Autonomous Programme Structure (Revision-1)
F. Y. B. Tech. Sem-I
Computer Engg and Information Technology 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
20BS02	Chemistry	3	0	0	50	50	0	100	3
20ES01	Basic Electrical and Electronics Engg.	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
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
20ES02L	Fundamentals of Programming Language- I Lab	0	0	2	25	0	0	25	1
20ES07L	Technical Skill Development Lab	0	0	2	25	0	0	25	1
Total		**14**	**2**	**8**	**300**	**225**	**0**	**525**	**19**
Grand Total		**24**			**525**			**525**	**19**

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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)

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)

20ES02 Fundamentals of Programming Language-1

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

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

20BS02L Chemistry Laboratory

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

Continuous assessment
Term Work: 25

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.

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.

20ES02L Fundamentals of Programming Language -I Lab

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 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

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
Computer Engg and Information Technology 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
20BS04	Physics	3	0	0	50	50	0	100	3
20ES04	Engineering Graphics	2	1	0	50	50	0	100	3
20ES05	Fundamentals of Programming Language- 2	3	0	0	50	50	0	100	3
20ES06	Geo Informatics	3	0	0	50	50	0	100	3
20BS04L	Physics Lab	0	0	2	25	0	0	25	1
20ES04L	Engineering Graphics Lab	0	0	2	25	0	0	25	1
20ES05L	Fundamentals of Programming Language- 2 Lab	0	0	2	25	0	0	25	1
20ES06L	Geo Informatics Lab	0	0	2	25	0	0	25	1
Total		**14**	**2**	**8**	**350**	**250**	**00**	**600**	**20**
Grand Total		**24**			**600**			**600**	**20**

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Chairman Governing Body
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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).

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 Objective:

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)**

20ES04 Engineering Graphics

Teaching Scheme	**Examination Scheme:**
Theory: 2 Hrs/week	In semester: 50 Marks
Tutorial: 1 Hr/week	End semester: 50 Marks
Credits: 3	

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 objectCO2 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, sectionalorthographic projections, Missing views. **(08)**

Unit – 3

Isometric Views Isometric axes, Isometric scale, isometric projections and views, construction ofisometric view from given orthographic views**.** **(08)**

Unit – 4

Development of Solids Parallel line development, radial line development, methods to transferpoints for development of prisms, pyramids, cylinder and cone. **(05)**

Unit – 5

Engineering Curves Construction of ellipse, parabola, hyperbola, involute, cycloid, Archimedeanspiral, 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

Dhananjay A. Jolhe, 'Engineering Drawing', Tata McGrawHill Publishing Co. Ltd.

20ES05 Fundamentals of Programming Language-2

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)

20ES06 GEO-INFORMATICS

Teaching Scheme:

Lectures: 3 Hrs/Week

Credits: 3

Examination Scheme:

In-Semester : 50Marks

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**

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.

20ES04L Engineering Graphics Lab

Teaching Scheme

Practical: 2 Hrs/week

Credits: 1

Examination Scheme

In Semester: 25 marks

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 arapid 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

20ES05L Fundamentals of Programming Language Lab-2

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.

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

Autonomous Program Structure
Second Year B. Tech. Third Semester
Computer Engineering
Academic Year: 2021-2022 Onwards

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Marks	Credits
		Lecture	Tutorial	Practical	In Semester	End Semester	Oral	Practical		
20HS301	Universal Human Values II	2	1	0	50	50	0	0	100	3
20CE301	Programming Paradigms	3	0	0	50	50	0	0	100	3
20CE302	Data Structures	3	1	0	50	50	0	0	100	4
20CE303	Discrete Mathematics	3	1	0	50	50	0	0	100	4
20CE304	Digital Systems and Computer Organization	3	1	0	50	50	0	0	100	4
20CE302L	Data Structures Laboratory	0	0	4	25	0	0	25	50	2
20CE304L	Digital Systems Laboratory	0	0	2	25	0	25	0	50	1
20CE305L	Programming Skills Development-I Laboratory	0	0	4	25	0	25	0	50	2
20AC301	Audit Course	0	0	1	0	0	0	0	0	No Credits
	Total	**14**	**4**	**11**	**325**	**250**	**50**	**25**	**650**	**23**
	Grand Total	**29**			**650**					**23**

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M.K.S.S.S. Cummins College of Engg. for Women KARVENAGAR Pune-52

20CE 301 Programming Paradigms

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. Explore the major programming paradigm
2. Introduce frameworks for specifying and reasoning about programming languages.
3. Understand principles and techniques involved in design and implementation of modern programming languages.
4. To provide an exposure to core concepts and principles of contemporary programming languages

Course Outcomes:

After completion of the course, students will be able to

1 Describe characteristics and design principles of imperative programming language paradigms

2 Demonstrate different forms of declaration, typing, binding, visibility, scoping, and lifetime management for various programming language constructs

3 Describe characteristics and design principles of declarative programming language paradigms

4 Choose a language or paradigm suitable for solving a particular problem

Unit I: Introduction to Programming Languages (6)

Role of programming languages, towards high level programming languages, problems of Scale, programming paradigms, Language implementation, Expression notations, Abstract syntax trees, Lexical syntax, Context free grammar, variants of grammars, The need of structured programming, syntax directed control flow, design considerations, handling special cases in loops, programming with invariants, control flow in C.

Unit II: Data Representation and procedure activation (10)

The role of Types, Basic Types, assignment and local state, the environment model of evaluation, Arrays, Records, Union and variant records, sets, pointers, two string tables, types and error checking, modelling with mutable data. Introduction to procedures, Parameter

passing methods, Scope rules for names, nested scope in source text, activation records, Lexical scope in C and Pascal

Unit III: Functional Programming Paradigm: (9)

Elements of functional programming, a little language of expressions, types: values and operations, function declarations, approached to expression evaluation, lexical scope, type checking. Exploring a list, function declaration by Cases, Functions as first class values. ML/Scheme/Lisp: Implicit types, Data types, Exception handling in ML/Scheme/Lisp. Functional programming features in Python.

Unit IV: Logic Programming (8)

Computing with relations, Introduction to Prolog, Data Structures in Prolog, Programming Techniques, Control in Prolog, Cuts.

Unit V: Object Oriented Programming and Recent Advances in Programming (9)

Constructs of program structuring, information hiding, program design with modules, modules and defined types, Object oriented programming in Python. Recent developments in the world of programming. Overview of emerging programming languages – Elm, Rust, Kotlin, Go, Ruby, Scala, Swift etc.

Text Books:

1. Sethi R., "Programming Languages concepts & constructs", 2nd Edition, Pearson Education, ISBN 81 - 7808 - 104 - 0
2. Harold Abelson, Gerald Jay Sussman, Julie Sussman, “Structure and Interpretation of Computer Programs”, 2nd Edition, ISBN 0-07-000484-6 (McGraw-Hill hardcover)

Reference Books:

1. Roosta S., "Foundations of Programming Languages", Thomson Brookes/Cole, ISBN 981 -243-141-1
2. Sebesta R., "Concepts Of Programming Languages", Pearson Education, (10th Edition)(2014)
3. Allen Tucker, Robert Noonan, “Programming Languages: Principles and Paradigms”, Tata McGraw Hill, (2nd edition),(2007)
4. Carlo Ghezzi, Mehdi Jazayeri, “Programming Language Concepts”,3rd Ed, Wiley Publication ISBN : 978-81-265-1861-6.

Online/Web/Other References:

1. https://nptel.ac.in/courses/106/102/106102067/

20CE 302 Data Structures

Teaching Scheme

Lectures: 3 Hours / Week

Tutorial: 1 Hour / Week

Examination Scheme

In Semester: 50 Marks

End Semester: 50 Marks

Credits: 4

Course Objectives:

To facilitate the learner to

1. Learn and understand representation, implementation and applications of data Structures
2. Choose and apply linear and non linear data structures for developing solutions for solving problems in various domains.
3. Demonstrate ability to use stack and queue data structures to solve problem
4. Understand and apply the concepts of hashing.
5. Analyze algorithms using time complexity analysis

Course Outcomes:

After completion of the course, students will be able to

1. Apply appropriate data structure to construct efficient algorithms to approach the problems.
2. Distinguish between various linear data structures based on their representations and applications.
3. Apply principles of data structures- stack and queue to solve computational problems.
4. Apply non linear data structures –Trees and Graphs to solve a problem.
5. Apply the concept of Hashing techniques for solving a problem.
6. Analyze algorithms using time and space complexity

Unit I: Introduction to Algorithms; Sorting and Searching (07)

Introduction to Algorithms, Pseudo code, Abstract Data Types (ADT): e.g. Arrays as ADT, Introduction to Data Structures, Frequency Count, Analyzing Algorithm using Frequency count, Time complexity of an Algorithm, Asymptotic notations, Best, Worst and Average case analysis of an Algorithm. Sorting: Bubble sort, Insertion sort, Quick Sort.
Searching: Linear Search, Binary Search. Time complexity analysis of sorting and searching

Algorithms. Case study: Timsort

Unit II: Linked List (07)

Concept of Linked List, Comparison of Sequential and Linked Organizations, Linked List using Dynamic Memory Management, Linked List as an ADT, Singly Linked List , Doubly Linke List, Circular Linked List operations. Time complexity analysis of Linked List operations.
Case study: Garbage collection

Unit III: Stack and Queue (07)

Stack as an ADT, Representation and Implementation of Stack using Sequential and Linked Organization, Applications of Stack- Simulating Recursion using Stack, Arithmetic Expression Conversion and Evaluation. Queue as an ADT, Representation and implementation of Linear Queue, Circular Queue, Priority Queue .Time complexity analysis of Stack and Queue operations. Time complexity analysis of algorithms using stack and queue data structures.
Case study: Priority queue in bandwidth Management

Unit IV: Trees (08)

Introduction to Non Linear Data Structure, Binary Trees, Types of Binary Trees, Properties of Binary Trees, Binary Tree as Abstract Data Type, Representation using Sequential and Linked Organization, Binary Tree creation , Recursive and Non Recursive Tree Traversals, Binary earch Tree and its operations, B Tree, Heap as ADT.
Case study: expression tree, Heap as priority queue.

Unit V: Graphs (07)

Basic Terminologies, Storage Representation, Graph Traversals, Graph as Abstract Data Type, Spanning Trees, Minimum Spanning Trees, Kruskal's Algorithm, Prim's Algorithm, Dijkstra's Single Source Shortest Path Algorithm. Time complexity analysis of graph algorithms.
Case study: Google maps.

Unit VI: Hashing (06)

General idea of Hashing, Hash Table, Hash function, Rehashing, Issues in Hashing, Collision Resolution Strategies: Linear Probing, Open addressing and Chaining. Time complexity analysis of hashing techniques.
Case study: Telephone dictionary.

Text Books:

1. Sartaj Sahani, "Data Structures, Algorithms and Applications in JAVA", Universities Press (2 nd edition).

2. Robert Lafore, "Data Structures Algorithms in JAVA", Techmedia,(1 st edition).
3. E. Horowitz, S. Sahni, D. Mehta, "Fundamentals of Data Structures in C++", Galgotia Publications ,(2 nd edition).

Reference Books:

1. Yedidyah Langsam, Moshe J Augenstein, Aron M Tenenbaum, "Data Structures using C and C++" , Pearson Education, (2 nd edition).
2. A. Aho, J. Hopcroft, J. Ulman, "Data Structures and Algorithms", Pearson Education, (2 nd edition).
3. Brassard and Bratley, "Fundamentals of Algorithmics", Prentice Hall India/Pearson Education, (2 nd edition) .
4. M. Weiss, "Data Structures and Algorithm Analysis in JAVA", Pearson Education (3rd edition), (2012).
5. Goodrich, Tamassia, Goldwasser, "Data Structures and Algorithms in JAVA", Wiley publication, (6th edition).
6. R. Gillberg, B. Forouzn, "Data Structures: A Pseudocode approach with C", Cenage Learning, (2 nd edition).

Online/Web/Other References:

1. https://nptel.ac.in/courses/106/102/106102064/
2. https://www.cs.usfca.edu/~galles/visualization/Algorithms.html
3. http://web.stanford.edu/class/cs166/

Suggestive List of the Tutorial Assignments:

Following list of tutorials can be considered as guideline for designing tutorials:
Every student should perform 12 to 14 tutorials which will cover topics of all units mentioned in the syllabus of Data Structures. Tutorial assignments will enhance the understanding of the concepts of problem solving, algorithms and data structures. Students will perform practice exercise on data representation and corresponding implementation of the data structures. Students will get opportunity to develop their logic building abilities.

Following list of tutorials can be considered as guideline for designing tutorials:

1. Demonstration of a program implementation and execution using eclipse tool.
2. Design an algorithm for simple problems like GCD calculation, power calculation etc.
3. Calculate frequency count, time complexity of sample algorithmic constructs.
4. For given algorithms of array operation, write equivalent JAVA code.
5. Practice exercise on sorting and searching algorithms for set of predefined inputs.
6. Calculate time complexity of sorting algorithms using concept of frequency count.
7. Create a linked list and write algorithms for traversal, delete a node, add a node operations on a list.
8. Create a doubly or circular linked list and write algorithms for traversal, delete a node, add a node operations on a list.
9. Solve brain teaser based on recursive code snippets.
10. Demonstration on debugging techniques.
11. Select appropriate data structures and design algorithmic solution to given application.
12. Solve puzzles based on queue data structure
13. Practice exercise on creating binary tree and perform recursive and non recursive traversal of binary tree on given data
14. Creating binary search tree for given data and perform inorder, preorder, postorder traversal.
15. Practice exercise on searching and deleting data values from given binary search tree.
16. Design a solution for "company survey" about its products in an area. Choose the appropriate algorithm to complete the survey within short period and cover all houses under that area. Give justification for your answer and also analyze your algorithm for time complexity
17. Visualize various data structures using open source tools
18. Given the input data and hash function , show the result using hashing methods .
19. Use different hashing functions to hash given values.

20. Construct a Btree of order 3 by inserting numbers of given data
21. Practice exercise on Dijkstra's algorithms.
22. Practice exercise on graph MST algorithms.
23. Practice exercise on Heap data structures.

20CE 303 Discrete Mathematics

Teaching Scheme
Lectures: 3 Hours / Week
Tutorials : 1 Hour / Week

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

Course Objectives:
To facilitate the learner to

1. To understand Discrete Mathematics concepts and their significance in Computer Engineering.
2. To understand set theory, logic and apply reasoning to solve problems.
3. To solve problems based on algebraic systems, permutation and combination.
4. To solve problems on functions and relations and learn the basic properties of graphs and trees.

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

1. Solve problems on set using Venn diagram, theorems like the principle of inclusion-exclusion and mathematical induction and solve problems on relations and functions.
2. Apply concepts of propositional calculus for solving problems, formal proofs, reasoning and represent problems using first-order logic.
3. Apply the concepts of groups, permutations and combinations to solve problems.
4. Apply basic terminologies of graphs and trees to solve problems on paper.

Unit I: Sets and Mathematical Induction (07)
Significance of Discrete Mathematics in Computer Engineering, Sets, Subset, Universal Set, Empty Set, Algebra of Sets and Duality, Operations on Sets, Finite and Infinite Sets, Un Countably Infinite Sets, Multi-Sets, Power Set, Venn Diagram, Principle of Inclusion and Exclusion, Principle of Mathematical Induction, Applications of Set.

Unit II: Logic and Propositional Calculus (06)
Propositions, Logical connectives, Conditionals and Bi-Conditionals, Tautology, Contradiction, Contingency, Logical Equivalences, Algebra of Propositions, Logical Implications, Conjunctive and disjunctive Normal Forms, Rules of Inference, Predicates and Quantifiers, Nested Quantifiers, Applications of Logic.

Unit III: Groups, Rings and Permutations and Combinations (08)
Algebraic Systems, Groups, Semi Groups, Monoids, Subgroups, Introduction to Isomorphism, Homomorphism and Automorphism of groups, Cosets and Normal Subgroups, Introduction to Rings, Integral Domain and Field, Applications of Algebraic System, Introduction to Permutations and Combinations.

Unit IV: Relations and Functions (08)
Introduction to Relations, Product Sets, Pictorial Representation of Relations, Composition of Relations, Closure of Relations, Warshall's Algorithm, Properties of Binary Relations,

Equivalence Relations and Partitions, Partial Ordering Relations, Hasse Diagram, Lattices, Chains and Anti-Chains.
Functions: Composition of Functions, Injective function, Surjective function, Bijective function, Invertible Functions, Hash function: Division method, Midsquare method and Folding method, Pigeonhole Principle.

Unit V: Graph Theory **(07)**

Basic Terminology, Multi-Graphs and Weighted Graphs, Sub-Graphs, Isomorphic Graphs, Complete, Regular and Bipartite Graphs, Operations on Graph, Factors of a Graph, Paths and Circuits, Connectivity, Hamiltonian and Euler Paths and Circuits, Planar Graph and Theorem, Shortest Path in Weighted Graphs (Dijkstra's Algorithm), Applications of Graph-Graph Coloring Problem, Travelling Salesman Problem.

Unit VI: Trees **(06)**

Basic Terminologies in Trees and Properties of Trees, Binary Search Trees, Tree Traversal, Spanning Trees, Fundamental Circuits and Cut Sets, Minimal Spanning Trees, Kruskal's and Prim's Algorithms for Minimal Spanning Trees, Transport Network.

Text Books:

1. C. L. Liu and D. P. Mohapatra, **"Elements of Discrete Mathematics"**, 4th Edition, *Tata McGraw-Hill*, 2017, ISBN 978-1-25-900639-5.
2. Kenneth H. Rosen, **"Discrete Mathematics and its Applications",** 7th Edition, 2012, *Tata McGraw-Hill*, ISBN 978-0-07-338309-5.

Reference Books:

1. B. Kolman, R. Busby and S. Ross, **"Discrete Mathematical Structures"**, 6th Edition, *Pearson Education*, 2009, ISBN 81-7808-556-9.
2. Seymour Lipsehutz and Marc Lars Lipson **"Discrete Mathematics"**, 3rd Special Indian Edition, ISBN-13: 978-0-07-060174-1.
3. J. P. Tremblay and R. Manohar, "**Discrete Mathematical Structures with Applications to Computer Science"**, 1997, *Tata McGraw-Hill*, ISBN 0-07- 463113-6.
4. E. Goodaire and M. Parmenter, **"Discrete Mathematics with Graph Theory"**, third edition, *Pearson Education*, 2008, ISBN 81 – 7808 – 827 – 4.
5. N. Deo, **"Graph Theory with application to Engineering and Computer Science"**, Eastern Economy Edition, *Prentice Hall of India*, 1990, 0 – 87692 – 145 – 4.

Online/Web/Other References:

1. 12 Week NPTEL course, https://nptel.ac.in/courses/106/106/106106183/#

List of the Tutorial Assignments

Every student should perform 12-14 tutorials which will cover topics of all units mentioned in the Syllabus of Discrete Mathematics.
Following list of tutorials can be considered as a guideline for designing tutorials in such a way that all topics should be distributed and covered amongst all batches.

1. Problems on set, multi-set operations, Venn diagram and algebra of sets.
2. Problems on Principle of Inclusion-Exclusion.
3. Illustrative example solving using Mathematical Induction.
4. Translating English statement into propositional logic and predicate logic.
5. Problems on groups.
6. Problems on permutation and combination.
7. Representation of relations and functions, closure of relations and equivalence relation.
8. Problems on partitions, POSET's, Hasse diagram and Lattices.
9. Problems on Warshall's Algorithm.
10. Problems on composition of functions, invertible functions, recurrence relation.
11. Problems on multi-graphs and weighted graphs, sub-graphs, isomorphic graphs.
12. Solve problems for shortest path in weighted graphs (Dijkstra's algorithm)
13. Solve problems on Kruskal's and Prim's algorithms for minimal spanning trees.
14. Solve problems on Cut sets and Transport network

20CE 304 Digital Systems And Computer Organization

Teaching Scheme
Lectures: 3 Hours / Week
Tutorial: 1 Hour / Week

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

Course Objectives:
To facilitate the learner to
1. Understand the basic digital circuits and logic design.
2. Apply techniques for designing combinational and sequential circuits.
3. Understand the functional components of a computer and its organization.
4. Understand design issues of instructions and instruction pipelining.
5. Understand and classify memory and input/output organizations.

Course Outcomes:
After completion of the course, students will be able to
1. Apply the knowledge of basic digital circuits and logic design.
2. Apply the knowledge of combinational and sequential digital circuits.
3. Relate the basic building blocks, their coordination and instruction pipelining in computer organization.
4. Utilize the concept of I/O and memory organization to computer system.

Unit I: Combinational Circuits (08)
Minimization of Product of Sum(POS) and Sum of Product(SOP) functions and realization using logic gates, Introduction to Numbers and Codes, BCD, Gray, Excess-3 and their applications, Code conversion, Integer and floating point number representation, Signed and unsigned numbers, arithmetic operations.

Unit II: Combinational Logic Design (06)
Realization of basic combinational functions like comparison, decoding, multiplexing, demultiplexing, Design of Half Adder and Full Adder, Design of Half Subtractor and Full Subtractor, BCD Adder, Look ahead and carry generator, Introduction to Carry Propagation Adder.

