Robots"**, *The MIT Press*, (2nd Edition), (2011).
2 Francis X. Govers, **"Artificial Intelligence for Robotics",** *Packt Publishing Ltd., United Kingdom*, (1st Edition), (2018).
3 Robin R. Murphy, **"Introduction to Artificial Intelligence for Robotics"**, *The MIT Press*,(2nd Edition), (2000).
4 S. K. Saha, **"Introduction to Robotics"**, *Tata McGraw Hill*, (2nd Edition), (2014).

Reference Books:

1 K. S.Fu, R. C. Gonzalez, C. S. G. Lee, "**Robotics Control, Sensing, Vision and Intelligence" ,** *Tata McGraw Hill* **,** (2nd Edition), (2008).
2 Robert J. Schilling, **"Fundamentals of Robotics- Analysis and Control",***Prentices Hall India*, (1st Edition), (2008).

Online Resources:

1 NPTEL Course **"Wheeled Mobile Robot"**
https://nptel.ac.in/courses/112/106/112106298/

20OE802D Building Automation and Energy Audit

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisites: Basics of Electronics and Instrumentation

Course Objectives:

1 To understand Need and Applications Building automation systems.
2 To understand the working of various Building automation components.
3 To Select and Implement Building automation with various applications.

Course Outcomes: The student will be able to

1 Investigate the system requirements for developing building automation systems
2 Compare and choose the suitable building automation systems for the applications
3 Design building automation system for required application
4 Evaluate the performance of the designed building automation system

Unit 1: Fire Alarm Systems I (08)

Introduction: to BAS, Need and Applications of BAS, Block diagram of BAS.FAS: Need and Applications of FAS, Types of FAS, Block diagram of FAS, Fire, Fire Development Stages, Fire Signatures, Initiation Devices, Notification Appliances, IDC Placements, NAC Placements, Fire Suppression: Fire Extinguishers & Its Classification, Fire Suppression Systems.

Unit 2: Fire Alarm Systems II (08)

IDC, NAC, SLC, FAS Wiring Standards, FAS Communication Protocols, Voltage Drop Analysis, Battery Capacity Analysis, Cause & Effect Matrix.

Unit 3: Access Control Systems (06)

Introduction to Security Systems, Types of Security systems, Access Control Systems: Introduction, Applications, Concept, Generic Model, Components, Card Technologies, Communication Protocols for ACS, Biometrics for ACS, CCTV System Types: CCTV Components, Digital Video Management System

Unit 4: HVAC- Air Systems (06)

Human Comfort Parameters and Air Properties Need of HVAC System, HVAC Block Diagram. AHU: Concept, Working, AHU Functions, AHU Components: Dampers, Filters, Cooling coil, Heating coil, etc., AHU Configurations, AHU Locations, AHU Terminal Units: CAV, VAV, Measurement and Control Loops for Air Systems.

Unit 5: HVAC- Water Systems (07)

Cold Water System: Refrigeration Cycles, Chillers, Cooling Towers, Types of chilled water system, Concept of Free Cooling : Direct Waterside, Series Waterside, Parallel Waterside. Hot Water Systems: Heating Circuits, Boilers, Types of Boilers, Heat Exchangers: Steam Input and Hot Water Input, Solar Hot Water System, Measurement and Control Loops for Water Systems.

Unit 6: Building Energy Management System (07)

Overview of Building Energy Management Systems, BEMS Control systems overview, Benefits of BEMS, Energy System Monitoring, Application of Energy Efficient Strategies, Effective Energy management, Computerized Energy Management Systems.