Unit III: Sequential Circuit's Design (07)
Flip flops (FF) and their excitation tables, FF conversions, Shift registers, Applications of FFs, Asynchronous and Synchronous counters, Sequence detectors using Moore and Mealy, Introduction to Algorithmic State Machines (ASM) charts, notations, design of a simple controller using ASM.

Unit IV: Introduction to Computer Organization (07)
Introduction to Computer Organization, Function and structure of a computer, Functional components and their Interconnection, Register organization, Case study of 8086, Number and size of registers, General purpose registers, Design and Organizational issues of registers, Control Unit organization, Hardwired vs. microprogrammed organization.

Unit V: Characteristics, Functions and Pipelining of Instructions (07)

Instruction cycle, type of instructions, types of operands, Instruction set design, machine instructions characteristics, design issues of instructions, addressing modes, Case study of 8086, Instruction pipelining, performance and hazards of pipelining, RISC, CISC.

Unit VI: Memory and Input/output Organization (07)

Memory devices and organization, ROM, RAM, EPROM, SDRAM, DDR4 RAM, Flash memory. Cache memory organization, principles, cache design elements, performance characteristics, External memory devices and organization, Introduction to buses, types of buses, bus organization, DMA organization, need, working principle.

Text Books:

1. R. P. Jain, 'Modern Digital Electronics', Tata McGraw-Hill, (4th Edition), (2009)
2. A. AnandKumar, 'Fundamentals of Digital Circuits', PHI Learning, (4th Edition), (2016)
3. C. Hamacher, Z. Vranesic and S. Zaky, 'Computer Organization and Embedded Systems', McGrawHill, (5th Edition), (2017)
4. W. Stallings, 'Computer Organization and Architecture - Designing for Performance', Prentice Hall of India, (10th Edition), (2016)

Reference Books:

1. Anil Maini, 'Digital Electronics: Principles and Integrated Circuits', Wiley India Ltd, (2019)
2. Malvino, D. Leach, 'Digital Principles and Applications', Tata Mc-Graw Hill, (8th edition), (2014)
3. John P Hays, 'Computer Architecture and Organization', McGraw-Hill Publication, (3rd Edition), (2017)
4. A. Tanenbaum, 'Structured Computer Organization', Pearson, (6th Edition), (2016)

Online/Web/Other References:

1. NPTEL series – nptel.ac.in/courses/117105080/ (Digital System Design by Prof. D. Roychoudhary, Dept. of Computer Science and Engineering, IIT Kh.)
2. Online Chapters – WilliamStallings.com/COA/COA8e.html

Suggestive List of Tutorials

Sr. No	Topics
1	SOP and POS examples to implement and verify Boolean laws.
2	K- Map Examples based on 2, 3 and 4 variables.
3	The output of a shaft encoder need to be given to a computer system. Design a suitable code converter circuit.
4	The output of a decimal counter need to be apply to a computer system which understands Bin/Oct/Hex Number system. Convert the decimal number in respective other number system.
5	A. Design a digital circuit to work as a TV remote having 8/16 inputs. B. Design a digital circuit to broadcast a message to 4/8 screens after a fixed time interval.
6	Design a digital circuit to convert JK flip-flop to the available D/T/SR Flip Flop.
7	Design a sequence detector to find the given sequence in a large bit stream using Moore/Mealy method.
8	Identify the Addressing modes for the given code/set of instructions.
9	Find speed up and throughput for a given system for a non-pipelined method and compare it with pipelined system having 5 stages.
10	Cache Memory Examples – Direct mapping, Fully Associative mapping, Set Associative mapping

20CE 302L Data Structures Laboratory

Teaching Scheme

Practical : 4 Hrs/Week

Examination Scheme

In Semester : 25 Marks

Practical : 25 Marks

Credits: 2

Prerequisite:

1. 20ES05 Fundamentals of Programming Language
2. 20ES05L Fundamentals of Programming Language Laboratory

Course Objectives:

To facilitate the learner to

1. Develop algorithmic foundations to solve problems.
2. Select and use appropriate data structure for a given problem statement.
3. Analyze algorithms using time complexity.
4. Implement small application using data structures.

Course Outcomes:

After completion of the course, students will be able to

1. Select appropriate data structure for given problem.
2. Develop the solution for the given problem using programming language.
3. Analyze solutions using time complexity.
4. Design a small application using data structure.

Preamble:

The laboratory assignments are designed in a set of group A, B and C such that students will be able to design and implement solution for a given problem using various data structures. Motivation here is that students should be able to code the basic algorithm and select appropriate data structure to implement the solution of given problem. Faculty members are encouraged to expand problem statements with variations. Assignments can be framed and expanded in such a way
that it explores concepts, 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.

Group B assignments are designed in such a way that students will choose appropriate data structures to implement solution of a given problem. Some assignments of group A are designed to make students able to implement Abstract Data Type of a data structure and use it for a given application. Faculty members should choose the assignments from group A such a way that all the units of the syllabus of Data Structures are covered. In group C assignments students will design an algorithmic solution for selected problem using concepts covered in the subject Data Structures.

The laboratory assignments of group A and B are to be submitted by student individually using C++/JAVA object oriented programming language. Group C assignments may be performed in a group of 2 to 4 students from the same batch. For each assignment program code with sample output is to be submitted as a soft copy.

Suggestive List of Assignments

Group A : (Any Six)

1. In a group of M persons, some people can speak English and some people can speak French. Implement program to find and display-
   1. People who speak either English or French or both.
   2. People who speak both English and French.
   3. People who speak only English not French.
   4. Remove the person from the group.
2. Consider students marks of specific subject are to be stored using Array as ADT. Implement operations to summarize/ analyze the marks of the subjects.
3. Consider a mobile phone stores name and contact number in ascending order. Write program to search a contact details of specified name.
4. Consider students roll numbers and percentages of SY class are stored. Implement operations to arrange students records in ascending/ descending order based on their marks using various sorting methods.
5. Implement Doubly Linked List as ADT .Use same ADT to simulate Browser URL application.
6. Implement Singly Linked List as ADT. Use same ADT to simulate deck of cards application.
7. A 'concordance List' is an alphabetical list of words that appear in the book. Implement concordance list using ordered Linked List with insertion function that restrict duplicate value to be inserted in the list.
8. Implement Singly Linked List as ADT. Use it to simulate banking operations.
9. Student's information along with their percentage is stored in linked list for every division. Generate a combine list of students which is sorted in descending order based on their percentage.
10. Implement Stack as ADT using linked list or array. Use same ADT to check given expression is well formed parenthesized.
11. Implement Stack as ADT using linked list or array. Use same ADT to evaluate given postfix expression.
12. Implement Priority Queue as ADT using linked list or array. Use ADT to simulate pizza parlor order management.
13. Operating system stores N jobs and processing time require to complete each job in data structure. Design a program to simulate the job execution sequence

14. Implement Queue as ADT . Use Queue ADT to simulate 'waiting list' operations of railway reservation system.
15. Company wants to lease phone lines to connect its offices of different cities, with each other. Company charges different amounts of money to connect different pairs of offices. Solve the problem using graph data structures to connect all offices of a company with a minimum cost.
16. Implement graph as ADT to represent current flow in electrical circuit board.
17. An airport is developing a computer simulation of air traffic control that handles events such as landings and takeoffs. Each event has a time stamp that denotes the time when the event will occur . Develop a code for inserting an event and exacting most recent event and display all events. Use heap as ADT to implement priority queue .
18. Consider players score obtained in game are stored. Find out maximum and minimum score obtained in that game using heap data structure.
19 . Implement binary tree as ADT and use it for simulating operations on employee data.
20. Implement open hashing technique and use it to quickly look up employee's information. Provide facility to insert, display, search record .
21. Consider telephone book database of N clients. Make use of a hash table implementation to quickly look up client's telephone number.
22. Implement dictionary as ADT using hashing technique.

Group B: (Mandatory)

1. Department of Computer Engineering has 'CSI student branch'. Students of second, third and final year can subscribe to membership. Design a system to maintain CSI student branch membership information to add, delete, and modify details of records with ease. Use appropriate data structure.
2 College Library maintains records of books. Book records contain basic information of book. Book records are to be listed in the specific order. List of books of specific author are to be searched. Use appropriate data structure to perform sorting, searching operations of book data effectively.
3. A dictionary t stores keywords and its meanings as a key value pair. Use appropriate data structure that will provide minimum comparisons to find any keyword. Provide facility to adding new keywords, deleting keywords and modifying meaning of keywords.
4. A news paper delivery boy every day drops news paper in a society having many lanes and houses. Design a program to provide different paths that he could follow. Solve the problem by suggesting appropriate data structures. Design necessary classes.

Group C:

1. Design a game like snake and ladder, tic-tac-toe, generating magic square.
2. Design a small application using appropriate data structures to manage library data medical shop data/ College admission data / P.M.P.M.L. bus scheduling data etc.

20CE 305L Programming Skills Development - I Laboratory

Teaching Scheme
Practical: 4 Hrs/week

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

Prerequisites:
1. Fundamentals of Programming Language Lab-I (20ES02L)
2. Fundamentals of Programming Language Lab-II (20ES05L)

Laboratory Objectives:
To facilitate the learners to -
1. Use basics of Python, including working with functions, numbers, lists, and strings.
2. Work with file handling concepts.
3. Use numpy, matplotlib libraries for python application.
4. Apply object-oriented features to Python code.
5. Create a simple GUI using Tkinter

Laboratory Outcomes:
By taking this course, the learner will be able to -
1. Make use of basics of Python, including working with functions, numbers, lists, and strings.
2. Implement a python program to work with files.
3. Write basic, object-oriented Python code.
4. Create Python programs using numpy, matplotlib libraries.
5. Build a simple GUI using Tkinter

A large part of the lab would be for understanding the basic concepts of Python programming and implementation of some real world simple applications. Assignment statements are in brief and should be implemented in Python programming language. Motivation here is that students should be able to code the basic algorithm and also should be able to make use of built in functions available in different libraries of Python. Faculty members are encouraged to expand problem statements with variations. Assignments can be framed and expanded in such a way that it explores concepts, 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. Group A assignments are based on basics of Python and file handing. Group B assignments are based on object oriented programming, use of Matplotlib and numpy libraries and GUI using Tkinter. Group C assignment is implementation on mini project.

Suggestive List of Assignments:

Group A: (Mandatory)

1. Assignments to explore Lists, Dictionary and tuples like Create a menu drive Python program with a dictionary for words and their meanings. Write functions to add a new entry (word: meaning), search for a particular word and retrieve meaning, given meaning find words with the same meaning, remove an entry, display all words sorted alphabetically.
2. Assignments to explore String. For Example: Write a function word_lengths that takes a sentence (string), computes the length of each word in that sentence, and returns the length of each word in a list. You can assume that words are always separated by a space character " ".
3. Assignment to display a particular pattern or sequence. For example: Generate a Pascal triangle for n rows
4. Assignment to perform file operations. For example: Write a program that opens a file dialog that allows you to select a text file. The program then displays the contents of the file in a textbox.

Group B: (Any four)

1. Assignment based on object oriented principles. For example: Design a student data base in Python using classes and objects to perform the following operations:
    a. add b) delete c) display d) update e) search
2. Implement a Python program to perform operations on arrays and matrices. For example, Matrix multiplication
3. Read data from CSV file and plot it using matplotlib library
4. A picture or image can be represented as a NumPy array of "pixels", with dimensions H × W × C, where H is the height of the image, W is the width of the image, and C is the number of colour channels. Typically, we will use an image with channels that give the Red, Green, and Blue "level" of each pixel, which is referred to with the short form RGB. You will write Python code to load an image, and perform several array manipulations to the image and visualize their effects.
5. Use Tkinter to build a simple graphical user interface. For example: GUI to maintain a simple phone list.

Group C: Mini Project (Any one: For example:)

1. Devise a Python program to implement the Rock-Paper-Scissor game.
2. Devise a Python program to implement the Hangman Game.
3. Creating a Calculator with Tkinter

References:

Text Books

1. Kenneth. A. Lambert, "**Fundamentals of Python First Programs**", Cengage, 2nd Edition, 2019

2. Vamsi Kurama, "**Python Programming: A Modern Approach**", Pearson, 1st Edition, 2017.

Reference Books:

1. Gowrishankar.S, Veena A, "**Introduction to Python Programming**", CRC Press, Paperback Edition, 2019.

2. Y. Daniel Liang, "**Introduction to Programming Using Python**", Pearson, Paperback Edition, 2017.

e-Resources:

1. https://www.tutorialspoint.com/python3/python_tutorial.pdf

20CE 304L Digital Systems Laboratory

Teaching Scheme

Practical : 2 Hours / Week

Examination Scheme

In Semester : 25 Marks

Oral: 25 Marks

Credits: 1

Prerequisite: Basic Electrical and Electronics Engineering (20ES01)

Course Objectives:

To facilitate the learner to

1. Understand the basic digital circuits and logic design.
2. Apply techniques for designing combinational and sequential circuits.
3. Apply the knowledge to select different digital IC packages as per design specifications.
4. Develop minimum digital systems for simple real time applications.

Course Outcomes:

After completion of the course, students will be able to

1. Apply the knowledge of basic gates to build digital circuits.
2. Make use of available circuit packages to develop combinational circuits.
3. Apply the knowledge of sequential circuits design to model digital systems.
4. Build a small digital system using an emulator tool.

The laboratory work of Digital Electronics Lab is designed to enhance problem solving in digital electronics with the help of Boolean algebra, logic gates, computer number systems, data encoding, combinational and sequential elements. The circuit optimization is introduced using K-Maps. The solution building to real world problems is aimed with the help of circuit packages. Faculty members are encouraged to expand problem assignments with variations for Group B and Group C assignments. Assignments can be framed and expanded to understand the basic concepts, design steps, logic of solution and simple digital application. The students will be also encouraged to experiment open problems with the designs using appropriate emulator tools. Faculty will ratify the assignments on similar lines as examples shown here. Majority of Group A assignments are based on combinational circuits such as code converter, multiplexer, decoder etc. and partially sequential circuits such as Asynchronous and Synchronous counters. Group B assignments are based on sequential circuits such as sequence generator, sequence detector, ASM using flip-flops as well as based on real world application level assignments. Group C

assignments are based on implementation of different real time applications based on combinational and sequential circuits.

Suggestive List of Assignments

Group A : (Perform minimum 6)

1. Design and implement different logic circuits by using Basic gates and Universal gates.
2. Design and implement code converter circuits e.g. Binary to Gray, BCD to Ex-3 etc.
3. Design and implement circuits using Multiplexer and Decoder.
4. Design and implement a circuit to detect the error in the digital data communication system.
5. Design and implement Binary subtractor using 1's and 2's complement method. Use binary adder IC 7483.
6. Design and implement Asynchronous counters using a given flip flop.
7. Design and implement Synchronous counters using a given flip flop.

Group B: (Perform any one assignment each from 1 to 4 and 5 to 8)

1. Design and implement Sequence generator circuit. Check for the lockout condition.
2. Design and implement Sequence detector circuit using Moore and Mealy.
3. Design and implement flip flop conversion circuit.
4. Design and implement a simple ASM chart using a digital circuit.
5. Design and implement a car parking system using Entry and Exit gate, synchronized with each other. Entry gate counter will increment the count for each car entry. When all parking slots are occupied, it should indicate that parking is Full.
6. Design and implement a car parking system using Entry and Exit gate, synchronized with each other. Exit gate counter will decrease the count for each car leaving the gate. When no vehicle is present in the parking slot system, it should indicate Parking is Empty.
7. Design and implement an Ice Cream cup distribution counter based on dozens system. Counter should decrement for each sale of the cup. When a dozen of cups in the box are sold, the counter should indicate the one box is done.
8. Design and implement a packaging counter for 16 items. Counter should increment for each entry of the item in the box. When the box is full, the counter should indicate the box is full and reset itself.

Group C (Perform any one)

Select any open source / freeware tool and design a digital system of your choice.

1. Design a trigger circuit which will activate next circuit after 45 clocks.
2. Design a square wave generator circuit.
3. Build a random sequence generator.
4. Design a decimal adder circuit.
5. Design an octal adder circuit.
6. Design a decimal subtractor circuit.
7. Design a traffic signal controller which can show red signal for 70 sec, yellow signal for 5 sec and green signal for 40 sec.
8. Design a 2 digit traffic signal controller.
9. Design a 2 digit Bank token system.
10. Design a 3 digit Vaccine token system.
11. Design a BCD to 7-Segment display.
12. Design a character to 7-Segment display.

Autonomous Program Structure
Second Year B. Tech. Fourth Semester
Computer Engineering
Academic Year: 2021-2022 Onwards

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Marks	Credits
		Lecture	Tutorial	Practical	In Semester	End Semester	Oral	Practical		
20BSCE 401	Calculus and Statistics	3	1	0	50	50`	0	0	100	4
20CE401	Theory of Computation	3	1	0	50	50	0	0	100	4
20CE402	Database Management Systems	3	0	0	50	50	0	0	100	3
20CE403	Operating Systems	3	0	0	50	50	0	0	100	3
20CE404	Machine Learning	3	0	0	50	50	0	0	100	3
20CE402L	Database Management Systems Laboratory	0	0	4	25	0	0	25	50	2
20CE403L	Operating Systems Laboratory	0	0	2	25	0	25	0	50	1
20CE404L	Machine Learning Laboratory	0	0	4	25	0	25	0	50	2
20AC401	Audit Course	0	0	2	0	0	0	0	0	No Credits
	Total	**15**	**2**	**12**	**325**	**250**	**50**	**25**	**650**	**22**
	Grand Total	**29**			**650**					**22**

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20BSCE 401 Calculus & Statistics

Teaching Scheme
Lecture : 3 Hrs./week
Tutorials: 1Hr/week

Examination Scheme
In semester : 50 marks
End semester : 50 marks
Credits : 04

Prerequisite:

1. First order linear ordinary differential equations.
2. Basics of Vector Algebra
3. Integration – basic properties, standard results, Beta & Gamma Functions.
4. Partial Fractions.
5. Permutation & Combination. Basics of probability.

Course Objectives: Mathematics is a necessary path to scientific knowledge which opens 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 analyse and solve engineering problems in their respective areas.

Course Outcome: Students will be able to

CO1 : Find the Solution of Higher order Linear differential equation.
CO2 : Apply the concepts of vector calculus to find vector differentiation and vector integration
CO3 : Find the mathematical transform of a given function, use tranform technique to solve integral equation, difference equation.
CO4 : Apply concepts of statistics to interprete the data, calculate probabilities of random events.

Unit 1: Higher Order Linear Differential equation and application (08)
Higher order Linear differential Equation with constant coefficients, Cauchy's and Legendre's Differential Equations, Simultaneous Differential Equations, Modelling of electrical circuits.

Unit 2: Vector Calculus (07)
Physical interpretation of vector differentiation, vector differential operator, Gradient, Divergence, Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, vector identities, Line integral.

Unit 3: Fourier Transform (06)
Complex exponential form of Fourier series, Fourier integral theorem, sine and cosine integrals, Fourier transform, Fourier Sine and Cosine transform , Inverse Fourier Transform, Introduction to Discrete Fourier Transform.

Unit 4: Z – Transform (06)

20CE401 THEORY OF COMPUTATION

Teaching Scheme
Lectures: 03 Hrs/Week
Tutorial : 01 Hrs/Week

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

Prerequisites:

1. Data Structures and Algorithms (20CE302)
2. Discrete Mathematics (20CE303)

Course Objectives:
To facilitate the learners -

1. Recall and understand the basics of mathematical concepts, formal languages and machines.
2. Understand and design different computational models like finite automata, regular expression, push down automata, context free grammar, turing machine for a given language.
3. Apply inter conversion between equivalent representations of a language.
4. Design appropriate computational models

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

1. Apply the knowledge of basics of mathematics and logic for problem understanding, representation and solving.
2. Construct different computational models like Finite automata, Regular Expression and Context Free Grammar.
3. Evaluate capabilities of computational models by inter-conversions.
4. Design appropriate computational models to solve given problems using PushDown Automata and Turing Machine.

Unit 1: Introduction (06)

Finite and infinite set. Basic concepts of symbol, alphabet, Kleene Closure and positive Closure of Alphabet, Strings, Empty String, Substring of a string, Concatenation of strings, Formal Language Definition, Finite representation of languages. Concept of Basic Machine and Finite State Machine. Finite Automata (FA): (Deterministic FA, Non-deterministic FA, Є-NFA): Definition.

Unit 2: Finite Automata (07)

Construction of FA (DFA, NFA, Є-NFA) - Transition Function and language acceptance, Transition graph. Conversion of NFA with Є moves to NFA without Є moves, Conversion of NFA without Є moves to DFA, Direct Conversion of NFA with Є to DFA.

Unit 3: Regular Expression (07)

Regular Expression (RE): definition and operators, Primitive Regular Expressions, Algebraic Laws of Regular Expressions, Languages Defined by Regular Expressions, Building Regular Expressions, Closure Properties of Regular Languages, Regular expression examples. Inter-conversion of RE and FA, Construction of FA equivalent to RE (RE to Є-NFA, Є-NFA to DFA). Construction of RE equivalent to FA using Arden's Theorem. Pumping Lemma for Regular languages, Limitations of FA.

Unit 4: Context Free Grammar and Languages (07)

Grammar: Definition, representation of grammar. Context Free Grammar (CFG) - Definition, Derivation – Leftmost, Rightmost, sentential form, parse tree, ambiguous grammar and removing ambiguity from grammar, Simplification of CFG, Normal Forms - Chomsky normal form, Greibach normal form, Closure properties of Context Free Languages (CFL), Decision properties of CFL, Chomsky hierarchy. Regular grammar- Definition, left linear, right linear grammar, Applications of grammar.

Unit 5: Push Down Automata (07)

Push Down Automata (PDA): Definition, Notations, Transition Table form, Types of PDA (Deterministic PDA and Non Deterministic PDA), acceptance by final state, acceptance by empty stack, Construction of PDA (DPDA, NPDA), Instantaneous Description of PDA. Equivalence of PDA and CFG - Grammar to PDA conversion, Applications of PDA.

Unit 6: Turing Machine (08)

Turing machine (TMs): Formal Definition, TM Instantaneous Description, Transition Function, Languages of TM, Turing Machine and halting, Deterministic Turing Machines (DTM), Construction of DTM. Universal Turing Machine (UTM), Church-Turing hypothesis, Comparison between FA, PDA and TM. Turing Machine Halting Problem. TM's as acceptors, Recognizing Languages with TM's.

Text Books:

1. Hopcroft J., Motwani R., Ullman J., "Introduction to Automata Theory, Languages and Computations", Third edition, 2008, Pearson Education Asia. ISBN: 9788131720479

2. Michael Sipser, "Introduction to The Theory of Computation", Third edition, 2017 Thomson Course Technology, ISBN: 9781131525296

Reference Books:

1. Daniel Cohen., "Introduction to Computer Theory", Second edition, 2011, Wiley Publications (India) ISBN: 9788126513345

2. H.R. Lewis, C. H. Papadimitrou, "Elements of the Theory of Computation", Second edition, 2006, Prentice Hall Inc. ISBN: 8131703878

3. John C Martin. "Introduction to Language and Theory of Computation", Third edition, 2012, Tata McGraw- Hill, ISBN: 978007660489

4. Vivek Kulkarni, "Theory of Computation", Oxford university edition, 2013, ISBN 13:9780198084587

5. K. L. P Mishra, N. Chandrashekaran (2003), Theory of Computer Science-Automata Languages and Computation, 2nd edition, Prentice Hall of India, India.

Suggestive List of Tutorials:

1. Design of Finite state machine
2. Design Deterministic Finite Automata
3. NFA design and NFA to DFA conversion
4. Design of Regular Expression from Language
5. Converting RE to NFA with null moves and then NFA with null moves to NFA without null moves
6. Formal language and CFG interconversion
7. Simplification / standardization of CFG to Normal Forms
8. Design of Push down Automata
9. Design of Turing Machine

4. Vivek Kulkarni, "Theory of Computation", Oxford university edition, 2013, ISBN 13:9780198084587

5. K. L. P Mishra, N. Chandrashekaran (2003), Theory of Computer Science-Automata Languages and Computation, 2nd edition, Prentice Hall of India, India.

Online/Web/Other References:

1. 1. Automata Theory. Estimated 7 weeks course of 5 -10 hours/week offered by edx 2020 https://www.edx.org/course/automata-theory

2. www.nptel.ac.in . 12 weeks course offered by IIT B. nptel.ac.in/courses/106104028/theory of computation.

20CE 402 Database Management Systems

Teaching Scheme
Lecture: 3 Hrs/week

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

Course Objectives
To facilitate the learners to-
1. Design database schema using an entity relationship diagram (ERD) and normalization.
2. Design queries using Structured Query Language (SQL) to retrieve the required data from the database.
3. Understand the storage systems and query processing and optimization concepts.
4. Understand Transaction management in a Database management System.
5. Understand NoSQL Databases to handle unstructured data.

Course Outcomes:
With successful completion of the course, the students will be able to–
1. Design the Entity Relationship diagram for the system / application considering its constraints and design issues.
2. Apply the knowledge of SQL to retrieve the required data from the database.
3. Understand the storage systems and query processing and optimization concepts.
4. Make use of various Transaction management concepts for scheduling concurrent transactions.
5. Apply the knowledge of NoSQL databases to handle unstructured data.

Unit 1: Database Design (10)
Introduction to database management systems, Advantages of a Database Management Systems over file processing systems. Data abstraction, Data Independence, DBMS Architecture.
Database Design - Entity Relationship Diagram (ERD), Converting Entity Relationship Diagram into tables, Extended Entity Relationship (EER) Diagram features, rules for converting EER diagram to tables, Primary key, Foreign key and other Integrity constraints.
Codd's Twelve Rules for Relational DBMS, Normalization.

Unit 2: Relational query languages (8)
Relational algebra, Introduction to Structured Query Language (SQL)
SQL - Data Definition Language (DDL): SQL Data Types, Null values and Literals, Creating, Modifying and Deleting tables. Views and Indexes.
SQL - Data Manipulation Language (DML): Insert, Update, Delete, Select, Set Operations, Joins, Tuple Variables, Nested sub-queries, Query Processing.
PL/SQL (Programming Language SQL): Stored Procedures and Functions, Cursors, Triggers.
SQL - Data Control Language (DCL): Grant and Revoke commands

Unit 3: Storage and Querying (8)
Storage and file systems: Storage and File structure, Files with Fixed / Variable Length Records, Hashed Files; Indexing: Indexed Files, Single Level and Multi Level Indexes, B+ Trees

Query Processing: Overview, measures of query cost, Selection and join operations, Evaluation of expressions, Introduction to query optimization, Estimation, Transformation of Relational expressions, Sort Operation, Impact of Indices on Query Performance;

Unit 4: Transaction management **(8)**

Transactions, ACID Properties of Transactions, Concept of Schedule, Serial Schedule, Serializability: Conflict serializability, View serializability, Cascaded Aborts, Recoverable and Non-recoverable Schedules. Concurrency Control: Need, Locking Methods, Deadlocks, Timestamping methods. Recovery methods: Shadow-Paging and Log-Based Recovery.

Unit 5: Advance topics in Databases **(8)**

NoSQL Databases

Introduction to NoSQL databases: Structured and unstructured data, NoSQL- Comparative study of SQL and NoSQL databases, Big data. BASE Properties, Types of NoSQL databases- Key-value store – JSON, Document Store – MongoDB: CRUD Operations, Indexing, Aggregation and MapReduce in MongoDB.

Special purpose databases :

Cloud, in memory, Spatial databases etc.

Introduction to data mining and machine learning

Text Books:

1. Abraham Silberschatz, Henry F. Korth, and S. Sudarshan, 'Database System Concepts', McGraw Hill, (6 th edition), (2013)
2. Jiawei Han, Micheline Kamber and Jian Pei, 'Data Mining – Concepts and Techniques', Morgan Kaufmann Publishers,(3 rd Edition), (2012)
3. Kristina Chodorow, Michael Dirolf, 'MongoDB: The Definitive Guide' , O'Reilly, (2 nd Edition), (2013)
4. Ramez Elmasri and Shamkant B. Navathe, 'Database Systems',Pearson, (6 th Edition), (2013)

References:

1. Raghu Ramakrishnan and Johannes Gehrke, 'Database Management Systems', McGraw Hill, (3 rd Edition), (2003)
2. C. J. Date, 'An Introduction to Database Systems', Pearson, (8 th Edition), (2006)
3. Thomas Connally, Carolyn Begg, 'Database Systems', Pearson, (4 th Edition), (2012)

20CE 403 Operating Systems

Teaching Scheme
Lectures: 3 Hrs/week

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

Prerequisites:

1. Fundamentals of Programming Languages – II (20ES05)
2. Digital Systems and Computer Organization (20CE 304)

Course Objectives:
To facilitate the learner -

1. To understand basic concepts of Operating Systems.
2. To understand process life-cycle, process control block and scheduling algorithms.
3. To apply memory management strategies.
4. To understand file System concepts, protection and security.
5. To learn operating system for managing resources such as I/O, CPU, memory etc.
6. To understand Inter-process Communication and deadlock concepts.

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

1. To build the basic knowledge of operating system.
2. To identify the process management concepts along with CPU scheduling algorithms.
3. To choose the memory management strategies.
4. To build the file management concepts along with protection and security features on various types of file.
5. To make use of the knowledge of storage devices for disk management.
6. To apply the concepts of Inter-process Communication.

Unit 1: Introduction to Operating Systems (06)

Introduction to Operating System (OS), Evolution of OS, Functions of OS, Types of OS, OS Concepts: Process, Files, Shell and its types, System calls and its types , Kernel and its types, Virtual Machine, Bootstrapping and shutdown, Case Study of introduction to UNIX Operating System.

Unit 2: Process and CPU Scheduling (08)

Process Concept, Operations On Processes, Creation, Termination, States, Transition and Context Switching, Process control block, Scheduling Criteria, Scheduling Algorithm, First-Come First-Serve (FCFS), Shortest Job First (SJF), Round-Robin (RR), Introduction to Threads and Benefits, Comparison of Thread and Process, Process related system calls (in UNIX) , Case Study of UNIX Process Management.

Unit 3: Memory Management **(08)**

Contiguous and Non-Contiguous Memory, Swapping, Paging, Segmentation, Virtual Memory, Demand Paging, Page Replacement Algorithms- First-In First-Out (FIFO), Least Recently Used (LRU),Optimal, Allocation of Frames and Trashing, Case Study of UNIX memory management.

Unit 4: Introduction to the File System (06)

File Concepts, File Attributes, File Operations, File Types, File Sharing, File Structure, Directory Overview, Types of Directories, File System Implementation- inode block/table, super block, data block, boot block, Allocation Methods, Types of Users, Access Modes, Introduction to Protection and Security, Case Study of UNIX File Structure.

Unit 5: I/O Management and Disk Scheduling **(06)**

I/O Devices, Organization of I/O Functions, Operating System Design Issues Related to I/O, I/O Buffering, Disk Scheduling - First Come-First Serve (FCFS), SCAN, Circular SCAN (C- SCAN), Shortest Seek Time First (SSTF).

Unit 6: Inter-Process Communication (IPC) **(08)**

Critical Section Problem, Hardware Support for Mutual Exclusion, Semaphores, Classical Problems of Synchronization, Monitors, Deadlocks, Methods of Handling Deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection and Recovery from Deadlock.

Text Books:

1. Silberschatz, Galvin, Gagnes, "Operating System Concepts", John Wiley & Sons, (8/e), ISBN: 9971- 51-388-9.
2. William Stallings, "Operating System-Internals and Design Principles ", Prentice Hall India, (5/e) ISBN: 81-297-0 1 094-3.
3. Maurice J. Bach, "The Design of the Unix Operating System", Pearson Education, ISBN: 81-7758- 770-6.

Reference Books:

1. Evi Nemeth, Garth Snyder, Tren Hein, Ben Whaley, "Unix and Linux System Administration Handbook", (4/e), ISBN: 978-81-317-6177-9. (2011).
2. Milan Milenkovic, "Operating Systems", TMH, (2/e), ISBN: 0-07-044700-4.
3. Andrew S. Tanenbaum, "Modern Operating Systems", Prentice Hall India, (4/e), ISBN: 81-203- 2063-8.

Web References:

1. NPTEL: Computer Science and Engineering: Introduction to Operating Systems: https://nptel.ac.in/courses/106/106/106106144/
2. NPTEL: Computer Science and Engineering: Operating System Fundamentals: https://nptel.ac.in/courses/106/105/106105214/

20CE 404 Machine Learning

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. Introduce students to the basic concepts and techniques of Machine Learning.
2. Utilize data pre-processing techniques and dimensionality reduction techniques for given data.
3. Become familiar with supervised machine learning algorithms such as regression, classification
4. Become familiar with unsupervised machine learning algorithms such as clustering, association rule mining method
5. Become familiar with Artificial neural networks and its learning algorithms.
6. Evaluate the performance of the designed machine learning model.

Course Outcomes:

After completion of the course, students will be able to

1. Acquire fundamental knowledge of machine learning theory.
2. Make use of data pre-processing and dimensionality reduction technique for given data.
3. Apply supervised machine learning techniques such as classification and regression for problem solving and evaluate the designed technique using performance measures.
4. Solve the problems using various unsupervised machine learning techniques such as clustering and association rule mining
5. Apply the artificial neural network technique to solve the problem.

Unit I: Introduction to Machine learning (6)

Types of Learning: Rote Learning, Learning by General Problem Solving, Concept Learning, Learning by Analogy, learning problems and designing the learning systems, Machine

Learning: Types of Problems in Machine Learning, Aspects of Inputs to Training, Supervised, unsupervised, semi supervised, reinforcement learning, overfitting, underfitting, best practices in machine learning, Intelligent Agents.

Unit II: Data Pre-processing and Dimensionality Reduction (6)

Data cleaning, data integration, data reduction, data transformation and data discretization, curse of dimensionality, Principle Components Analysis, Bias/Variance trade-off.

Unit III: Supervised Learning (12)

Regression: Correlation and regression, line fitting by least square, outliers, linear and multiple regression
Classification: Logistic regression, Nearest Neighbour Classification: K-nn, Introduction to Decision tree and Bayesian Classification

Performance Measures: Confusion matrices, accuracy, sensitivity, specificity, kappa statistics, precision, recall, F-measure, Methods of cross-validation, Types of Errors: RMSE, MSE etc

Unit IV: Unsupervised Learning (10)

Introduction to Clustering methods, k-means clustering, Hierarchical clustering: agglomerative clustering method, decisive clustering method
Market Basket analysis, Apriori Algorithm, Association rule mining, Outlier analysis

Unit V: Introduction to Artificial Neural networks (8)

Supervised learning: McCulloch-Pitts model, Perceptron model, multi-layer perceptron, feed forward networks, Perceptron learning algorithm
Unsupervised learning: Self organizing maps

Text Books:

1. Peter Flach, "Machine Learning: The Art and Science of Algorithms that make sense of data", Cambridge University Press, 1st Edition, 2015, ISBN No.: 978-1-316-50611-0
2. Ethem Alpaydin, "Introduction to Machine Learning", PHI, 2nd edition, 2013, ISBN 978-0- 262-01243-0

3. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", 3rd Edition, 2012, Morgan Kaufmann publishing, ISBN: 978-0-12-381479-1

4. V. Susheela Devi, M. Narasimha Murty, "Pattern Recognition: An introduction", University Press, 2011, ISBN 978-81-7371-725-3

Reference Books:

1. Rodolfo Bonnin, "Machine learning for developers" , Packt publication, 2017, ISBN 978-1-78646-987-8

2. Vinod Chandra S. S., Anand Hareendran S., 'Artificial Intelligence and machine learning', PHI, (2014), ISBN 978-81-

3. Tom M. Michell, 'Machine Learning', McGraw Hill Education, Indian edition 2013, ISBN 978-1-25-909695-2.

4. John Paul Mueller, Luca Massarom, "Machine learning (in python and R) dummies", Wiley publication, 2016, ISBN 978-81-265-63050

5. Manohar Swamynathan, "Mastering Machine learning with python in six steps", Apress publication, 2018, ISBN 978-1-484-24044-1

Online/Web/Other References:

1. Nptel/coursera courses on Machine Learning

20CE 402L Database Management Systems Laboratory

Teaching Scheme
Practical: 04 Hours/Week

Examination Scheme
In-semester: 25 Marks
Practical: 25 Marks
Credits: 2

Course Objectives:
To facilitate learners to-
1. Implement/Execute Structured Query Language (SQL) queries.
2. Implement/Execute PL/SQL stored procedures and functions.
3. Implement/Execute MongoDB queries.
4. Develop database applications.

Course Outcomes:
On completion of the course, student will be able to–
1. Apply the knowledge of Structured Query Language (SQL) clauses to query the relational database.
2. Apply the knowledge of PL/SQL to solve the given business problem.
3. Apply the knowledge of NoSQL databases to query semi structured documents.
4. Solve the given database problem using database programming skills.

The lab is designed in such a way that the student can apply the DBMS concepts and implement the SQL commands. Once they are thorough with the SQL commands, they can build a database application using front end and back end concepts. The students can handle the semi-structured data and query it by using MongoDB commands. Motivation here is that the students should get a good practice of the SQL, PL/SQL and MongoDB syntax. Faculty members are encouraged to use different database systems and design different queries such that all the SQL clauses are covered. Group A assignments are mandatory and four assignments from group B can be given to the students such that each assignment is implemented in some or the other batch. Group C consists of a mini project which aims at giving the students an experience of building a database application from the scratch.

Example List of Assignments for the Laboratory

GROUP A (Mandatory)

1. Design and Execute SQL Data Definition Language (DDL) commands to create tables and insert data into the tables.
2. Design and Execute SQL queries for suitable database application using SQL Data Manipulation Language (DML) commands: Insert, Select, Update and Delete.
3. Design and execute SQL queries for suitable database application using SQL DML statements: all types of Joins and Sub-Query. Implement the concept of index and View.
4. Build a 2-tier database application.
5. Create a MongoDB collection and implement the CRUD operations.

GROUP B (Any 4)

1. Consider a library management system. Create a PL/SQL stored procedure for returning a book. Make suitable assumptions wherever necessary.
2. Consider a payroll system of a company. Write a PL/SQL stored procedure for calculating the income tax of employees of the company. Make suitable assumptions wherever necessary.
3. Consider a student information system in which total marks scored by the student is inserted by the teacher. Write a PL/SQL stored procedure for populating the "Class" field in the 'Students' table which indicates the class secured by every student in the class. If marks>=75% then Class= Distinction. If marks>=60% and marks<75% then First Class. If marks>=50% and marks <60% the Higher Second Class. If marks>=40% and Marks<50% then Second class. If marks<40% then class= Fail
4. Consider a Library management system where there are two tables in which the Books data is stored. Write a PL/SQL block of code that will merge the data from the "old_Books" table to the "new_Books" table. If the data in the first table already exist in the second table then that data should be skipped. Make suitable assumptions wherever necessary.
5. Consider an Employee management system of a company. Write a database trigger which will ensure that when data is inserted in the EMPLOYEES table, the department name is always in Upper case.
6. Consider the accounts system of a company. Write a database trigger which will ensure that when data in the Accounts table is updated, the old copy is preserved in the "Transaction_Log" table along with the date and userID.
7. Consider an Employee management system of a company. Write a database trigger which will ensure that when data in the EMPLOYEE table is deleted, it is first copied in the Ex-employees table along with the date of deletion.
8. Consider a student management system of our college. Write a PL/SQL function to calculate the number of distinction holders, first class holders, second class holders in the class. Make suitable assumptions wherever necessary.
9. Implement aggregation and indexing in MongoDB.
10. Implement Map reduce operation in MongoDB.

GROUP C (Mandatory)

Mini Project

Mini project aims at giving students a hands-on experience of building a Database application from the scratch and includes following tasks and deliverables:

- Gather requirements for the system and generate the requirements document
- Design the database system for the above requirements using ER-Diagram
- Convert the ERD to tables and normalize the tables up to Third Normal Form.
- Create a 2tier/ 3tier database application using frontend and backend concepts.
- Demonstrate the mini project on completion.

20CE 404L Machine Learning Laboratory

Teaching Scheme
Practical: 4 Hours / Week

Examination Scheme
In Semester : 25 Marks
Oral : 25 Marks
Credits: 2

Prerequisite:
1) 20 CE 306 Programming Skills Development-I Laboratory

2) 20ES05 Fundamental of Programming Languages-II

Course Objectives:
To facilitate the learner to

1. Implement some pre-processing operations on given data.
2. Implement supervised machine learning algorithms such as regression, classification.
3. Implement unsupervised machine learning algorithms such as clustering, association rule mining method.
4. Implement artificial neural networks and its learning algorithms.
5. Implement a small machine learning application and evaluate the performance of the designed machine learning model.

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

1. Apply pre-processing operations on given data.
2. Apply the classification and regression machine learning techniques to solve the problem.
3. Apply various clustering and association rule mining techniques of machine learning to solve the problem.
4. Apply the artificial neural network technique to solve the problem.
5. Develop small machine learning applications using different techniques.

A large part of the lab would be for understanding the basic concepts of machine learning and implementation of some real-world simple applications. Assignment statements are in brief and should be implemented in JAVA/Python programming language. Motivation here is that students should be able to code the basic algorithm and also should be able to make use of built-in functions available in different libraries of Java/Python. Faculty members are encouraged to expand problem statements with variations. Assignments can be framed and expanded in such a way that it explores concepts, 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. Group A assignments are on pre-processing data, supervised learning methods such as classification and regression, and simple logic gates implementation using artificial neural network. Group B assignments are on unsupervised learning and Group C assignment is on case study implementation for

different application.

Suggestive List of Assignments

Group A : (Mandatory)

1. Explore language used for Machine Learning Python/Java and perform the following operations: Understand the basic functionality, visualization of data. Study the different file format, explore the available data sets and its usage using programming language.

2. Suppose that the data for analysis includes the attribute age: 13, 15, 16, 16, 19, 20, 20, 21, 22, 22, 25, 25, 25, 25, 30, 33, 33, 35, 35, 35, 35, 36, 40, 45, 46, 52, 70. (a) Plot an equal-width histogram of width 10. (b) Sketch examples of each of the following sampling techniques: SRSWOR, SRSWR, cluster sampling, and stratified sampling. Use samples of size 5 and the strata "youth," "middle-aged," and "senior." (c) scale and also normalize the data. Pre-process the given data as given here.