Text Books:

1 Robert Gagnon, Design of Special Hazards and Fire Alarm Systems
2 Damjanovski, Vlado, CCTV, Butterworth-Heinemann, 3rd ed
3 Benantar M., Access Control System
4 Montgomery R, Fundamentals of HVAC Control Systems, Elsevier Publications
5 Roger W. Haines "HVAC Systems Design Handbook", Fifth Edition
6 James E. Brumbaugh "HVAC Fundamentals", volume 1 to 3
7 "Basics of Air Conditioning" ISHRAE, Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0004 for online shopping)

Reference Books:

1 "All About AHU's", ISHRAE. Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0005 for online shopping)
2 "Chillers Basics", ISHRAE. Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0009 for online shopping)
3 "HVAC Handbook Part-1", Indian Society of Heating, Refrigerating & Air Conditioning Engineers
4 "Handbook – Industrial Ventilation Application", 2004, Indian Society of Heating, Refrigerating & Air Conditioning Engineers

20OE 802E Data Analysis and Visualization

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisites:

1 Basic Mathematics
2 Basics of Python Programming

Course Objectives:
To facilitate the learners
1 To understand the data analytics and visualization as well as the statistics behind it.
2 To understand and analyze the machine learning methods used in data analysis
3 To understand the modern tools used for data analytics and visualization.

Course Outcomes:
By taking this course, the learner will be able to
1 Develop the knowledge of data analysis and the statistical tools used for analysis
2 Identify the relevant data analysis method for a real time application
3 Select the appropriate data visualization method for the application in hand
4 Understand recent trends in data analysis and visualization

Unit 1: INTRODUCTION TO DATA ANALYTICS (06)
Introduction to Data, Data types and their relationships, Data Analytics workflow, Types of analysis Applications.

Unit 2: BASIC DATA ANALYTICS (08)
Statistical analysis, Attribute correlation, Regression analysis, Dimensionality reduction, Feature extraction and selection, Time series prediction, Hypothesis Analysis
Case study, Python based examples

Unit 3: MACHINE LEARNING FOR DATA ANALYTICS (10)
Data analysis methods used for Clustering, Classification, Regression, Outlier Detection, Time Series Prediction, Anomaly Detection, Association, Recommendation Systems
Case study, Python based examples

Unit 4: DATA VISUALIZATION (10)
Purpose and types of Visualization, Graphical Representation, Multidimensional Visualization, Handling data Cleaning, data reduction for visualization, Sorting and Scaling, Multivariate Glyphs
Case study, Python based examples

Unit 5: RENDS IN DATA ANALYSIS AND VISUALIZATION (08)

Deep Learning for Data Analysis, handling of small and Big Data,
Storytelling and Data Visualization Dashboards
Case study, Python based examples, Demo with tool like Tableau.

Text Books:

1 Dr. Anil Maheshwari, '**Data Analytics'**, McGraw Hill Education (India) Pvt. Ltd. (2017)
2 Dr. Ossama Embarak, **'Data Analysis and Visualization Using Python'**, aPress (2018)

Reference Books:

1 Wes McKenny, **'Python for Data Analysis'**, O'Reilly (2013)
2 Han and Kamber, **'Data Mining: Concepts and Techniques'**, The Morgan Kaufmann Series in Data Management Systems (2011)
3 Christopher Bishop, **'Pattern Recognition and Machine Learning'**, Springer (2010)
4 Edited by Chun-houh Chen, Wolfgang Härdle and Antony Unwin, **'Handbook of Data Visualization'**, Springer (2008)

Web References:

1 Academic use of Tableau - https://www.tableau.com/academic/teaching
2 NPTEL Courses
   a Introduction to Data Analytics https://nptel.ac.in/courses/110/106/110106064/
   b Data Analytics with Python https://nptel.ac.in/courses/106/107/106107220/
   c Python for Data Science https://nptel.ac.in/courses/106/106/106106212/
   d Introduction to Learning Analytics https://nptel.ac.in/courses/127/101/127101012/
   e Data Analytics with Python https://onlinecourses.nptel.ac.in/noc20_cs46/preview

20OE 802F Data Science Using Python

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisites:

1 Basic Mathematics
2 Basics of Python Programming

Course Objectives:
To facilitate the learners
1 To understand the data analytics and visualization as well as the statistics behind it.
2 To understand and analyze the machine learning methods used in data analysis
3 To understand the modern tools used for data analytics and visualization.

Course Outcomes:
By taking this course, the learner will be able to
1 Develop the knowledge of data science.
2 Identify the relevant Python method used in data science.
3 Select the appropriate data operation method for the application in hand.
4 Understand recent trends in data science and analysis.

Unit 1: INTRODUCTION TO DATA (06)
Introduction to Data, Data types and their relationships, Handling different types of data using Python, Handling numeric and categorical data using Python

Unit 2: BASIC DATA Processing using NumPy, Pandas (08)
Statistical operations, data cleaning, missing data, indexing, slicing, iterating, attribute selection, dimensionality reduction, Handling tabular data, time series
Case study, Python based examples

Unit 3: MACHINE LEARNING using Sci-Kit, Tensorflow - I (08)
Clustering, Classification, Regression, Outlier Detection
Case study, Python based examples

Unit 4: MACHINE LEARNING using Sci-Kit, Tensorflow- II (08)
Time Series Prediction, Anomaly Detection, Association, Recommendation Systems
Case study, Python based examples

Unit 5: REGRESSION ANALYSIS AND PREDICTIVE ANALYSIS (06)

Introduction to types of analysis - Predictive, descriptive and decision based, Regression analysis, types - linear, logistic, ridge, lasso

Unit 6: DATA VISUALIZATION AND GRAPHICS USING Matplotlib / Seaborn (06)

Basic visualization plots - Area, histogram, bar, Specialized plots - pie, box, scatter, bibble, Waffle, Word clouds, Seaborn, Regression plots
Introduction to Folium, maps with markers, choropleth maps, dashboards

Text Books:

1 Aurélien Géron, '**Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems'**, O'Reilly Media (2017)
2 Samir Madhavan, '**Mastering Python for data science'**, Packt (2015)
3 David Beazley, '**Python CookBook**', O'reilly (2013)
4 Dr. Ossama Embarak, **'Data Analysis and Visualization Using Python'**, aPress (2018)

Reference Books:

1 Wes McKenny, **'Python for Data Analysis'**, O'Reilly (2013)
2 Han and Kamber, **'Data Mining: Concepts and Techniques'**, The Morgan Kaufmann Series in Data Management Systems (2011)
3 Christopher Bishop, **'Pattern Recognition and Machine Learning'**, Springer (2010)
4 Edited by Chun-houh Chen, Wolfgang Härdle and Antony Unwin, **'Handbook of Data Visualization'**, Springer (2008)

Web References:

1 Academic use of Tableau - https://www.tableau.com/academic/teaching
2 NPTEL Courses
   a Python for Data Science https://nptel.ac.in/courses/106/106/106106212/
   b Introduction to Data Analytics https://nptel.ac.in/courses/110/106/110106064/

20OE802G Industrial Drives and Control

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisites:

Course Objectives:

1 To evaluate and select a suitable drive for a particular application.
2 To analyse the basic drive system dynamics
3 To develop the basic design of an electric drive system.

Course Outcomes:

1 Selection of appropriate drive for the given application
2 Selection of suitable control system scheme along with the interlocking for given application
3 Analysis of the control drive dynamics for the desired drive system
4 Design of the total electric drive system based on desired application

Unit 1: Introduction to Industrial Drives (07)
Concept of electric drive, Power modulators, Motors used in drives, types of loads choice of drives, classification of drives Multi quadrant operation of Drives.

Unit 2: Introduction to Control Systems (07)
Open and closed loop systems with examples, automatic control, speed control of motors

Unit 3: Electrical Control of Machines (08)
Manual control – Magnetic control – Semi-automatic and Automatic control of Modern machinery – Development of Control circuits–Two wire and Three wire control – Remote control –

Unit 4: Interlocking of drives (08)
Control circuit components –Symbols for control components–Fuses, Switches and Fuse Switch units.