3. BMI and body fat of persons are given. Use this BMI to predict the body fat of a person. Implement predictive modelling using regression analysis using a programming language that you are familiar with such as Java/Python. Fit the model and predict the value for given problem.

4. Data given for the SPEED and AGILITY rating of 20 college athletes and whether they were drafted by professional team. Implement k-nn classification technique of Machine learning using a programming language that you are familiar with such as Java/Python. Compare the performance of classification by changing value of k for the given data.

5. Build the logic gates AND, OR, NOT, NOR, NAND gates using ANN assuming random initialization. Write a program to implement Perceptron learning in an artificial neural network using Java/Python.

Group B: (Any Two)

1. You have a list of shopping items purchased by many people. Find out what are the frequently purchased combination of 2 items. Implement Apriori, a Frequent Pattern Analysis algorithm using Java/Python.

2. One of the earliest and well-known applications of the SOM is the phonetic typewriter of Kohonen. It is set in the field of speech recognition, and the problem is to classify phonemes in real time so that they could be used to drive a typewriter from dictation. The real speech signals obviously needed pre-processing before being applied to the SOM. Simulate this application where 4-dimensional input space is mapped to 2 nodes. Write a program to implement Self Organising Map (SOM) using Java/Python.

3. A Hospital Care chain wants to open a series of Emergency-Care wards within a region. We assume that the hospital knows the location of all the maximum accident-prone areas in the region. They have to decide the number of the Emergency Units to be opened and the location of these Emergency Units, so that all the accident-prone areas are covered in the vicinity of these Emergency Units.

   The challenge here is to decide the location of these Emergency Units so that the whole region is covered. Implement a K-means clustering algorithm using a programming language that you are familiar with such as Java / Python. Compare the performance of your algorithm on the dataset by changing input parameter value such as K

Group C

1. Machine learning case study for readily available data sets using the techniques studied, and evaluate the designed and implemented model.

20CE 403L Operating Systems Laboratory

Teaching Scheme
Practical: 2 Hours / Week

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

Prerequisites:

1. Fundamentals of Programming Language Lab-II (20ES05L)
2. Data Structures and Algorithms (20CE 302)
3. Digital Systems and Computer Organization(20CE 304)

Course Objectives:
To facilitate the learner to

1. Understand the fundamentals of Operating Systems.
2. Understand shell scripting to automate operating system operations.
3. Apply the concepts of Operating System for Process and Memory management.
4. Understand the operations performed by the Operating System as a resource manager.
5. Understand the communication among the processes.

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

1. Choose UNIX/Linux Commands for Shell Programming.
2. Make use of different CPU scheduling algorithms.
3. Apply Memory Management algorithms.
4. Implement various disk scheduling algorithms.
5. Explore the Inter-Process Communication concepts.

Preamble:
Operating Systems Laboratory is designed to understand and implement the fundamental concepts of Operating System. Motivation here is that students should be able to code the basic shell script and make use of various Operating system services algorithms. Faculty members are encouraged to expand problem statements with variations. Assignments can be framed and expanded in such a way that it enhances the concepts and logic of the solution. Students will be encouraged to solve open problems in different operating systems. Faculty will appropriately adopt assignments on similar lines as the examples shown here. Group A assignments are on Unix/Linux commands, shell script and process creation using system calls. Group B assignments are on simulation of schedulers, memory and I/O management algorithms and Inter-process communication problems using Semaphores. Group C assignment is on case study for different Operating Systems and its services.

Suggestive List of Assignments

Group A : (Mandatory)

1. Demonstration of Installation of Linux Operating System.
2. Exploration of Unix/Linux Commands (File, Directory and Process commands).
3. Write a shell script for adding users / groups and modifying permissions of file / directory accordingly.
4. Write a program to implement operations on processes using fork and join system calls.

Group B: (Any Four)

5. Simulation of the scheduling algorithms. For example: First Come First Serve (FCFS), Shortest Remaining Time First (SRTF).
6. Simulation of scheduling algorithms. For example: Round-Robin (RR), Shortest Job First (SJF).
7. Simulation of memory allocation strategies. For example: First Fit, Best Fit and Worst Fit.
8. Simulation of Page replacement algorithms. For example: First-In-First-Out (FIFO), Least Recently Used (LRU), optimal page replacement.
9. Simulation of disk scheduling algorithms. For example: First Come First Serve (FCFS), SCAN, Circular – SCAN (C-SCAN), Shortest Seek Time First (SSTF).
10. Write a program to implement Banker's Algorithm for deadlock handling.
11. Write a program to implement Reader-Writer problem using semaphores.

Group C

Case study of various Operating systems services. (Example: Android, RTOS, Linux, IOS, Windows etc.)

Autonomous Program Structure
Third Year B. Tech. Fifth Semester
Computer Engineering
Academic Year: 2022-2023 Onwards

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Marks	Credits
		Lecture	Tutorial	Practical	In Semester	End Semester	Oral	Practical		
20CE501	Computer Networks	3	1	0	50	50	0	0	100	4
20CE502	Design and Analysis of Algorithms	3	0	0	50	50	0	0	100	3
20CE503	Software Design and Architecture	3	1	0	50	50	0	0	100	4
20PECE 501	Programme Elective-I	3	0	0	50	50	0	0	100	3
20PECE 502	Programme Elective-II*	3	0	0	50	50	0	0	100	3
20OEHS 501	Open HS Elective –I	3	0	0	50	50	0	0	100	3
20CE501L	Computer Networks Laboratory	0	0	2	25	0	0	25	50	1
20CE504L	Programming Skills Development- II Laboratory	0	0	4	25	0	25	0	50	2
20PECE 501L	Programme Elective Laboratory-I	0	0	2	25	0	25	0	50	1
	Total	**18**	**2**	**8**	**375**	**300**	**50**	**25**	**750**	**24**
	Grand Total	**28**			**750**					**24**

Programme Elective-I	Programme Elective-I Laboratory	Programme Elective-II
20PECE501A Digital Image Processing 20PECE501B Java Full Stack Technologies 20PECE501C Statistics for Computer Science 20PECE501D Linux Internals	20PECE501LA Digital Image Processing 20PECE501LB Java Full Stack Technologies 20PECE501LC Statistics for Computer Science 20PECE501LD Linux Internals	* NPTEL / Swayam Course

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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

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M.K.S.S.S. Cummins college of Engg. for Women ★ KARVENAGAR Pune -52

20CE 501 Computer Networks

Teaching Scheme

Lectures: 3 Hours / Week

Tutorial: 1 Hours / Week

Examination Scheme

In Semester: 50 Marks

End Semester: 50 Marks

Credits: 4

Course Objectives:

To facilitate the learner to

1. Distinguish the fundamental concepts of networking standards, protocols and technologies
2. Identify role of protocols at various layers in the protocol stack
3. Select and Compare the appropriate network and protocols by understanding the given requirements for a given system
4. Get familiar with fundamental concepts of network security and recent trends in networking

Course Outcomes:

After completion of the course, students will be able to

1. Build an understanding of network types, architectures, topologies, networking components, communication media and techniques along with trends in networking
2. Identify data flow between two communicating hosts using various protocols at TCP/IP layers
3. Identify the role of various addresses in TCP/IP Protocol stack
4. Discover relevance of various protocols for given application

Unit I: Introduction to Computer Networks (7)

Definition, Types of Networks: Local area networks (LAN), Metropolitan area networks (MAN), Wide area networks (WAN), Wireless networks, Protocol, Design issues for the Network layers, Network Models: The OSI Reference Model, TCP/IP Model, Network Topologies. Types of Transmission Medium, Network Architectures: Client-Server, Peer To Peer, Hybrid. Network Devices: Bridge, Switch, Router, Gateway, Access Point, Modulation, Line Coding Schemes, Switching: Circuit switching, Packet switching, Multiplexing: FDM, TDM.

Unit II: Data Link Layer (8)

Introduction, functions, Design Issues, Services, Framing, Error Detection and correction, Parity Bits, Hamming Codes and CRC. Flow Control Protocols: Unrestricted Simplex, Stop and Wait,

Sliding Window Protocol, MAC Sub layer : Multiple Access Protocols: Pure and Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA, Introduction to Ethernet IEEE 802.3, IEEE 802.11 a/b/g/n, IEEE 802.15 Standards.

Unit III: Network Layer (10)

Functions of Network layer, Design Issues, IP Protocol: Classes of IP (Network addressing), IPv4, IPv6, Network Address Translation, Sub-netting, CIDR, Routing Algorithms: Dijkstra's, Distance vector Routing, Link State Routing, Network Layer Protocols: Address Resolution Protocol, Reverse Address Resolution Protocol, Internet Control Messaging Protocol, Routing Protocols: Routing Information Protocol, Open Shortest Path First , Border Gateway Protocol, Unicast Routing Protocols, Multicast Routing Protocol.

Unit IV: Transport Layer (7)

Transport layer design issues, Protocol Overview, Header Structure, Transmission Control Protocol (TCP) functions such as Connection Management, Error control, Flow control, Congestion control, User Datagram Protocol (UDP) overview, typical applications support, TCP Vs. UDP, TCP and UDP Socket Primitives.

Unit V: Application Layer (6)

Hyper Text Transport Protocol (HTTP): Overview, header structure, connections, request and response messages, persistence and non-persistence HTTP. Cookies, Simple Mail Transport Protocol (SMTP): Overview and Working of MIME, POP3, File Transfer Protocol (FTP): Overview and Working, identifying protocols for given application with example, Introduction to various Types of Servers, Dynamic Host Configuration Protocol (DHCP): Header, Working, Domain Name Server (DNS): Working, Proxy Server: Need and Significance, working.

Unit VI: Trends in Communication Networks (4)

Introduction to Network Security, Security mechanism, need and Services, Introduction to classical cryptography and its Type, Introduction to software defined network (SDN), Characteristics, Operations and Applications. Introduction to virtualization. (Reference from Research Papers and web)

Text Books:

1. Andrew S Tanenbaum, David J Wetherall,**'Computer Networks'**, *Pearson,* (5th Edition), (2019).
2. Forouzan B **'Data Communication and Networking'**, *Tata McGraw Hill,* (5th Edition), (2019).

Reference Books:

1. Kurose, Ross **'Computer Networking a Top Down Approach Featuring the Internet'** *Pearson,* (6th Edition), (2017).

2. Stallings W **'Data and Computer Communications'** *Prentice Hall Pvt. Ltd*. (10th Edition), (2019).
3. W. Richard Stevens, Bill Fenner, Andrew M. Rudoff **'Unix Network Programming Volume 1'**, *Addison-Wesley Publication*, (3rd Edition), (2005).
4. Geoffrey C. Fox, Jack Dongarra, and Kai Hwang, **'Distributed and Cloud Computing'** Morgan Kaufmann, (1st Edition),(2011).
5. Stallings W, **'Cryptography and Network Security: Principles and Practice'***, Pearson*, (7th Edition), (2020).

Online/Web/Other References:

1. http://intronetworks.cs.luc.edu/current/ComputerNetworks.pdf
2. nptel.ac.in/courses/106/105/106105183
3. nptel.ac.in/courses/106/105/106105081
4. nptel.ac.in/courses/106/106/106106091
5. nptel.ac.in/courses/106/105/106105031

Suggestive List of Tutorials

1. Study of various networks components, devices, and cabling
2. Problem solving on Line Coding Scheme
3. Problem solving based on error control using parity code, hamming and CRC
4. Scenario based problem solving on flow control stop and wait, go back N and Selective repeat
5. Problem solving based on IP Header
6. Problem solving based on subnetting / supernetting
7. Problems based on routing algorithm.
8. Demonstration of Routing protocols on simulator
9. Problems based on TCP and UDP header
10. Case study of college network
11. Designing network for given specification
12. Research paper reading based on SDN, Network Security, Virtualization, and Satellite Network

20CE 502 Design and Analysis of Algorithms

Teaching Scheme:
Lecture: 3 Hrs/Week

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

Prerequisite:

1. Data Structures and Algorithms (20CE302)
2. Discrete Mathematics (20CE303)

Course Objectives:

To facilitate the learners :-

1. Understand and apply methods of analysis of algorithms.
2. Learn and apply strategies for designing the algorithms.
3. Learn and apply the concept of computational complexity classes for the given problem.
4. Get acquainted with the concept of evolutionary algorithms design.

Course Outcomes:

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

1. Apply the knowledge of analyzing the algorithm.
2. Evaluate algorithm design techniques for solution of a problem.
3. Perceive the given problem solution from computational complexity classes point of view.
4. Build knowledge to understand the design requirements of evolutionary algorithms.

UNIT I: Introduction [7]

Basic steps to solve the problems, Performance analysis of recursive and non-recursive algorithms, Recurrences: substitution method, recursion-tree method, master method.

UNIT II: Computational Complexity Classes [7]

Basic Concepts of complexity classes, Non deterministic algorithms, The classes P and NP, NP Complete and NP Hard.

Decision problems: Clique Decision problem, Node cover Decision problem, Directed Hamiltonian Cycle Problem, Satisfiability problem, Travelling salesman problem, NP Hard problems

UNIT III: Divide and Conquer and Greedy Strategy [7]

Divide and Conquer: General Strategy, Control Abstraction, min/max problem, Binary Search, Quick Sort, Randomized quick sort and Merge Sort.

Greedy Method: General strategy, control abstraction, Knapsack problem, Job sequencing with Deadlines (Scheduling Algorithm), Minimal Spanning Tree algorithms(Graph Based Algorithm).

UNIT IV: Dynamic Programming [7]

Dynamic programming: General Strategy, Multi stage graphs, Optimal Binary Search Tree problem(OBST), 0/1 Knapsack problem, Travelling Salesperson Problem.

UNIT V: Backtracking and Branch and Bound [7]

Backtracking: General Strategy, Implicit and Explicit constraints, DFS State space tree formulation, Sum of subsets, Hamiltonian Cycle problem/Graph colouring problem, 4/8 Queens problem, Maze problem /Tower of Hanoi, 15-puzzle problem/Sudoku.

Branch and Bound: General Strategy, BFS state space tree formulation, Traveling Salesperson Problem.

UNIT VI: Introduction to Advanced Algorithms [7]

Introduction to Parallel Algorithms Matrix Multiplication/Sorting, Genetic Algorithms, Approximation Algorithms, Randomized Algorithms.

Text Books:

1. Horowitz and Sahani, "Fundamentals of Computer Algorithms", 2nd edition. Galgotia publication,, 2008, ISBN: 978 81 7371 6126
2. Gilles Brassard and Paul Bartley, "Fundamental of Algorithm.", PHI, 2010, ISBN-9788120311312 New Delhi
3. Thomas H Cormen and Charles E.L Leiserson, "Introduction to Algorithm", 3rd edition, 2009,PHI

Reference Books:

1. Fayez Gebali, "Algorithms and Parallel Computing", Willy, 2015, ISBN 9788126553891
2. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 2014, Pearson Education

3. A. V. Aho and J.D. Ullman, "Design and Analysis of Algorithms", Pearson Education, 2006, ISBN: 978 81 317 0205 5
4. Parag Himanshu Dave, Himanshu Bhalchandra Dave, " Design And Analysis of Algorithms", PEARSON Education, ISBN 81-7758-595-9

MOOC Courses:

1. https://nptel.ac.in/courses/106/101/106101060/ 12 weeks course offered by IIT B.
2. https://www.mooc-list.com/course/algorithms-design-and-analysis-part-1-coursera
3. https://www.cse.iitb.ac.in/~akshayss/courses/cs310-2019/index

20CE 503 Software Design and Architecture

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

Examination Scheme
In Semester: 50 marks
End Semester: 50 marks
Credits: 4

Prerequisite: Data structures (20CE 302)

Course Objectives:

To facilitate the learner to -

1. Develop familiarity with the basic concepts of software architecture and quality attributes of a system.
2. Model the software requirements of a system using Unified Modeling Language (UML) to understand the architectural, structural and behavioral aspects of the system.
3. Understand and apply various design patterns in creating an object oriented design.
4. Get exposure to the various software testing techniques and methods.

Course Outcomes:

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

1. Analyze the concepts of software architecture and quality attributes to realize the solution of a system.
2. Build structural and behavioral models using Unified Modeling Language (UML).
3. Apply various design patterns to understand reusability in object oriented design.
4. Apply various software testing techniques at unit level, suitable to different problem areas.

Unit 1: Introduction to Software Architecture (06)

Software Development Life Cycle (SDLC), SDLC Models, Software Requirements Specification (SRS), What is Software Architecture, Why Software Architecture is important, Architectural Styles.

Unit 2: Design Using Unified Modeling Language (UML) (08)

Importance of modeling, Introduction to UML: Object-oriented modeling language, Use case Diagrams, Activity Diagrams, Class Diagrams, Sequence Diagrams.

Unit 3: Quality Attributes (08)

Understanding Quality Attributes, Quality Attribute Scenarios and Tactics - Performance, Security, Usability.

Unit 4: Creational and Structural Design Patterns (07)

What is Design Pattern, Classification of Design Patterns, Elements of Design Pattern, Creational Design Patterns - Singleton, Factory Method, Structural Design Patterns - Proxy, Adapter.

Unit 5: Behavioral Design Patterns **(06)**

Observer, Iterator, Model View Controller (MVC), Mediator.

Unit 6: Software Testing **(07)**

Introduction, Verification and Validation, V-Model, White Box testing - Structural Testing – Unit / Code functional testing, Code coverage testing, Code complexity testing, Black Box testing - Equivalence Class Partitioning, Boundary Value Analysis, Use case based testing.

Text books:

1. Len Bass, Paul Clements, Rick Kazman, **'Software Architecture in Practice'**, *Pearson Education,* (3rd Edition)(2013).
2. Grady Booch, James Rumbaugh, Ivar Jacobson, **'The Unified Modeling Language User Guide'**, *Pearson Education,* (2nd edition)(2008).
3. Erich Gamma, Richard Helm, Ralph Johnson and John Vlissides, **'Design Patterns-Elements of Reusable Object-Oriented Software',** *Pearson Education,* (2002).
4. Srinivasan Desikan, Gopalaswamy Ramesh, **'Software Testing Principles and Practices'**, *Pearson Education*, ISBN 81-7758-121-X (2013).

Reference books:

1. Len Bass, Paul Clements, Rick Kazman, **'Software Architecture in Practice'**, *Pearson Education,* (2nd Edition) (2006).
2. Mary Shaw and David Garlan, **'Software Architecture – Perspectives on an Emerging Discipline'**, *Prentice Hall of India,* (1996).
3. Richard N. Taylor, Nenad M. and Eric M. Dashofy, **'Software Architecture: Foundations, Theory and Practice'**, *Wiley,* (2006).
4. Jim Arlow and Ila Neustadt, **'UML 2 and the Unified Process –Practical Object-Oriented Analysis and Design',** *Pearson Education*, (2nd edition) (2006).
5. Iien Burnstein, **'Practical Software Testing',** *Springer (India) private limited,* (2005).

Tutorials - Preamble:

The scope of tutorials for "Software Design and Architecture" includes exercises based on requirements capturing, analysis, design and testing of sample applications. During tutorials, problem solving and system design skills of students are challenged and improved. For a chosen hypothetical system, students are expected to identify its scope, prepare SRS document, build analysis/design level UML models and identify the test cases. The students are also expected to analyze the quality attributes requirements for the chosen system and elaborate the same using quality attributes scenarios. The following is a sample list of tutorials, covering the various concepts in the course. The objective of tutorials is to provide an opportunity for students to explore as per their interests. Consequently, these tutorial statements will be further detailed during conduction, according to the scenarios under consideration.

Example List of Tutorials:

1. Study architectural styles and submit a report on these styles.
2. A case study of any website or any other large system and its architecture for quality attributes requirements such as Performance, Security, Usability and Availability.
3. Design a Software Requirement Specification (SRS) document for a given system.
4. Draw Use case diagrams for capturing and representing requirements of a given system.
5. Draw Activity diagrams to display the business flows for a given system.
6. Draw Class diagrams to identify and describe key concepts like classes, relationships and other classifiers like interfaces.
7. Draw Sequence diagrams to show message exchanges in a given system.
8. Identify suitable design patterns for a given application.
9. Apply various Black Box testing methods for unit testing of a sample application.
10. Apply various White Box testing methods for unit testing of a sample application.

20CE 501L Computer Networks Laboratory

Teaching Scheme

Practical: 2 Hours / Week

Examination Scheme

In Semester: 25 Marks
Practical : 25 Marks

Credits: 1

Prerequisite:

Course Objectives:

To facilitate the learner to

1. Learn computer network topologies and types of network
2. Use modern tools for network traffic analysis and various networking configurations.
3. To learn network programming.
4. To develop an understanding of various protocols, modern technologies and applications

Course Outcomes:

After completion of the course, students will be able to

1. Demonstrate error control, flow control techniques and analyze them
2. Configure switches and routers.
3. Demonstrate LAN and WAN protocol behaviour using Modern Tools
4. Develop Client-Server architectures and prototypes

Preamble:

A large part of the lab would be for understanding the concepts of Computer Networking. Assignment statements are in brief and should be implemented in JAVA/Python programming language along with packet tracer and wire shark tool. Motivation here is that students should be able to code the basic algorithm and also should be able to make use of built-in functions available in different libraries of Java/Python. Faculty members are encouraged to expand problem statements with variations. Assignments can be framed and expanded in such a way that it explores concepts, logic of solution. Students will be encouraged to solve open problems in different domains. Faculty will appropriately adopt assignments on similar lines as the examples shown here. Group A assignments consisting of simulation of static and dynamic routing using cisco packet tracer tool. Group B assignment comprises socket programming to demonstrate process to process communication. Group C assignment consists of case study implementation.

Suggestive List of Assignments

Group A : (Mandatory)

1. Demonstrate the different types of topologies and types of transmission media by using a packet tracer tool.
2. Design an IP scheme for a WAN network (minimum 3 networks) using Cisco Packet Tracer tool (Static Routing).
3. Setup a WAN which contains wired as well as wireless LAN by using a packet tracer tool. Demonstrate transfer of a packet from LAN 1 (wired LAN) to LAN2 (Wireless LAN).
4. Write a program for error detection and correction for 7/8 bits ASCII codes using Hamming Codes or CRC.
5. Write a program to simulate Go back N and Selective Repeat Modes of Sliding Window Protocol in Peer-to-Peer mode.

Group B: (Any Two)

1. Use packet Tracer tool for configuration of 3 router network using one of the following protocol RIP/OSPF
2. Write a program using TCP socket for wired network for following a. Say Hello to Each other b. File transfer c. Calculator
3. Write a program for DNS lookup. Given an IP address as input, it should return URL and vice versa.
4. Write a program to demonstrate Sub-netting and find subnet masks.
5. Configuring Ftp server for file upload /download using Cisco Packet Tracer.

Group C

1. Create a network for N (e.g. More than 10) users all user should get the concurrent internet connectivity.
2. Create and configure Virtual Machine

Virtual Laboratory: http://vlabs.iitb.ac.in/vlab

20CE 504L Programming Skills Development II Laboratory

Teaching Scheme
Practical: 4 Hours / Week

Examination Scheme
In Semester: 25 Marks
Oral : 25 Marks
Credits: 2

Prerequisite:

1. Fundamentals of Programming Languages – II (20ES05)
2. Data Structures and Algorithms-II (20CE305)
3. Programming Skills Development-I Laboratory (20CE 306)

Course Objectives:
To facilitate the learner to

1. Explore the usage of mobile development tools.
2. Learn the process of development of mobile application
3. Create data-driven mobile applications
4. Create mini project using all the concepts

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

1. Select suitable configuration parameters, components, API's, libraries for mobile application development.
2. Design an android application using widgets, layouts, event handlers, intents etc.
3. Develop mobile application using advance features of android like database, multimedia, canvas, graphics etc.
4. Create a small mobile application.

Preamble:

The lab would be for understanding the syntax and semantics of Android programming and implementation of some real-world simple applications. Assignment statements are in brief and should be implemented using android studio.

Motivation here is that students should be able learn the App development and also should be able to analyze problems and select suitable built-in tools/API. Faculty members are encouraged to expand problem statements with variations. Assignments can be framed and expanded in such a way that it explores concepts, constructs and design of simple applications. Students will be encouraged to solve open ended problems in different domains. Faculty will appropriately adopt assignments on similar lines as the examples shown here.

Group A assignments are for learning the basics of android programming

Group B assignments are for learning advanced features like fragments, custom views, animations, Sensor capabilities to the App. .Group C assignment is open ended application development

Suggestive List of Assignments

Group A : (Mandatory)

1. Download, install and configure android development tools, plugins and SDK / Studio
2. Develop a simple Applications like
   a. Calculator
   b. Unit Converter (Scale,Temperature)
   c. BMI using UI Widgets – button, textview, editview etc.
3. Develop an application that uses Spinner component
4. Develop an application that uses intent, event listener and different Layout Managers
5. Develop an application that draws basic graphical primitives on the screen
6. Develop an application that make use of Alert Dialog

Group B: (Any Three)

1. Develop a mobile application that makes use of database for student/employment/ Library
2. Develop a mobile application that makes use of Uri,XMlPullparser like RSS feed
3. Develop a mobile application that implements Multi threading
4. Develop a mobile application that creates an alert upon receiving a message.
5. Develop a mobile application that uses time picker,alarm,adapter like creating alarm clock
6. Develop a mobile application for multimedia Application
7. Develop a mobile application for image transformations like Translation,Scaling and rotation
8. Develop an application that reads/writes data to-from the SD card.
9. Develop an application that uses contact class and methods like send email/SMS
10. Develop a sensor based application using Motion sensors,Position sensors, Environmental sensor

Group C

1. Mini Project

20PECE 501A Digital Image Processing

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 basic concepts of digital image processing.
2. Learn and apply image enhancement and Image Segmentation techniques.
3. Understand object Recognition, Image Restoration and reconstructions.
4. Learn and apply image compression techniques and Understand image processing applications.

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

1. Apply basic steps of digital image processing on given images
2. Select the image enhancement techniques.
3. Make use of Image Restoration, reconstructions techniques.
4. Identify the image compression techniques.
5. Choose Image Segmentation techniques for given images.

Unit I: Introduction to Image Processing **(07)**
Introduction to digital image processing: Origin, usage and application of image processing, Fundamental steps and component of image processing system,representation of digital images. Basic relationships between pixels, introduction to Human Visual System,Image sensing and acquisition,Basic concepts in sampling and quantization,Basic operations:Convolution,Arithmetic and Logical Operations.

Unit II: Image Enhancement Techniques **(08)**
Basic image preprocessing (contrast enhancement, simple noise reduction) some basic gray level transformations,Histogram Processing-Histogram Equalization,Histogram stretching,Spatial filtering- Smoothing and Sharpening Spatial filters. Frequency Domain: Introduction to Fourier Transform– frequency domain filters.

Unit III: Image Compression **(07)**
Introduction to Image Compression and its need, Coding Redundancy,Classification of Compression Techniques (Lossy and Losless - JPEG,RLE, Huffman, Shannon fano,Arithmetic coding), Scalar & Vector Quantization.

Unit IV: Image Restoration & Reconstruction **(06)**
Model of Image degradation, Noise Models,Classification of image restoration techniques,Order Statistics fileters-Mean,Median,Min,Max,Alpha trimmed mean

filter,Geometric and harmonic mean filter,Inverse filtering, Wiener filtering,Blind-deconvolution techniques.

Unit V: Image Segmentation, Analysis and Object Recognition (08)

Point detection, Lines detection,Edge detection,Classification of image segmentation techniques: Edge-based Segmentation, Region based techniques. Binarization: Global Thresholding, Adaptive thresholding. Types of Edge detector: derivative filters-Prewitt, Sobel, Canny.

Introduction to Object Recognition, Object Representation(Signatures, Boundary Skeleton), Simple Boundary Descriptors, Regional descriptors- Topological feature(Texture).

Morphological Operations:Basics of Set Theory; Dilation and Erosion - Dilation,Erosion; Structuring Element; Opening and Closing;

Unit VI: Advances in Image processing Applications (06)

Medical Image Processing, Remote Sensing, Synthetic-aperture radar (SAR) Image Processing,Image registration,Biometric Authentication Methods like Face detection, Iris Recognition.

Text Books:

1. R.C. Gonzalez, R.R. Woods, '**Digital Image Processing'**, ISBN 978-81-317-2695-2,*Person (*Third Edition) ,(2011)
2. Sridhar S. '**Digital Image Processing',** *Oxford University Press, (Second Edition),(2016)*
3 S.Jayaraman, S. Esakkirajan,T. Veerakumar , **'Digital Image processing',**ISBN 978-0-07-014479-8, *Mcgraw Hills Publication (Tenth reprint),(2013)*

Reference Books:

1. Sonka, Hlavac, Boyle, '**Digital Image Processing and Computer Vision',** ISBN 978-81-315-0555-7,*Cenage Learning* (Sixth Indian Reprint) ,(2011)
2. B. Chanda, D.Datta Mujumdar '**Digital Image Processing And Analysis',** *PHI*, ISBN 978- 81-203- 4325-2, (Second Edition),(2013)
3 Anil Jain, '**Fundamentals of Digital Image Processing'**, *PHI*, ISBN-81-203-0929-4 (Indian Reprint) ,(1995)
4 Basudeb Bhatta ' **Remote Sensing and GIS'** *Oxford University Press*, ISBN 978-0-19-807239-3 (Second Edition)(2014)

Online/Web/Other References:

1. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6504845

2 https://searchsecurity.techtarget.com/definition/biometric-authentication

20PECE 501B Java Full Stack Technologies

Teaching Scheme
Lectures: 3 Hrs/week

Examination Scheme
In Semester: 50 marks
End Semester: 50 marks
Credits: 3

Prerequisites: Data Structures (20CE 302)

Course Objectives:
To facilitate the learner to -

1. Get exposure to full stack development in Java technologies.
2. Develop familiarity with the client side Java technologies.
3. Gain comprehensive knowledge about Java server side technologies for enterprise application development in practice.
4. Get familiar with the web services based approach for real-life application development.
5. Get acquainted with the database development technologies in Java.

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

1. Choose suitable client side Java technologies.
2. Analyze Java server side technologies for enterprise application development.
3. Analyze the characteristics of web services paradigm.
4. Analyze the role of Java database development technologies to realize their suitability for application development.

Unit 1: Client Side Web Technologies **(07)**

n-tier architecture, HTTP request - response, Web browser, HTML, CSS, XML, JSON, JavaScript (JS), Document Object Model (DOM), Introduction to jQuery, Asynchronous JavaScript And XML (AJAX).

Unit 2: Server Side Java Web Technologies **(07)**

Introduction to server side technology, Common Gate Interface (CGI), Java Servlets, Java Server Pages (JSP), Session tracking, JSP tags, Java Beans, MVC architecture.

Unit 3: ReactJS **(06)**

Overview of ReactJS: Introduction, Features, Advantages, Comparison with AngularJS, Introduction to Nodejs; ReactJS concepts like components, virtual DOM, JSX and APIs.

Unit 4: Java 2 Enterprise Edition (J2EE) Technologies **(08)**

Introduction to J2EE technologies, Enterprise Java Beans (EJB), Java Messaging Service (JMS), Remote Method Invocation (RMI).

Unit 5: Java Web Services **(07)**

Web Services: Overview; Service Oriented Architecture (SOA), Java Web services based on SOAP and REST, Java Web services API for SOAP and REST based web services: JAX-WS, JAX-RS.

Unit 6: Java Database Programming and Hibernate **(07)**

Java Database Connectivity (JDBC), Java Transaction API (JTA), Java Persistence API (JPA), Hibernate: Overview, architecture, Object Relational (OR) Mapping.

Text books:

1. Kogent Learning Solutions Inc., **'Web Technologies: HTML, JS, PHP, Java, JSP, ASP.NET, XML, AJAX, Black Book'**, *DreamTech Press*, ISBN: 978-81-7722-997-4, (2015).
2. Kogent Learning Solutions Inc., **'Java Sever Programming Java EE6 Black Book'**, *DreamTech Press*, ISBN: 978-81-7722-936-3, (2013).
3. Stoyan Stefanov, **'React - Up & Running: Building Web Applications',** *O'Reilly,* ISBN: 9781491931820, (2016).
4. William Crawford, Jim Farley, **'Java Enterprise in a Nutshell'**, *O'Reilly*, ISBN-13: 978-0596101428, 3rd Edition, (2005).

References books:

1. Mark Tielens Thomas, **'React in Action'**, *Manning Publications*, ISBN: 978-1617293856, (2018).
2. Kevin Mukhar, Chris Zelenak, James L. Weaver and Jim Crume, **'Beginning Java EE5: From Novice to Professional'**, *Apress*, ISBN-13: 978-8181284020, (2006).
3. Kirupa Chinnathambi, **'Learning React: A Hands-on Guide to Building Web Applications Using React and Redux',** *Addison Wesley,* (2016).
4. Jim Keogh, **'The Complete Reference J2EE'**, *McGraw Hill Education*, ISBN: 978-0-07-052912-0, (2012).

Web References:

1. https://learn.jquery.com
2. https://docs.oracle.com/javaee/7/tutorial/
3. https://reactjs.org

20PECE 501C Statistics for Computer Science

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. Utilize fundamentals of statistics and descriptive statistics concepts.
2. Analyse data using correlation, regression and multivariate analysis.
3. Apply statistical inference techniques for dealing with uncertainty in decision making.
4. Apply analysis of variance technique to check how different the samples are from each other.
5. Apply statistics concepts in different applications.

Course Outcomes:
After completion of the course, students will be able to
1. Apply the methods of descriptive statistics on different types of data.
2. Experiment with statistical analysis and multivariate analysis using correlation and regression.
3. Make use of sample inferential statistics to draw inference.
4. Perform analysis of variance for groups of data.
5. Apply the statistics concepts in applications such as manufacturing, economics, business analysis and forecasting.

Unit I: Basic statistics (10)
Definition, collection and type of data, processing of data, classification, tabulation and graphical representation of data, limitation of statistics.
Types of averages: arithmetic mean, median, mode, geometric mean, harmonic mean, relationship among averages, variation, merits and limitations of variation, standard deviation.

Unit II: Correlation and Regression (7)
Introduction, types of correlation, methods of studying correlation: scatter diagram, graphic method, Karl Pearson's coefficient of correlation, Rank correlation coefficient
Regression analysis: Introduction, uses of regression analysis, difference between correlation and regression analysis. Regression lines, regression equations, regression coefficient and its properties.

Unit III: Multivariate Analysis (4)
Partial regression, partial correlation, multiple correlation, multivariate regression, principal component analysis (PCA).

Unit IV: Statistical Inference -Test of Hypothesis (7)

Introduction, procedure of testing hypothesis, types of hypothesis, two types of error in testing of hypothesis, two-tailed and one-tailed test t-test, chi-square test, F-test, degrees of freedom, relation between t-test, chi-square and F-test.

Unit V: Analysis of Variance (6)

Introduction, assumptions and techniques of analysis of variance, One-Factor analysis of variance, two factor analysis of variance: Parameter estimation and testing hypotheses.

Unit VI: Applications of Statistics (8)

Introduction to statistical quality control, acceptance sampling, Introduction to business forecasting, Introduction to index numbers for economic and business analysis.

Text Books:

1. "Statistical Methods", S.P. Gupta, 41st Edition, 2011, ISBN :978-81-8054-862-8, Sultan Chand and Sons publication.
2. "Basic statistics", B.L. Agarwal, 9th Edition, 2011, ISBN:978-81-224-2472-0, New Age publication.
3. "Statistics in Nutshell", Sarah Boslaugh and Paul Andrew Watters, 2008, ISBN: 978-81-8404-568-0, SPD O'Reilly publication.

Reference Books:

1. "Statistical Data analytic" by Piegorsch W.W., 2017, ISBN:978-81-324-2472-4, Wiley publication
2. "Introductory statistics", Sheldon M. Ross, 2nd Edition, 2006, ISBN: 81312-00485, Elsevier publication.
3. "Applied multivariate statistical analysis", Richard A. Johnson, Dean W. Wichern, 6th edition, 2012, ISBN-978-81-203-4587-4, PHI Learning

Online/Web/Other References:

1. Nptel, coursera courses on probability and statistics

20PECE 501D Linux Internals

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 basic concepts of UNIX Operating System and booting process.
2. Understand Linux Process and threads.
3. Understand memory management in Linux.
4. Learn basics of Inter process communication with respect to Linux.
5. Understand use of AWK scripting and MAKE tool in Linux.
6. Learn advance concepts in Linux operating system.

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

1. Apply the basic knowledge about UNIX operating system.
2. Build basics concepts in Linux process and thread management.
3. Make use of Linux Memory management concepts.
4. Utilize the concepts of inter-process communication.
5. Choose AWK scripting and MAKE tool for Linux programming.
6. Explore the advancements in Linux Operating Systems.

Unit I: Fundamental of UNIX operating system (07)
Introduction, UNIX Operating Systems structure, Kernel architecture, types of kernel, Operating system: Booting process, Grub I, Grub II, Representation of files, Systems Call File system, Free Space Management, Disk management, Concept of Buffer management in UNIX /Linux.

Unit II: Process and threads in Linux (08)
Process states and transitions, layout of system memory, Context of a process, saving the context of a process, Process creation, Signals, Process termination, Concept of threads, Linux processes and thread management, Introduction to threads , Thread libraries, Thread issues, Multithreading models, Process management and Linux scheduler.

Unit III: Memory management and virtual memory in Linux (07)
Swapping, Demand Paging, A hybrid system with swapping and demand paging, memory management requirements, Memory partitioning, Security Issues in memory management, Linux memory management.

Unit IV: Inter-process Communication in Linux (07)

Process tracing, System V IPC, Network communication, sockets, Multiprocessor systems: problem with multiprocessor systems, solution with master slave processes, Linux Inter process communication: User level IPC mechanism, Kernel synchronization, socket programming.

Unit V: Tools and Technologies (07)

Search and Sort tools: grep, egrep, fgrep, MAKE tool: When to use MAKE, Macros, abstractions and shortcuts, make, nmake, cmake. AWK tool: AWK syntax, AWK grammar, AWK scripting, Linux Utilities, Version Control Systems for Linux.

Unit VI: Variants in Linux (06)

Hand-held systems: requirements, Linux as hand-held operating system, Linux for distributed systems, technology overview, Case-study of Google Android, Linux in Supercomputing, Linux and Cloud, Linux in Business, Linux Container and Virtual Machines.

Text Books:

1. Maurice J. Bach, "The Design of the Unix Operating System", Third Edition, 2013, Pearson, ISBN 978-81-203-0516-8.
2. Pramod Chandra P. Bhatt, "An introduction to Operating Systems: Concepts and Practice (GNU/Linux)", PHI, (Fourth edition), (2014), ISBN-978-81-203-4836-3.
3. Evi Nemeth, Garth Snyder, Tren Hein, Ben Whaley, "Unix and Linux System Administration Handbook", Pearson, (Fourth Edition), ISBN: 978-81-317-6177-(2014).

Reference Books:

1. William Stallings, "Operating System-Internals and Design Principles", Prentice Hall India, ISBN-81-297-0 1 094-3.
2. David Rusling, "The Linux Kernel", Addison Wesley, (Second edition), ISBN 978-0201770605.
3. Sumitabha Das, "UNIX Concepts and Applications", ISBN 0-07-053475-6.

20PECE 501LA Digital Image Processing Laboratory

Teaching Scheme
Practical: 2 Hours / Week

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

Prerequisite:

Course Objectives:

To facilitate the learner to

1. Learn Basics Image Processing operations like image Read, Write, Add, subtract
2. Understand and apply algorithms used for image enhancement, edge detection
3. Able to develop an Image Processing application using various techniques
4. Learn and use different Image Processing Tools

Course Outcomes:

After completion of the course, students will be able to

1. Apply basic operations on given image
2. Apply effectively algorithms for image enhancement, edge detection
3. Develop small image processing application using various techniques
4. Make use of Image Processing Tool

Preamble:

The lab would be for understanding the basic concepts of image processing and implementation of some real-world simple applications. Assignment statements are in brief and should be implemented Using Opencv in Python/JAVA programming language. Motivation here is that students should be able to code the basic algorithm and also should be able to make use of built-in functions available in different libraries of Opencv and Python/Java. Faculty members are encouraged to expand problem statements with variations. Assignments can be framed and expanded in such a way that it explores concepts, 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.

Group A assignments are on capturing images and performing different manipulation on image data such as arithmetic and logical operations, to improve the quality of image using different enhancement techniques. Group B assignments are on filtering techniques and Group C assignment is open ended application development

Suggestive List of Assignments

Group A : (Mandatory)

1. Study different file formats and Write a program to create a simple image file in .tiff format, and display it .
2. Write a program to perform Arithmetic operations/Logical operations
3. Write a program to perform Intensity Transformation technique on given image
4. Write a program for image enhancement techniques using Histogram

Group B: (Any Three)

1. Write a program using derivative filtering technique for Edge detection
2. Write a program to illustrate Morphological transformation
3. Write a program to illustrate Image Restoration techniques
4. Write a program using Edge detectors for Edge detection
5. Write a program for Non-Linear filtering using convolutional masks- effects of a median filter on an image corrupted with impulsive noise.

Group C

1. Implement a small Image processing application using MATLAB/ OpenCV

20PECE 501LB Java Full Stack Technologies Laboratory

Teaching Scheme
Practical: 2 Hrs/week

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

Course Objectives:
To facilitate the learners to -

1. Understand the Installation and Configuration setting related aspects of web server, integrated development environments and various frameworks, in the development of web applications.
2. Understand the role of various technologies used for real-life application development.
3. Get exposure to full stack development in Java which includes client side and server side technologies, web services and database development technologies.
4. Gain practical knowledge about the various client side and Java server side technologies for application development in practice.

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

1. Make use of suitable client side Java technologies.
2. Experiment with various Java server side technologies like Java Servlets, Java Server Pages, Web services and JPA for web application development.
3. Make use of Java Sockets library and Java RMI framework for the development of sample client-server applications.
4. Build a sample web application using suitable technologies at various tiers.