Unit 5: Dynamics and Control of Electric Drives (06)
D.C. motor drives, Induction motor drives, Synchronous and Brushless D.C. motor drives.

Unit 6: Industrial process and drives (06)

Process flow diagram of paper mill, cement mill, sugar mill, steel mill, Hoists and cranes, centrifugal pumps and compressors, solar powered pump drives, selection of drives for the above processes

Text Books:

1 Electrical Motor Drives, R. Krishnan [PHI-2003]

2 Electric Drives, Vedam Subrahmaniam [TMH-1994]

3 Industrial Drives and Control, Sandeep M. Chaudhari, Nilesh R. Ahire [Nirali Prakashan]

Reference Books:

1 Control of Electric Drives,W. Leonard, [Springer- 2001]

2 Electrical Drives, Second Edition, S.A. Nasar, Boldea [CRC Press - 2006]

20OE802H Smart Sensors and Systems

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisites:

Course Objectives:

1 Theoretical understanding of various physical phenomena behind the operation of different types of sensors and microsystems
2 Overview of micro/nano fabrication process
3 Develop a complete sensor or sensor system, MEMS device or microsystem

Course Outcomes:

1 Selection of suitable sensor along with the associated electronics and fabrication process for given application
2 Selection of appropriate smart sensors for the desired application in the field of Automobile, Biomedical, Military, Space and Défense.
3 Design of application-based sensors in the field of Military, Défense, Spacecraft and environment
4 Analysis of the system designed for applications in the field of Biomedical and Automobile

Unit 1: Introduction to Smart Sensors and Systems (07)

Principles of Sensing, Classification and Terminology of Sensors. Introduction to micromachining - Fabrication and miniaturization techniques
Digital Signal Controllers (Microcontrollers and Digital Signal Processors) for Smart sensors
Key features, Certain case studies - for eg: temperature, fingerprint recognition

Unit 2: Microfabrication process (08)

Fabrication and miniaturization techniques, Steps involved in fabrication

Unit 3: Smart sensors in Biomedical field (08)

Bio-analytical [sample preparation and detection of compound] sensors & systems, Transduction modes & classifications,
Hall Effect sensors and associated signal conditioning circuits, Sensors for displacement (linear and angular), velocity, acceleration, force, torque, vibration and shock measurements. Sensor measurements for conductivity and viscosity. Electrochemical transducer in Biology and medicine Biochemical Transducer, Enzyme-based electrochemical biosensors, electronic tongue, few related Case studies

Unit 4: Smart sensors in Automobile industry (07)

Introduction to Modern Automotive Systems and need for electronics in Automobiles, Sensors for vehicle body management, Sensors for automotive vehicle convenience and security systems, Sensors for chassis management, Powertrain sensors, Air Bag and Seat Belt Pre tensioner Systems, Case studies explaining the Modern Trends and Technical Solutions, Related communication systems

Unit 5: Smart sensors related to Environment and in Spacecraft (06)

Human Toxicology Ecotoxicology, W ater and air pollution sources
E-nose for Sensitive and Selective Chemical Sensing, Chemical sensors, Ocean environment
Smart sensors in spacecraft - in monitoring applications, Smart Instrumentation Point Bus (SIP), Solid state micro-gyroscopes, related Case studies

Unit 6: Smart sensors in Military and Defence (06)

Types of sensors (Accelerometers, Inertial Sensors, Pressure Sensors, Force Sensors, Motion Sensors, Gyroscopes, Temperature Sensor and Others), Device-based Sensor, Clothing-based Sensor, Application based sensors - Wrist Wear, Foot Wear, Eye Wear, Body Wear and Neck Wear, intelligent sensor technology for surveillance and electronic intelligence, Case studies, related communication systems

Text Books:

1 Understanding Smart Sensors, Randy Frank [Artech House, Boston London]
2 Smart Sensors for Environmental and Medical Applications, Hamida Halilil, Hadi Heidari [Wiley]
3 Smart Sensors and MEMS: Intelligent Devices and Microsystems for Industrial Applications, S Nihtianov, Antonio Luque [Science Direct]

Reference Books:

1 Smart Sensors and Systems, Lin, Y.-L., Kyung, C.-M., Yasuura, H., Liu, Y. [Springer]
2 Smart Sensor Systems, Gerard Miejer [Wiley]

20OE802I Wireless Networks

Teaching Scheme
Lectures**:** 3 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisites: Nil

Course Objectives:

1 To explain the importance of wireless communication and multiple access techniques
2 To elaborate the behavior of communication system for indoor and outdoor wireless networks
3 To introduce 3G, 4G cellular network components and 5G future wireless network
4 To explain MIMO technology
5 To introduce visible light communications

Course Outcomes:
After completion of the course, students will be able to

CO1 Explain fundamentals of wireless communication and multiple access techniques
CO2 Analyze the behavior of communication system for indoor and outdoor wireless networks
CO3 Apply 3G, 4G cellular network standards and describe 5G future wireless network
CO4 Interpret MIMO technology its advantages and limitations
CO5 Explain LiFi networking and technology for indoor network access

Unit I: Introduction to wireless communication (08)

Fundamentals of Wireless Communication: Advantages, Limitations and Applications, Frequency Spectrum, Radio and Infrared Frequency Spectrum, Wireless Media, Spread spectrum, Multiple access technique: TDMA, CDMA, FDMA, CSMA, OFDMA.

Unit II: Wireless indoor and outdoor networks (08)

WLAN, WiFi, Bluetooth, Zigbee, Ultra Wideband communication, Infrared, UHF narrowband, WiMax, Limitation of indoor networks.

Unit III: Cellular Network (08)

Spectrum reuse and re-framing, Cell cluster concept, Co-channel and adjacent channel interference, Cell site, call blocking and delay, Channel allocation strategies, 3G and 4G standard.

Unit IV: Future Wireless networks (10)

Introduction to 5G, Modulation techniques for 5G, Architecture, MIMO, Massive MIMO, Limitations and applications.

Unit V: Visible Light Communications (08)

LiFi Technology, LiFi Networking, LiFi technology for indoor network access, Applications.

Text Books:

1 T. Rappaport, "**Wireless Communications - Principles and Practice**", *Prentice Hall* , (2nd Edition) , (2011).
2 Vijay Garg, "**Wireless Communications and networking**", *Elsevier*, (1st Edition), (2007).
3 **Jonathan Rodriguez,** "Fundamentals of 5G Mobile Networks"**, *Wiley*, (1st Edition),(2015).**
4 Mohamed Gado, Doaa Abd El-Moghith, "**Li-Fi Technology for Indoor Access**", *LAMBERT Academic Publishing*, (1st Edition), (2015).

Reference Books:

1 Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "**3G Evolution HSPA and LTE for Mobile Broadband"**, *Academic Press*, (2nd Edition) , (2008).
2 Anurag Kumar, D.Manjunath, Joy kuri, "**Wireless Networking**", *Elsevier*, (1st Edition), (2011).
3 Simon Haykin, Michael Moher, David Koilpillai, "**Modern Wireless Communications**", *Pearson Education* , (1st Edition), (2013)
4 Aditya K. Jagannatham, "**Principles of Modern Wireless Communications Systems***", McGraw Hill Education (India) Private Limited*, (1st Edition), (2016).

Online Resources:

1 NPTEL Course on **"Introduction to Wireless and Cellular Communications",** https://nptel.ac.in/courses/108/106/106106167/#
2 NPTEL Course on **"Advanced 3G and 4G Wireless Mobile Communications**", https://nptel.ac.in/courses/117/104/117104099/