Preamble:

Development of web applications need technologies at various levels, which play different roles in the overall web architecture. The intent of Java Full Stack Technologies Laboratory is to enable the understanding of the role of various technologies in full stack development and implementation of some real world application scenarios using these technologies. Assignment statements are in brief and should be implemented with Java web technologies. Motivation here is that students should be able to develop the user interface, business logic and the database programming parts of a typical web application, using the APIs/libraries provided by various client side and server side Java technologies. Faculty members are encouraged to expand problem statements with variations. Assignments can be framed and expanded in such a way that it explores concepts, logic of solution and simple application. Students will be encouraged to build solutions for real world business scenarios in different domains, to fulfil the end-user requirements. Faculty will appropriately adopt assignments on similar lines as the examples shown here. Group A assignments are on applying

various client side technologies and basic server side technologies. Group B assignments are on exploring the use of technologies like EJB, Web services and Hibernate. Group C assignment is on the development of sample web application.

Suggestive List of Assignments:

Group A: (Mandatory)

1. Develop dynamic and interactive web client using HTML, CSS and JavaScript technologies. Make use of these technologies to develop suitable web forms, layout and to perform validation of form data, for this web client.

   Sample application scenario:
   Consider that a student needs to register for an online course portal. For this scenario, develop an HTML form for "Course Registration", make use of CSS for layout design of this form and perform validation on various fields of this form using JavaScript.

2. Develop dynamic and interactive web client using XML and AJAX technologies, to enable rich user experience.

   Sample application scenario for AJAX:
   Consider a web form for an administrator of an "Online Shopping Application". An administrator can select the name of a customer from the drop down list box on the web form. Then on the same page, the details of the customer such as shipping address should get displayed.

3. Develop dynamic and interactive web client using jQuery as a client side JavaScript library. For this web client, implement event handling and animation effects using jQuery.
4. Develop dynamic and interactive web client using ReactJS as a client side library. Make use of various features of ReactJS such as components, APIs etc.
5. Implement a simple client-server application like echo server or chat server using Java Sockets. Make use of multithreading in Java for handling the requests from multiple clients.
6. Implement an application using Java RMI to understand distributed application environment. The remote object accesses database using JDBC.
7. Implement a sample web application scenario using Java Servlets, Java Server Pages and Java Beans as the server side dynamic content generation technologies. Make use of MVC architecture for this implementation and also show the appropriate usage of the various capabilities of these technologies such as session tracking, tag library, implicit objects, directives etc.

   Sample application scenario:
   Consider a simple web form where you give Student Roll number and get back Student Profile details from the database. Make use of MVC architecture, based on Java Servlet, JSP and Java Bean to implement this web based scenario.

Group B: (Any One)

1. Implement a sample EJB based scenario for any application like online movie ticket booking, online college admission portal, online railway reservation etc. Make use of various types of beans such as session beans and entity beans, for the implementation of business methods and persistence of data.
2. For a sample application scenario, implement and consume the suitable web services using SOAP or REST protocol.
3. Make use of JPA with Hibernate framework for performing the create, retrieve, update and delete (CRUD) operations on the backend database.

   Sample application scenario:
   Consider "Course Information Management" as a typical Database Application. This application may have database tables like Courses, Participants etc. Make use of JPA with Hibernate framework to access the data from the Courses table in this above application.

Group C:

1. Design and develop a typical web application like online cab booking, online food ordering application, online tours and travel portal etc. For the development of this application, choose the appropriate technologies for the client side aspects, server side business logic and database development.

20PECE 501LC Statistics for Computer Science Laboratory

Teaching Scheme

Practical : 2 Hours / Week

Examination Scheme

In Semester: 25 Marks

Oral: 25 Marks

Credits: 1

Prerequisite: NA

Course Objectives:

To facilitate the learner to

1. Understand and use the basic statistical tool for statistical operations and interpretation of data.
2. Use knowledge of data representation for given data points.
3. Apply correlation, regression model and ANOVA model for given data.
4. Apply hypothesis testing to draw conclusions for given data.
5. Use concepts of statistics for real life problems.

Course Outcomes:

After completion of the course, students will be able to

1. Perform basic statistical operations on given data using statistical programming and tools.
2. Apply different data representation methods for interpretation of given data.
3. Apply various models of regression, correlation and ANOVA to predict and find relation between given data.
4. Apply hypothesis testing to draw inference for given data.
5. Develop small statistical applications using different statistical techniques.

Preamble

A large part of the lab would be for understanding the basic concepts of statistics and implementation of some real-world simple applications. Assignment statements are in brief and should be implemented in R/Python programming language. Motivation here is that students should be able to code the basic statistical techniques on given data and also should be able to make use of built-in functions available in different libraries of R/Python. Faculty members are encouraged to expand problem statements with variations. Assignments can be framed and expanded in such a way that it explores concepts, 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. Assignments can be done on any data dataset. Students and faculty are advised to consider different datasets.

Suggestive List of Assignments

Group A: (Mandatory)

1.Getting started with software, installation, its objects and data types
2.Graphical presentation of data in different plot forms/diagrams using software tool
3.Apply basic statistical operations, measure of location (Arithmetic mean, harmonic mean, geometric mean, median, mode)
4.Perform measure of dispersion, standard deviation, quartile deviation etc.

Group B: (Any Four)

1.Plot the diagram for the given data, develop the regression model that best describes the data, and also predict output for the given value.
2.Perform correlation analysis (positive, negative, zero) that describes the degree to which variables are linearly related to each other.
3.Perform test of hypothesis, one sample t-test, paired t-test on given data and see how to use them for statistical inference.
4.Perform test of hypothesis, chi-squared goodness of fit test, on given data and see how to use them for statistical inference.
5. Perform analysis of variance (ANOVA) on data for evaluating hypothesis.

Group C

Data analysis case study for readily available data set using the statistical techniques studied. Take a dataset freely available, apply statistical analysis technique or statistical machine learning technique on that dataset, also graphically represents the results.

20PECE 501LD Linux Internals Laboratory

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
In-Semester: 25 Marks
Oral: 25 Marks
Credits: 1

Prerequisite:

- Operating Systems Laboratory (20CE 407)

Course Objectives:
To facilitate the learner to

1. Understand basic commands of LINUX Operating System.
2. Understand and write shell script for a given task.
3. Apply socket programming concepts.
4. Learn use of AWK programming and MAKE tool.
5. Apply Inter process communication concepts for solving a problem.

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

1. Apply fundamental concepts of LINUX Operating System.
2. Implement shell script for a given problem statement.
3. Build the concepts for socket programming.
4. Explore AWK script and MAKE tool to write basic programs.
5. Make use of Inter-process communication concepts for solving a problem.

Preamble:

Linux Internals Laboratory is designed to understand and implement the concepts of Linux operating System. Motivation here is that students should be able to code the shell script and make use of inter-process communications concepts. Assignments can be framed and expanded in such a way that it enhances the concepts and logic of the solution. Students will be encouraged to solve open problems using different tools like MAKE, AWK script. Group A assignments are based on Linux commands, shell script and inter-process communication using pipes. Group B assignments are on AWK script, MAKE tool and Sockets programming. Group C assignment is to explore Linux Environment in more advanced way.

Suggestive List of Assignments

Group A : (Mandatory)
1.Exploration of Linux commands - File handling utilities, Process utilities, Disk utilities, Networking commands, Text Processing utilities and Back-up utilities.

2. Write a program for counting characters, words or lines and searching text file contents using grep command.
3. Write a program for Inter-process communications between related processes using pipes.

4. Write a Java program to implement the following UNIX commands using following system calls:

- cat
- ls
- mv

5. Write a shell script that displays a list of all the files in the current directory to which the user has read, write and execute permissions.

Group B: (Any Four)

7. Write an AWK script to count the number of lines in a file that do not contain vowels.

8. Write a program using the MAKE tool to compile all java source files that need to be re-built.
9. Write a program in Java/Python to create a RAMDRIVE and associate an acyclic directory structure to it.
10. Write a Java program to create Child process (using fork), Zombie, Orphan and displaying system information.
11. Write a AWK script to filter, split a line into fields, printf, variables and expressions, the comparison operator, number processing.
12. Write an IPC program using pipe. Process A accepts a character string and Process B inverses the string. Pipe is used to establish communication between A and B processes using Python or Java.

Group C (Any One)

1. Write a program to implement Linux installation commands/administrative commands / security commands/version controlling commands/IPC Commands/ File Management Commands.
2. Write client and server programs for interaction between server and client processes using Unix Domain sockets and Internet Domain Sockets.

Autonomous Program Structure
Third Year B. Tech. Sixth Semester
Computer Engineering
Academic Year: 2022-2023 Onwards

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Marks	Credits
		Lecture	Tutorial	Practical	In Semester	End Semester	Oral	Practical		
20CE601	Microprocessor and Microcontroller	3	1	0	50	50	0	0	100	4
20CE602	Software Engineering	3	1	0	50	50	0	0	100	4
20CE603	Cloud Computing	3	0	0	50	50	0	0	100	3
20HS601	Professional and Societal Awareness for Engineers	3	0	0	50	50	0	0	100	3
20PECE 601	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
20CE601L	Microprocessor and Microcontroller Laboratory	0	0	2	25	0	0	25	50	1
20CE603L	Cloud Computing Laboratory	0	0	2	25	0	25	0	50	1
20AC 601	Audit Course	0	0	2	0	0	0	0	0	No Credits
	Total	**18**	**2**	**6**	**350**	**300**	**25**	**25**	**700**	**22**
	Grand Total	**24**			**700**					**22**

Programme Elective-III
20PECE601A DevOps Fundamentals
20PECE601B Compiler Construction
20PECE601C Deep Learning
20PECE601D Data Management, Protection and Governance by Veritas Technologies

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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

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Autonomous Program Structure
Third Year B. Tech. Sixth Semester
Computer Engineering
Academic Year: 2022-2023 Onwards

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Marks	Credits
		Lecture	Tutorial	Practical	In Semester	End Semester	Oral	Practical		
20CE601	Microprocessor and Microcontroller	3	1	0	50	50	0	0	100	4
20CE602	Software Engineering	3	1	0	50	50	0	0	100	4
20CE603	Cloud Computing	3	0	0	50	50	0	0	100	3
20HS601	Professional and Societal Awareness for Engineers	3	0	0	50	50	0	0	100	3
20PECE 601	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
20CE601L	Microprocessor and Microcontroller Laboratory	0	0	2	25	0	0	25	50	1
20CE603L	Cloud Computing Laboratory	0	0	2	25	0	25	0	50	1
20AC 601	Audit Course	0	0	2	0	0	0	0	0	No Credits
	Total	**18**	**2**	**4**	**350**	**300**	**25**	**25**	**700**	**22**
	Grand Total	**24**			**700**					**22**

Programme Elective-III
20PECE601A DevOps Fundamentals
20PECE601B Compiler Construction
20PECE601C Deep Learning
20PECE601D Data Management, Protection and Governance by Veritas Technologies

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

20CE 601 Microprocessor And Microcontroller

Teaching Scheme:

Lectures: 3 hours/Week

Tutorial: 1 hour/Week

Examination Scheme:

In Semester: 50 Marks

End Semester: 50 Marks

Credits: 4

Prerequisite:

1. Digital Systems and Computer Organization (20CE 304)

Course Objectives:

To facilitate the learners

1. To understand basic architecture and programming of Pentium microprocessor.
2. To understand and analyze the protected mode of the Pentium processor.
3. To understand the architecture of an 8051 microcontroller.

Course Outcomes:

By taking this course, the learner will be able to

1. Demonstrate the knowledge of basic Pentium processor concepts.
2. Infer the advanced microprocessor architectures.
3. Make use of the 8051 microcontrollers for interfacing the devices.
4. Apply the programming concepts using x86 and 8051 assembly level language.

Unit – 1: PENTIUM MICROPROCESSOR ARCHITECTURE (06)

Pentium Architecture, Pipeline stages, Superscalar pipeline issues, Instruction pairing rules, Branch prediction, Memory organization with Instruction and Data caches Pentium programmers' model, register set, Addressing modes and instructions.

Unit – 2: PROTECTED MODE ARCHITECTURE IN PENTIUM (08)

Real Mode vs. Protected mode, Memory management with segmentation and paging Protection mechanism in segmentation and paging, Virtual 8086 Mode (support registers, descriptors, privilege-level, protection, exclusive instructions, inter-privilege level, transfer control, Paging-support registers, Descriptor, linear to physical address translation, TLB, page level protection).

Unit – 3: MULTITASKING, INTERRUPTS, EXCEPTION AND INPUT/OUTPUT (08)

Multitasking, support registers, Descriptors, Task switching, Nested task, I/O handling in Pentium, I/O instructions, I/O Permission bitmap, Interrupts and Exceptions structure in real, protected and virtual modes.

Unit – 4: 8051 MICROCONTROLLER ARCHITECTURE (06)

Features, Microcontroller MCS-51 family architecture. Programmers model-register set, register bank, SFR's, addressing mode, instruction set, Memory organization on-chip data memory External data memory and program memory. Memory interfacing-external RAM/ROM interface.

Unit – 5: 8051 AND INPUT-OUTPUT INTERFACING (08)

CPU timings, Interrupt structure, Timers and their programming, Serial port and programming, Serial Data Communication using RS-232C. I/O devices-ADC / DAC and Stepper Motor, Power saving modes in 8051.

Unit–6: INTRODUCTION TO ADVANCED MICROPROCESSORS AND MICROCONTROLLERS (06)

Introduction to multicore architectures i3/i5/i7, Cache coherency,
Processor Architectures for Mobile Application, Embedded Application and Enterprise Application.
Introduction to Advanced Microcontrollers for Embedded Systems, A case study in embedded or IoT based systems.

Text Books:

1. 8086 and peripherals – Intel Manual
2. Pentium Architecture – Intel Manual
3. Intel 8-bit Microcontroller Manual

Reference Books:

1. Douglas Hall, **'Microprocessors & Interfacing'**, *McGraw Hill*, (Revised 2nd Edition), (2006)
2. James Antonakos, **'The Pentium Microprocessor'**, *Pearson Education,* (2nd Edition), (2004)
3. Sivarama P. Dandamudi, **'Introduction to Assembly Language Programming For Pentium and RISC Processors'**, *Springer*,(2nd Edition), (2004)
4. Muhammad Ali Mazidi and Janice Gillispie Mazidi, **"The 8051 Microcontroller and embedded systems**", 2009, Pearson education. ISBN – 81-7808-574-7
5. W. Stallings, '**Computer Organization and Architecture - Designing for Performance'**, *Prentice Hall of India*,(8th edition), (2002)

Web References:

1. NPTEL series – nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/
2. NPTEL series for 8051 – https://nptel.ac.in/courses/108/105/108105102/
3. service.scs.carleton.ca/sivarama/org_book/org_book_web/slides/chap_1_versions/ch7_1.pdf

List of Tutorial Assignments:

The subject Microprocessor and Microcontroller introduces the processor evolution from basic to advanced. It also signifies the use of microcontrollers in multiple real-life applications.
The tutorial is designed to develop the assembly language programming ability of an individual student.
The teachers can design different problems based on the topics suggested below –

1. & 2. Write small code snippets using arithmetic, logical and conditional jump instructions.
3. Learning how to use the DOS/LINUX system calls for program I/O.
4. Write small codes using string instructions.
5. Evaluate the output of small ALP's.
6. Numerical examples solving logical, linear and physical address translation for x86.
7. Draw memory maps and evaluate the changes after a particular instruction.
8. Develop 8051 program snippets.
9. Understand the basics of SFRs and register banks.
10. 8051 addressing modes.
11. Design delays using 8051 timers.
12. A design case study using 8051 and its interfacing with memory, I/O, sensors.

20CE 602 Software Engineering

Teaching Scheme
Lectures: 3 Hours/Week
Tutorial: 1 Hour/Week

Examination Scheme
In Semester: 50 marks
End Semester: 50 marks
Credits: 4

Prerequisites: Software Design and Architecture (20CE 503)

Course Objectives:
To facilitate the learner to -

1. Develop familiarity with the software design and component based software engineering.
2. Get exposure to the various facets of agile software process model.
3. Learn the basic concepts of refactoring.
4. Gain knowledge about the various aspects of designing and testing of web applications.

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

1. Apply the concepts of component-level design to realize the solution of a system.
2. Analyze the agile software process model for application development.
3. Analyze the refactoring methods to restructure the classes.
4. Make use of various concepts of designing and testing for web applications.

Unit 1: Software Design Concepts and Component-Level Design (07)
Design within the context of Software Engineering, The design process, Design concepts, Design model. Component-Level Design: What is a component, Designing class-based components, Steps of component-level design, Component-based development.

Unit 2: Introduction to Agile Software Development (07)
Why agile software development - Limitations of traditional process models, Evaluating Agile Benefits, Understanding the Agile Manifesto, Outlining the Four Values of the agile Manifesto, Defining the 12 Agile Principles, Agile approaches - Lean, Scrum and Extreme Programming, Agile team.

Unit 3: Agile Project Planning and Software Practices (07)
Agile project inception, User stories, Estimation, Agile plan.
Agile software practices: Refactoring, Test-driven development, Continuous Integration Continuous Delivery (CICD); DevOps: Lifecycle, Benefits, Use cases, DevOps and Deployment.

Unit 4: Introduction to Refactoring **(07)**

What is Refactoring, Why and when to refactor, Code smells, Duplicated code, Long method, Extract method, Large class, Extract class, Alternative classes with different interfaces, Move method, Move field, Rename method, Rename variable, Replace method with method object.

Unit 5: Refactoring Methods **(07)**

Replace data value with object, Change unidirectional association to bidirectional, Switch statements, Replace conditional with polymorphism.

Remove control flag, Introduce assertion, Replace constructor with factory method, Replace error code with exception.

Pull up field, Pull up method, Push down method, Push down field, Extract subclass, Extract superclass, Extract interface, Replace inheritance with delegation.

Unit 6: Design and Testing of Web Applications **(07)**

WebApp design quality, Design goals, Design pyramid, WebApp interface design, Asthetic design, Content design, Architecture design, Navigation design, Component-level design, Object-oriented hypermedia design method.

Testing concepts for WebApps, Testing process - overview, Content testing, User interface testing, Component-level testing, Navigation testing, Configuration testing, Security testing, Performance testing.

Text books:

1. Roger S. Pressman, **'Software Engineering: A Practitioners Approach'**, *Tata McGraw Hill*, (7th Edition) (2010).
2. Jonathan Rasmusson, **'The Agile Samurai: How Agile Masters Deliver Great Software',** *Shroff Publishers and Distributers (SPD)*, ISBN: 978-93-5213-411-3, (2016).
3. Martin Fowler, Kent Beck, John Brant, William Opdyke and Don Roberts, **'Refactoring: Improving The Design of Existing Code'**, *Pearson Education,* ISBN: 978-81-317-3466-7, (2017).
4. Mark C. Layton, Steven J. Ostermiller, **'Agile Project Management for Dummies',** *Wiley*, (2nd Edition), (2017).

Reference books:

1. Sanjeev Sharma and Bernie Coyne, **'DevOps for Dummies'**, *IBM Limited Edition*, John Wiley and Sons, Inc. (2015).
2. Ian Sommerville, **'Software Engineering'**, *Person Education,* (8th Edition) (2008).
3. Grady Booch, James Rumbaugh, Ivar Jacobson, **'The Unified Modeling Language User Guide'**, *Pearson Education,* (2nd Edition) (2008).

Web References:

1. Official website of R. S. Pressman and Associates, Inc: http://www.rspa.com/
2. Agile Software process model: https://www.agilealliance.org/
3. Basics of Scrum: https://www.scrumalliance.org/
4. https://www.bmc.com/blogs/devops-basics-introduction/

Tutorials - Preamble:

The scope of tutorials for "Software Engineering" includes exercises based on component-level design concepts, agile software practices, refactoring concepts and design and testing of web applications. During tutorials, problem solving and system design skills of students are challenged and improved.
For a chosen hypothetical system, students are expected to identify its scope, suitable classes, modules and build the component and deployment models. The students are also expected to apply the relevant refactoring techniques to improve the quality of the design. The following is a sample list of tutorials, covering the various concepts in the course. The objective of tutorials is to provide an opportunity for students to explore as per their interests. Consequently, these tutorial statements will be further detailed during conduction, according to the scenarios under consideration.

Example List of Tutorials:

1. Draw Component Diagrams to model components, interfaces and dependencies as part of an implementation view of a given system.

2. Draw Deployment Diagrams to show the configuration of run-time processing nodes and the components that reside on them, depicting the working scenario for a given application.

3. Apply CRC modeling to identify classes, their responsibilities and the collaborators for a given system. Also for this system, identify the relevant user interface classes, business domain classes, system classes, process classes and persistent classes.

4. For a given large and complex system, create a "NOT List". Also for this system, identify the various modules and specify the responsibilities of these modules.

5. For a given system, identify the different users and write down the User Stories for the various features of this system, using the user story template.

6. Imagine that you are part of an agile team involved in the development of some software product. For this product, design a Product Box.

7. Write an Elevator Pitch in proper format for any software product of your choice.

8. For the given requirement / function, apply and describe with code/pseudo code the 3 steps of Test Driven Development.

9. Refactor the given code using "Rename method" and "Rename variable" techniques. Write the refactored code.

10. Refactor the given code using "Extract method" technique and Write the refactored code.

11. Refactor the given code using "Replace error code with exception" technique and Write the refactored code.

12. Refactor the given code using "Remove control flag" technique and Write the refactored code.

13. Refactor the given code using "Introduce Assertion" technique and Write the refactored code.

14. Refactor the given code using "Move method" and "Move field" techniques. Write the refactored code.

15. Refactor the given code using "Replace conditional with polymorphism" technique and Write the refactored code.

16. For a given an inheritance hierarchy, apply "Pull up field/method" technique and Write the refactored code.

17. For a given an inheritance hierarchy, apply "Push down field/method" technique and Write the refactored code.

18. For the given code, apply the relevant refactoring techniques from "Extract class", "Extract subclass", "Extract superclass" and Write the refactored code.

19. For any typical web application of your choice, specify the various features and write down a set of test cases to test these features/functionalities.

20CE 603 Cloud Computing

Teaching Scheme
Lecture: 3 Hours/week

Examination Scheme
In Semester: 50 marks
End Semester: 50 marks
Credits: 3

Prerequisites: Operating Systems (20CE 403)

Course Objectives:
To facilitate the learner to -

1. Understand the basic concepts related to cloud computing.
2. Analyze the underlying principles of different cloud service models.
3. Understand and apply the security techniques in cloud computing.
4. Get exposure to emerging trends in cloud computing.

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

1. Apply cloud computing concepts and the emerging trends to cloud based systems.
2. Analyze the cloud services and models.
3. Analyze various cloud platforms and tools for realization of different services.
4. Apply security concepts to the cloud environment.

Unit 1: Introduction **(06)**

Introduction to Cloud Computing, Cloud Economics, National Institute of Standards and Technology (NIST) Definition of Cloud Computing, Cloud Characteristics, Cloud Service Models, Cloud Deployment Models, Benefits, Challenges and Risks.

Unit 2: Infrastructure-as-a-Service (IaaS) **(08)**

Introduction to Infrastructure-as-a-Service (IaaS), Virtualization – Introduction, Taxonomy, Characteristics, Pros and Cons, Types of Service Level Agreement (SLA), Hypervisors - Xen, Kernel Virtual Machine (KVM), VMware, Docker Containers, Serverless computing, Microservices, Microservices architecture, Case Study- Amazon Web Services (AWS).

Unit 3: Platform-as-a-Service (PaaS) **(07)**

Introduction to Platform-as-a-Service (PaaS), Data in Cloud: Relational Databases, NoSQL Databases, Big Data, Cloud File System: Hadoop Distributed File System (HDFS), HBase, Map-Reduce Model, Case Study- Google App Engine (GAE).

Unit 4: Software-as-a-Service (SaaS) **(08)**

Introduction to Software-as-a-Service (SaaS), Multi-tenancy, Mashups, Service Oriented Architecture (SOA), Web Services based on Simple Object Access Protocol (SOAP) and REpresentational State Transfer (REST), SaaS Applications, Case Study- Salesforce.com.

Unit 5: Cloud Security **(07)**

Cloud Security Fundamentals, Cloud Security Challenges and Risks, Virtualization Security, Identity Management and Access Control, Secure Execution Environment and Communication.

Unit 6: Recent Trends **(06)**

Inter-cloud / Federated Cloud, Internet of Things (IoT) and Cloud Computing, Mobile and Cloud Computing, Data Centers- Introduction, Cloud Applications, Cloud and DevOps, Research trends in Cloud Computing.

Text books:

1. Rajkumar Buyya, Christian Vecchiola, S Thamarai Selvi, '**Mastering Cloud computing**', *McGraw Hill Education*, (2013), ISBN 978-1-25-902995-0.
2. Gautam Shroff, '**Enterprise Cloud Computing**', *Cambridge University Press*, (2010), ISBN 978-0-521-13735-5.
3. Ronald Krutz and Russell Dean Vines, '**Cloud Security**', *Wiley India Pvt. Ltd.*, (2010), ISBN 978-81-265-2809-7.
4. Kailash Jayaswal, Jagannath Kallakurchi, Donald Houde, Dr. Deven Shah, '**Cloud Computing Black Book**', *DreamTech Press*, (2015), ISBN 978-93-5119-418-7.

Reference books:

1. Thomas Erl, Zaigham Mahmood and Ricardo Puttini, '**Cloud Computing Concepts, Technology and Architecture**', *Prentice Hall*, (2013), ISBN 978-01-333-8751-3.
2. Barrie Sosinsky, '**Cloud Computing Bible**', *Wiley India Pvt. Ltd.*, (2015), ISBN 978-81-265-2980-3.
3. Rajkumar Buyya, James Broberg, Andrzej Goscinski, '**Cloud Computing Principles and Paradigms**', *Wiley India Pvt. Ltd.*, (2015), ISBN 978-81-265-4125-6.
4. Dr. Kumar Saurabh, '**Cloud Computing**', *Wiley India Pvt. Ltd.*, (2011), ISBN 978-81-265-2883-7.
5. Tim Mather, Subra Kumaraswamy, Shahed Latif, '**Cloud Security and Privacy**', *O'Reilly*, (2011), ISBN 13:978-81-8404-815-5.
6. A. Srinivasan, J. Suresh, '**Cloud Computing: A Practical Approach for Learning and Implementation**', *Pearson*, (2014), ISBN 978-81-317-7651-3.

Web References:

1. http://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.500-291r2.pdf
2. https://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf
3. https://docs.docker.com
4. https://www.bmc.com/blogs/devops-basics-introduction/
5. http://searchdatacenter.techtarget.com/definition/data-center
6. http://www.sapdatacenter.com/article/data_center_functionality/
7. https://www.salesforce.com

20HS 601 Professional And Societal Awareness For Engineers

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 professional ethics, communication and practices
2. Relate Intellectual property concepts to various documents , products
3. Study Sustainability issues and green computing in environmental context
4. Study social issues in the computing world

Course Outcomes:

After completion of the course, students will be able to

1. Apply professional and computing ethics
2. Relate Intellectual property basics to information management, storage and sharing
3. Apply sustainability paradigms to various computing centric issues
4. Relate green computing basics to IT systems
5. Apply sustainability principles to new world

Unit I: Professional Ethics and communication (08)

Morals, values and Ethics, Integrity, Work ethic, Civic virtue, Valuing time, Cooperation, Commitment, Empathy, Self-confidence, stress management, Senses of Engineering Ethics, Kohlberg‟s theory, Gilligan‟s theory, Models of professional roles, Uses of Ethical Theories, Communicating professionally with stakeholders

Unit II: Intellectual Property (08)

Philosophical foundations of intellectual property, Intellectual property rights (cross-reference IM/Information Storage and Retrieval/intellectual property and protection) ,Intangible digital

intellectual property (IDIP), Copyrights, patents, trade secrets, trademarks, Plagiarism, non disclosure agreement

Unit III: Sustainability & CSR (09)

Basics of sustainability in IT and computing, Global social and environmental impacts of computer use and disposal, Business Ethics, Ethics Vs Social Responsibility, A view of corporate social responsibility (Legal, Ethical, Economic, Philanthropic) and its importance, ESG(Environmental, Social and Governance standards), Evolution of ESG from CSR

Unit IV: Green Computing (09)

Green IT Fundamentals: Business, IT, and the Environment , Green computing: carbon footprint, scoop on power, Green IT Strategies: Drivers, Dimensions, and Goals , Environmentally Responsible Business: Policies, Practices, and Metrics, Virtualization of IT systems, Role of electric utilities, Telecommuting, teleconferencing and teleporting , Materials recycling , Best ways for Green PC, Green Data center, Green Grid framework.

Unit V: Sustainability in Healthcare (08)

Basics, Societal expectations, Sustainability and Pharmaceutical products-Role in Human health, Sustainable Concerns All Along the Life Cycle of the Health-care Industry, Global corporate governance and IT

Text Books

1. Bhuvan Unhelkar, "Green IT Strategies and Applications-Using Environmental Intelligence", CRC Press, June 2014
2. Ming din, "Sustainable development for health care industry" , Springer
3. Niraja Pandey, Khushdeep Dharni, "Intellectual Property Rights", PHI
4. Caroline Whitbeck, "Ethics in Engineering Practice and Research", Cambridge Press, ISBN:978-1-107-66847-8

Reference books

1. Woody Leonhard and Katherine Murray, "Green IT for Dummies", Wiley Publications (2009),ISBN: 978-0-470-74349-2

Online resources

NPTEL on Professional Ethics :https://nptel.ac.in/courses/110/105/110105097/

20CE 601L Microprocessor And Microcontroller Laboratory

Teaching Scheme:
Practical: 2 hours./Week

Examination Scheme:
In Semester : 25 marks
Practical :25
Credits: 1

Prerequisite:
1. Digital Systems and Computer Organization (20CE 304)
2. Digital Systems and Computer Organization Laboratory (20CE 307)

Course Objectives:
To facilitate the learners
1. To understand and apply x86 instructions to write assembly language programs.
2. To learn, apply and analyze microprocessor and peripherals interfacing techniques.
3. To learn and use the interfacing of assembly language and higher-level language.
4. To be able to solve moderately complex problems using modular assembly language programming.
5. To understand and use privileged instructions.

Course Outcomes:
By taking this course, the learner will be able to
1. Apply x86 instructions to write assembly language programs.
2. Apply modular programming using assembly level language.
3. Apply 8051 instructions to develop simple microcontroller programs.
4. Build a small system using microcontroller interfacing techniques.

The Microprocessor and Microcontroller laboratory assignments are designed for problem solving using assembly language programming. The laboratory work also covers the introduction to microcontroller assembly language and real-life case studies. It also aims to familiarize the concepts of use of modular programming and higher level language with ALP. The assignments in Group A cover basic concepts of assembly language programming whereas Group B cover structured assignments with advanced assembly language approaches. The indicative titles are mentioned in Group C, where students will be able to select a title and apply the learned concepts to understand the requirements of a real world application.

Group A Assignments (Perform all assignments)
1. Develop an application using x86 ALP to perform data declarations, arithmetic and logical operations and check the output in debugger.
2. Develop an application using x86 ALP to accept a signed number and check if it is positive or negative.
3. Develop an application using x86 ALP to accept a string from user and perform operations like
   (a) Convert a string to uppercase / lowercase
   (b) Toggle the case of the string

(c) Concatenation of another string
(d) Find if it is palindrome
(e) Find a substring
(Use of macros and procedures is recommended.
For this assignment make a group of 3-4 students, each one performing each task and then combine all functions to apply modular programming.)

4. Develop an application using 8051 Assembly language programming for addition, subtraction, multiplication and division of two 8-bit numbers.
5. Develop an application using 8051 Assembly language programming for block data transfer between internal and external memory including overlapping blocks.

Group B Assignments

Part B-1 – Select any one assignment from the following.

1. Develop an application using x86 ALP to simulate TYPE or COPY commands with the help of command line arguments.
2. Develop a modular application using x86 ALP PUBLIC/GLOBAL and EXTERN. Choose any application of your choice.
3. Develop an application by selecting any high-level language and insert assembly language code into it.

Part B-2 – Select any one assignment from the following.

1. Develop a suitable application using 8051 ALP with the help of timer, counter and interrupts.
2. Develop a suitable application using 8051 ALP for serial communication.
3. Develop a suitable application using 8051 ALP to interface I/O and DAC.

Group C Assignments

1. Design and build system for any real world application using 8051. Suggestive titles can be -
   i) Digital clock programming using 7- segment display.
   ii) Programming of LCD.
   iii) Programming on the keyboard.
   iv) Programming of parallel ADC.
   v) Interfacing Stepper Motor.
   vi) Speed Control of DC motor.
   vii) Interfacing Relay.
2. Study assignment - Perform a case study for a real time application of microprocessor or microcontroller. E.g. Application using DSP processor, ARM, embedded systems, vector, multi-core or array processor.

Text Books:

1. 8086 and peripherals – Intel Manual
2. Pentium Architecture – Intel Manual
1. Intel 8-bit Microcontroller Manual

Reference Books:

1. Douglas Hall, **'Microprocessors & Interfacing'**, *McGraw Hill*, (Revised 2nd Edition), (2006)
2. James Antonakos, **'The Pentium Microprocessor'**, *Pearson Education,* (2nd Edition), (2004)
3. Sivarama P. Dandamudi, **'Introduction to Assembly Language Programming For Pentium and RISC Processors'**, *Springer*,(2nd Edition), (2004)
4. Muhammad Ali Mazidi and Janice Gillispie Mazidi, **"The 8051 Microcontroller and embedded systems**", 2009, Pearson education. ISBN – 81-7808-574-7
5. W. Stallings, '**Computer Organization and Architecture - Designing for Performance'**, *Prentice Hall of India*,(8th edition), (2002)

Web References:

1. NPTEL series – nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/
2. NPTEL series for 8051 – https://nptel.ac.in/courses/108/105/108105102/
3. service.scs.carleton.ca/sivarama/org_book/org_book_web/slides/chap_1_versions/ch7_1.pdf

20CE 603L Cloud Computing Laboratory

Teaching Scheme
Practical: 2 Hours/week

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

Course Objectives:
To facilitate the learners to -

1. Explore the underlying principles of Infrastructure-as-a-Service (IaaS), virtualization and containers.
2. Understand the use of the Hadoop ecosystem.
3. Get exposure to the use of cloud Application Programming Interfaces (APIs) for developing sample application(s).
4. Study different cloud platforms and tools for various cloud service models.

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

1. Apply the hypervisor and container-based virtualization.
2. Experiment with the Hadoop ecosystem by implementing sample programs for Hive/HDFS/Map-Reduce.
3. Make use of CloudSim framework for understanding cloud computing infrastructure and services.
4. Analyze the use of different cloud platforms and tools/APIs for various cloud service models.

Preamble:

The intent of Cloud Computing Laboratory is to enable the understanding and implementation of the basic concepts of Cloud Computing. Assignment statements are in brief and can be implemented with Java/Python programming language. Motivation here is that students should be able to experiment with different aspects of IaaS, PaaS and SaaS using various APIs/libraries. Faculty members are encouraged to expand problem statements with variations. Assignments can be framed and expanded in such a way that it explores concepts, logic of solution and simple application. Students will be encouraged to explore different cloud platforms and tools. Faculty will appropriately adopt assignments on similar lines as the examples shown here. The basic and the next level experimentation with CloudSim, Docker container, virtualization and Hadoop ecosystem is covered by the assignments in Group A and those in Group B, respectively. Group B assignments are also on exploring the various cloud APIs. Group C assignments are on exploring the various cloud platforms.

Suggestive List of Assignments:

Group A: (Mandatory)

1. Explore the CloudSim platform for cloud modelling. For example: Create a data centre with one host and run one cloudlet on it using CloudSim.
2. Demonstrate the use of Docker container by exploring its related commands. Also, show the use of Fedora/Ubuntu images over the Docker engine.
3. Demonstrate the use of MySQL/Tomcat/MongoDB image over the Docker engine.
4. Demonstrate the use of Hive query language (HQL) to process the data using Hadoop ecosystem.
5. Create a virtual machine using Kernel Virtual Machine (KVM) and explore commands for virtualization.

Group B: (Any Three)

1. Experiment with the CloudSim platform for modelling and simulation of cloud infrastructure. For example: Create and configure the data centre and user base to show response time, request servicing time and data centre loading.
2. Frame Python scripts to perform operations (for e.g. start/pause/stop) on the Virtual Machine using Libvirt and Operating System (OS) calls for virtualization.
3. Build the Docker image from a Docker file and demonstrate the use of it over the Docker engine.
4. Using Hadoop ecosystem, implement Map-Reduce word count program on single node cluster for the given sample data.
5. Using Hadoop ecosystem, implement Map-Reduce program for the given log file data.
6. Explore and configure the Xen/VirtualBox/VMware hypervisor.
7. Execute Hadoop Distributed File System (HDFS) commands on Hadoop ecosystem.
8. Install Google App Engine. Create hello world application and other simple web applications using Python/Java.
9. Explore the use of API for cloud storage application (for e.g. DropBox API) with the Linux command line interface and Python script.
10. Create an application using Force.com API.
11. For a sample application, implement and consume web service using social networking APIs with Simple Object Access Protocol (SOAP).

12. For a sample application, implement and consume web service using cloud APIs with REpresentational State Transfer (REST).

Group C: (Any One)

1. Installation and configuration of an open source cloud platform.
2. Explore the use of different cloud platforms such as Google App Engine (GAE), Amazon Platform Services, Microsoft Azure services, Openstack and Rackspace.

20PECE 601A DevOps Fundamentals

Teaching Scheme
Lectures: 3 Hours/Week

Examination Scheme
In Semester: 50 marks
End Semester: 50 marks
Credits: 3

Prerequisites: Software Design and Architecture (20CE 503)

Course Objectives:
To facilitate the learner to -

1. Understand and appreciate the need for the DevOps as a state-of-art software engineering practice.
2. Learn the basic concepts related to DevOps.
3. Get acquainted with the various tools which are used in different phases of DevOps model.
4. Get exposure to emerging trends in software development related to DevOps.

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

5. Apply the fundamental concepts and emerging trends of DevOps to software development.
6. Analyze the various concepts of application development such as agile software model, microservices to understand the need of DevOps based solution of a system.
7. Compare various concepts and tools of continuous integration, continuous delivery, continuous testing and monitoring for DevOps based realization of solution of a system.
8. Analyze the various deployment platforms as part of DevOps lifecycle.

Unit 1: Introduction to DevOps **(06)**

Overview, Features, Components, Why to use DevOps - Benefits, Business need for DevOps, Using DevOps to solve new challenges like enabling mobile applications, scaling agile and managing multitier applications; DevOps lifecycle - DevOps stages: Develop, Code/build, Test, Deploy; DevOps use cases DevOps techniques: Continuous improvement, Release planning, Continuous integration, Continuous delivery, Continuous testing, Continuous monitoring and feedback; DevOps tools.

Unit 2: Application Development **(07)**

Agile software development, User stories, Automating SDLC and DevOps, DevOps team. Serverless computing. Microservices and DevOps: Monolithic to microservices Project in terms of microservices, need/applicability of DevOps Microservices - what, characteristics, how are they used, nature in continuous release, architecture, services design.

Unit 3: Continuous Integration Continuous Delivery (CICD) Pipeline (08)

CICD pipeline - basics, Source code repository, Version control and source code management - GitHub, Git commands. Creating Automated build, Automated build frameworks like Maven, Ant for Java. Automated configuration and automated deployment, Configuration management with tools like Puppet and Chef, Ansible; Continuous integration with Jenkins.

Unit 4: Continuous testing and Continuous monitoring (08)

Continuous Unit testing and Integration testing, Test Driven Development (TDD), Release testing, Testing in development, Testing in production, Selenium: Introduction, Why to use, automating test cases for testing web elements, Creating test cases in Selenium WebDriver. Testing and Bug tracking Frameworks such as JUnit, TestNG and JIRA. Continuous monitoring and logging with tools like Nagios.

Unit 5: Deployment Platforms (07)

Containerization and DevOps: Virtualization, Application runtime environment, Application needs/dependencies, Containerization, Containerization Tools, Benefits of containers in enabling DevOps workflow.

Dockers for DevOps: Docker - Overview, Docker lifecycle, Docker Image, Docker file, Docker registry, Docker engine, Docker runtime container, Docker installation, commands, Namespaces, Docker layered approach, Docker applications/use cases. Container Orchestration: Kubernetes.

Unit 6: DevOps - Applications, Case studies and Trends (06)

Cloud's benefit to DevOps, Web Applications on Cloud Platform

Automation of infrastructure: Terraforms - Infrastructure as code (IaC) software tool.

DevSecOps: Agile security, DevOps and security, Low code solutions.

Text books:

1. Sanjeev Sharma and Bernie Coyne, 'DevOps for Dummies', IBM Limited Edition, John Wiley and Sons, Inc., ISBN- 978-1-119-04705-6, (2015).
2. Viktor Farcic, 'The DevOps 2.0 Toolkit: Automating the Continuous Deployment Pipeline with Containerized Microservices', CreateSpace Independent Pub, (2016).
3. Katrina Clokie, 'A Practical Guide to Testing in DevOps', Leanpub, (2017).

Reference books:

1. Bass, L., Weber, I.M., Zhu, L., 'DevOps: a software architect's perspective'. Pearson Education, ISBN: 9789332570375, (2016).
2. Davis J., Daniels K., 'Effective DevOps: Building a Culture of Collaboration, Affinity and Tooling at Scale', O'Reilly, ISBN- 9789352133765, (2018).

3. Farooqui S. M., 'Enterprise DevOps Framework: Transforming IT Operations', CA Press / Apress, ISBN- 9781484240618, (2019).
4. Sanjeev Sharma, 'The DevOps Adoption Playbook: A Guide to Adopting DevOps in a Multi-Speed IT Enterprise', Wiley, ISBN- 9788126569083, (2017).
5. Humble, J., Farley, D.: 'Continuous Delivery: Reliable Software Releases Through Build, Test, and Deployment Automation'. 1st edn. Addison-Wesley Professional (2010).

Web References:

1. https://devops.com/
2. https://docs.docker.com
3. https://www.bmc.com/blogs/devops-basics-introduction/
4. https://www.ibm.com/in-en/cloud/devops
5. https://aws.amazon.com/devops/what-is-devops/

20PECE 601B Compiler Construction

Teaching Scheme
Lectures: 3 Hours/week

Examination Scheme
In Semester : 50 Marks
End Semester : 50 marks
Credits : 3

Course Objectives:

To facilitate the learners -

1. To describe the phases of the compiler and the translation process.
2. To understand various parsing techniques
3. To discuss the effectiveness of optimization.
4. To learn and use tools for automatic compiler generation.

Course Outcomes:

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

1. Build the knowledge of various system software.
2. Make use of Finite automata and tools to tokenize the given source code.
3. Construct a parser for a small context-free grammar.
4. Create symbol table and intermediate code for a simple programming language.
5. Apply the code optimization and code generation algorithms to get the machine code for the optimized code.

Unit 1: Introduction to System Programming and Compilation (06)

Components of System Software, Language Processing Activities, Fundamentals of Language Processing, Assembler, Compiler, Interpreter, Linkers and Loader, Dynamic Link Libraries. What is a Compiler, what is the Challenge, Compiler Architecture, Front end and Back end model of compiler, Cross compiler, Incremental compiler, Bootstrapping.

Unit 2: Lexical Analysis (06)

Concept of Lexical Analysis, Regular Expressions, Deterministic finite automata (DFA), Non- Deterministic finite automata (NFA), Converting regular expressions to DFA, Converting NFA to DFA, Hand coding of Lexical analyzer, Introduction to LEX Tool and LEX file specification

Unit 3: Syntax Analysis (10)

Context Free Grammars (CFG), Concept of parsing, Parsing Techniques, Top-Down Parsers: Introduction, Predictive Parsing - Removal of left recursion, Removal of left factoring, Recursive Descent Parsing, Predictive LL(k) Parsing Using Tables, Bottom Up parsing: Introduction, Shift-Reduce Parsing Using the ACTION/GOTO Tables, Table Construction, SLR(1), LR(1), and LALR(1) Grammars, Practical Considerations for LALR(1) Grammars, Introduction to YACC Tool & YACC file specification

Unit 4: Semantic Analysis (06)

Need of semantic analysis, Abstract Parse trees for Expressions, variables, statements, functions and class declarations, Syntax directed definitions, Syntax directed translation schemes for declaration processing, type analysis, scope analysis, Symbol Tables (ST), Organization of ST for block structure and non-block structured languages, Symbol Table management, Type Checkers: type checking for expressions, declarations (variable, type, function, recursive), statements

Unit 5: Intermediate Code Generation and Code Optimization (08)

Intermediate languages, Design issues, Intermediate representations: three address, postfix & abstract syntax trees, Intermediate code generation for declaration, assignment, iterative statements, case statements, arrays, structures, conditional statements and Boolean expressions. Model of a program in execution, Stack and static allocation, Activation records. Introduction to optimization, Principal sources of optimization, Machine Independent Optimization and Machine Dependent Optimization.

Unit 6: Code Generation and Advances in Compilation (06)

Issues in the design of code generation, Target machine description, Basic blocks & flow graphs, Expression Trees, Unified algorithms for instruction selection and code generation., Sethi Ullman algorithm for expression trees, Aho Johnson algorithm, Different models of machines, order of evaluation, register allocation. Advances in compilation.

Text Books:

1. Aho, Sethi, Ulman, Lam, "Compilers: Principles, Techniques and Tools", Pearson, 2nd Edition, ISBN 978-93-325-1866-7
2. Dhamdhere D., "Systems Programming and Operating Systems", 2nd Edition, ' McGraw Hill, 1999, ISBN 0 - 07 - 463579 – 4.

Reference Books:

1. Andrew Appel, "Modern Compiler Implementation in C", Cambridge
2. Kenneth C. Louden, "Compiler Construction: Principles and Practice", Cengage Learning, ISBN-13:978-0534939724
3. J. R. Levine, T. Mason, D. Brown, "Lex & Yacc", O'Reilly, 2000, ISBN 81-7366 –061-X

20PECE 601C Deep Learning

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 building blocks of Deep Neural Networks.
2. Understand various optimization algorithms used for training Deep Neural Networks.
3. Understand the working of CNN, RNN
4. Have knowledge of Deep Architectures for solving various applications.

Course Outcomes:

After completion of the course, students will be able to

1. Apply mathematical concepts and Machine Learning Basics for understanding Deep Learning topics
2. Apply concepts of Feedforward Networks for understanding Deep Learning topics
3. Apply the basic concepts of CNN and RNN to real time problems
4. Apply available Deep Learning solutions to real time applications.

Unit I: Machine Learning and Deep Learning (07)

What Is Deep Learning and Machine Learning Work? Limitations of Machine Learning, History of Deep Learning, Advantages/ Challenges of Deep Learning, Bias Variance trade off, hyper- parameters, Regularization, Confusion matrix, Building a Machine Learning Algorithm, Deep Learning tools/frameworks.

Unit II: Deep Learning Basics (07)

Linear Algebra, Probabilities and Information theory, Linear Dependence and Span, Norms, Eigen decomposition, The Trace Operator, The Determinant, Principal Components Analysis, Activation Functions, Loss Functions, Perceptron, Sigmoid neurons.

Unit III: Feedforward Networks for Deep Learning (07)

Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise, Early Stopping, Parameter Tying and Parameter Sharing, Dropout, Introduction to Keras, TensorFlow, Theano, and CNTK, Setting up a deep-learning workstation.

Unit IV: Convolution Neural Network (CNN) (08)

Biological Inspiration and Motivation, The Convolution Operation, Pooling, Padding, Overview of CNN Architecture, Input Layers, Convolutional Layers, Pooling Layers, Fully Connected Layers, Back propagation in CNN, Applications of CNNs, Introduction to convnets.

Unit V: Recurrent Neural Network (RNN) (07)

Working with text data, One-hot encoding of words and characters, Using word embeddings, Wrom raw text to word embeddings, Wrapping up, Recurrent Neural Network (RNN), A recurrent layer in Keras, Understanding the LSTM and GRU, Advanced use of recurrent neural networks, A temperature-forecasting

Unit VI: Advanced Deep Learning (06)

Introduction to Deep Learning applications in Computer Vision / NLP / Text Mining, Understanding use of CNNs for classification, Semantic Segmentation, Image denoising, Object Detection. Introduction to Generative Adversarial Networks, Deep Reinforcement Learning, AlexNet/VGG Net/ResNet etc.

Text Books:

1. Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press Ltd. ISBN:9780262035613, 0262035618, 2016
2. Deep Learning with Python, FRANÇOIS CHOLLET, Manning Publications Co., ISBN 9781617294433, 2017
3. Python Deep Learning,Valentino Zocca, Gianmario Spacagna, Daniel Slater, Peter Roelants, Packt Publishing, ISBN 9781786460660, 2017

Reference Books:

1. Fundamentals of Deep Learning: Designing Next Generation intelligence Alogrithms, Nikhil Baduma, Nicholas Locascio, O'Reilly Publication, ISBN 10: 9352135601 , ISBN 13: 978- 9352135608, 2017

2. Deep Learning – A Practitioner's approach, Josh Patterson and Adam Gibson, O'Reilly Publication, 1st edition, ISBN : 9789352136049, 2017
3. Deep Learning with PyTorch, ELI STEVENS, LUCA ANTIGA, AND THOMAS VIEHMANN, Manning Publications Co, ISBN 9781617295263, 2020

Autonomous Program Structure
Final Year B. Tech. Eighth Semester Computer 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		
20CE801	Information Security	3	0	0	50	50	0	0	100	3
20PECE801	Program Elective-IV	3	0	0	50	50	0	0	100	3
20PECE802	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
20CE801L	Information Security Laboratory	0	0	4	25	0	25	0	50	2
20PECE801L	Program Elective–IV Laboratory	0	0	2	25	0	25	0	50	1
	Total	**15**	**0**	**6**	**300**	**250**	**50**	**0**	**600**	**18**
	Grand Total	**21**			**600**					**18**

Programme Elective-IV	Programme Elective-IV Laboratory
20PECE801A Introduction to Natural Language Processing 20PECE801B User Experience Design (UX/UI) 20PECE801C Multimedia Systems 20PECE801D Artificial Intelligence 20PECE801E Internet of Things	20PECE801LA Introduction to Natural Language Processing 20PECE801LB User Experience Design (UX/UI) 20PECE801LC Multimedia Systems 20PECE801LD Artificial Intelligence 20PECE801LE Internet of Things

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Secretary, Governing Body
MKSSS's Cummins College of Engineering
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Programme Elective-V
20PECE802A Operation Research **20PECE802B** Distributed Systems **20PECE802C** Information Retrieval **20PECE802D** Parallel Computing **20PECE802E** Introduction to Blockchain

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 * Multi-disciplinary Course			**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 Structures	Y	Y	Y	Y	N
9	20OE802I	Wireless Networks	N	Y	Y	N	Y

20CE 801 Information Security

Teaching Scheme
Lecture: 3 Hours. /week

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

Prerequisite(s): Computer Networks (20CE 501)

Course Objectives:
To facilitate the learners to-
1. Understand the fundamental concepts of security.
2. Know the basics of cryptography
3. Identify the role of security protocols at various layers.
4. Understand network security threats, security services and countermeasures.

Course Outcomes:
By taking this course, the learner will be able to–
1. Make use of principles of Cryptosystem for Data Protection
2. Identify various techniques to provide Data security and Integrity over the network
3. Choose appropriate security mechanisms to mitigate various security challenges
4. Identify security mechanisms for Network Perimeter and specific Applications

Unit 1: Introduction to Security (06)
Need and significance of Security, Architectures, Introduction to common attacks (e. DOS, Phishing, SQL injection, Cross site scripting etc), Active Vs Passive Attacks, A model for Network and Internetwork Security, TCP/IP security Architecture (services and Mechanism),Introduction to cryptography- Classical Cryptography.

Unit 2: Introduction to Cryptography (07)
Introduction to secrete key cryptography, Cipher Basics, Introduction to DES, DES Analysis, DES variants, Introduction to AES and IDEA, Block cipher modes
of operations.

Unit 3: Public Key Cryptography and Key Management (08)
Introduction to Public Key cryptography, The RSA algorithm, Analysis of RSA, Key Management Basics, Diffie- Hellman Key exchange, Key distribution of Private and Public Keys.

Unit 4: Message Integrity and Authentication (08)
Need and Significance of Message Digest, One way hash functions and properties of hash functions, MD5, SHA, Message authentication, Introduction and overview of Digital Signatures: Implementation, Algorithms standards(DSS),Digital Certificates and X.509, Certificate structure, Certificate revocation.

Unit 5: Network Security **(07)**

Introduction to Network Layer Security- Overview of Firewall, Design principles of Firewalls, Various types of firewalls and their working principles, Concept of VPN,Tunnelling protocols, working of IPSEC. Introduction to transport Layer security – SSL/ TLS protocol.

Unit6: Application Security and Authentication Mechanisms **(06)**

Overview of Application Security, Overview of Wireless Security. User Authentication Mechanisms, Kerberos v4 and v5.Overview of Cloud security, Overview of IOT security,

Text Books:

1. William Stalling **'Cryptography and Network Security, principles and practices'**, 7th *Edition. Pearson* ISBN 978-93-325-8522-5

2 William Stalling, Lawrie Brown **'Computer Security: Principles and Practice,** 4th Edition, Pearson ISBN 978-9353438869

Reference Books:

1. Atul Kahate, **'Cryptography and Network Security'**, 4*rd edition McGraw Hill Publication.2019* ISBN 9789353163310

2. Bernard Menezes, **'Network Security and Cryptography'**, *Cengage Learning*. ISBN 978-8131513491

3. *Bruce Schneier:* **'Applied Cryptography –Protocols, Algorithm and Source Code in C'**, *Second Edition, John Wiley & Sons, New York,* ISBN 978-1-119-09672-6.

4. Charlie Kaufman, Radia Perlman and Mike Speciner, **'Network security, private Communication In a Public World'** ISBN978-0130460196

20CE 801L Information Security Laboratory

Teaching Scheme
Practical: 4 Hours/week

Examination Scheme
In Semester : 25 Marks
Oral : 25 Marks
Credits: 2

Course Objectives:

To Facilitate the Learners to:-

1.Understand Basic CryptographyAlgorithms
2.Learn various techniques for secure data transmission
3.Recognize the need of Network Perimeter Security
4.4.Learn various techniques used for common attacks

Course Outcomes:

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

1. Implement Standard CryptographyAlgorithms
2. Apply the digital signature for authentication
3. Apply packet filtering concept to configure Firewall
4. Demonstrate common attacks

Sample /Suggested List of Assignments:

1. Implement DES algorithm

2. Implement RSAalgorithms

3. Implement Message Digest Algorithm and demonstrate the collision resistance property

4. Implementation of Diffie Hellman Key exchange for sharing the secret key.

5. 2 users are doing business online. Develop and demonstrate suitable solutions which will take care of user authentication along with Non repudiation.

6. Simulation of packet Filtering concepts.

7. Create a small application to demonstrate attacks (e.g SQL injection ,Cross Site scripting)

8. Develop and demonstrate how the contents of the web site will be made secure against the common attacks.

9. Case Study - Enterprise network Security/ Wireless Security / Security Information and Event Management

20PECE 801A Introduction to Natural Language Processing

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 various aspects of Natural Language Processing.
2. Learn Phonological, Morphological, Syntactic and Semantic processing
3. Understand issues related to ambiguity of Natural Language.
4. Understand the advanced applications of Natural Language Processing.

Course Outcomes:

After completion of the course, students will be able to

1 Identify importance of Natural Language Processing.
2 Apply the fundamental concepts and techniques of Natural Language.
3 Identify ambiguous structure of Language.
4 Analyze the advanced applications of Natural Language Processing.

Unit I: Introduction to Natural Language Processing (6)

The Study of Language, Applications of Natural Language Understanding, Evaluating language Understanding Systems, Different levels of Language Analysis.

Unit II: Fundamentals of Phonics (7)

Speech Sounds and Phonetic Transcription, Articulatory Phonetics, The Vocal Organs, Place of Articulation of Consonants, Manner of Articulation of Consonants, Vowels, Syllables, Phonological Categories and Pronunciation Variation, Phonetic Features, Predicting Phonetic Variation, Factors Influencing Phonetic Variation.

Unit III: Fundamentals of Morphology (7)

Concept of Morphology, Survey of English Morphology, Inflectional Morphology, Derivational Morphology, Cliticization, Non-Concatenative Morphology, Agreement, Finite-State Morphological Parsing, Construction of Finite-State Lexicon, Finite-State Transducers(FST), Sequential Transducers and Determinism, Finite-State Transducers for Morphological Parsing, Transducers and Orthographic Rules, Word and Sentence Tokenization.

Unit IV: Semantic Analysis (8)

Part-of-Speech Tagging, POS-Tagging Perspective, POS tagging and HMM, POS-Tag Set, Parsing Algorithms,Parsing in case of Ambiguity; Probabilistic Parsing .Parser Comparison, Grammar; Constituency, Dependency , Inside Probability; Parse Tree construction,language modelling

Unit V: Discourse and Pragmatics (7)

Discourse Structure and Reference, Relating Discourse Structure and Inference, Discourse Structure, Tense, and Aspect, Managing the Attentional Stack, Concept of Pragmatics

Unit VI: Applications of Natural Language Processing (7)

Machine Translation, Sentiment Analysis, Question Answering Systems, Cross Lingual Information Retrieval,Natural Language Interface to Database, Extractive and Abstractive Summarization Systems, Indian Language WordNets.

Text Books:

1. Jurafsky, David, James H. Martin, 'Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition', Pearson Education Limited, Dorling Kindersley(India) Pvt. Ltd. (Indian Subcontinent Version)(2014), ISBN: 987-93-325-1814-4.
2. James Allen, 'Natural Language Understanding', Pearson Education Limited, Dorling Kindersley(India) Pvt. Ltd. (Indian Subcontinent Version)(2007), ISBN: 987-81-317.

Reference Books:

1. Manning, Christopher D., Hinrich Schütze, 'Foundations of Statistical Natural Language Processing', Cambridge Publication(1999), ISBN: 0262133601. 2. Steven Bird, ewan Klein, and Edward Loper, 'Natural Language Processing with Python', O'Reilly Media, 2009.
2. Flanagan, J. L. Speech Analysis, Synthesis and Perception. 2nd ed. New York, NY: Springer-Verlag,. ISBN: 9780387055619.

Online/Web/Other References:

1. NPTEL NLP course: https://nptel.ac.in/courses/106/105/106105158/

20PECE 801B User Experience Design (UX/UI)

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 basic concepts of UI/UX Design in order to design with intention.
2. Achieve a deep understanding of the entire life-cycle of design process.
3. Provide a visual understanding of product to make user interaction as easy and efficient as possible.
4. Understand various design technologies for mobile and web to help avoid common mistakes and meet user requirements
5. Understand the advanced techniques of User Experience Design

Course Outcomes:

After completion of the course, students will be able to

1. Apply the concepts areas of study in UX to enhance the user experience
2. Apply the key psychological principles that underlie UX design principles
3. Construct the wireframes and prototypes for interactive products to establish the structure and flow of possible design solutions.
4. Apply the fundamental aspects of designing and evaluating the interfaces for mobile and web.
5. Compare the advanced techniques of User experienec Design

Unit I: Introduction to User Experience **(6)**

What is User Experience, Relationship Between UI and UX, Why is UX Design so Important, What is UX Design and Where is Used, Usability: A part of the User Experience, Understanding User Experience, Psychology of everyday actions, Concept of UX, Trends in UX, What is User Interaction, Mental Model, Cognitive Model in UX, Emerging Technologies in UX, Universal Design, User-centered design, Human Centered Design.

Unit II: Design Thinking **(8)**

Key elements of Design thinking, Design Thinking Skills-What are wicked problems and its solution, Good and poor design, Empathy Users- User research, Personas, Define problem, , Ideation- Identifying Customer Needs, Translate user needs into product specifications, Applied Creativity, Brainstorming, Prototyping, From Prototype to Product Development, Testing Design Solutions, Relation of Design thinking with UX, Design thinking applications, Applying design thinking to mobile and wed.

Unit II: Interaction Styles **(6)**

Design principles and rules, Shneiderman's golden rules, Normans seven principles, Nielsens ten heuristics with example of its use,Heauricstic evaluation. Direct Manipulation – Windows Characteristics, Components, Presentation styles, Icons, Multimedia and colors, Menu selection, Form Fill-in and Dialog Boxes, Icons, Fitts'law and Hick-Hyman's law.

Unit IV: UX Design Process **(7)**

Elements of User Experience Design, Stages of UX design,
Visual Design - Vision and Memory,Visual Design Principles, Data Visualization, Wire framing & Storyboarding, Converting the wireframes into visual design, Prototyping, Various Prototyping Tools, Elements and Widgets. Gestalt Principles and Grids, Layout Expectations, Forms and Data Entry
Screen Design and Layout- Screen planning and purpose, organizing screen elements, ordering of screen data and content , screen navigation and flow, Visually pleasing composition, amount of information, focus and emphasis, presentation information simply and meaningfully
UX Design Tools

Unit V: UX Design for Mobile and Web **(8)**

Mobile Usability Research – The Important Differences from the Desktop. Smartphone vs. Tablet, UI mobile components and patterns, Application frameworks: Types of Mobile Applications: Widgets, Applications, Mobile Design: Elements of Mobile Design
Web user Interface - The Gestalt Principles of Perceptual Organization, The Law of Similarity, Proximity, Familiarity/Meaningfulness, Symmetry, Continuity, The Principle of Closure, 'New' Grouping Laws, The Law of Element Connectedness, The Law of Common Region.
Types of Evaluation research, Usability Testing.

Unit VI: Interaction Technologies **(7)**

Explicit and Implicit Human Computer Interaction – Gesture interfaces, Speech Recognition, Tangible interfaces, Auditory Interfaces, Natural Language Interfaces, User Interfaces and Interaction for Four Widely Used Devices.
Hidden User Interface via Basic smart Devices, Hidden User Interface via Wearable and Implanted Devices, Virtual and Augmented Reality.

Text Books:

1. Interaction Design: Beyond Human-Computer Interaction: Book by Helen Sharp Jenny Preece, and Yvonne Rogers
2. Wilbert O. Galitz'Wiley The Essential Guide to User Interface Design' 3rd Edition Apr 2007

Reference Books:

1. Don Norman, 'The Design of Everyday Things', Basic Books, A member of the Perseus Books Group, (2013)
2. Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, 'Designing the User Interface: Strategies for Effective Human-Computer Interaction', Pearson Education Limited (India),(2010)

Online/Web/Other References:

1. https://www.interaction-design.org/courses/user-experience-the-beginner-s-guide
2. https://www.coursera.org/learn/user-experience-design#syllabus

20PECE 801C Multimedia 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. Understand the Basics of Multimedia Systems.
2. Understand various file formats.
3. Learn Multimedia editing tools.
4. Analyse various compression techniques.
5. Learn advances in Multimedia.

Course Outcomes:

1. After completion of the course, students will be able to
2. Build the knowledge of multimedia systems and its characteristics.
3. Utilize text and audio file formats and compression techniques in multimedia Applications.
4. Apply digital image and video processing techniques used in multimedia Applications.
5. Build the knowledge of animation and virtual reality concepts.
6. Build the knowledge of advances in multimedia.

Unit I: Introduction to Multimedia **(06)**

What is multimedia (Text, Graphics, Audio, Video, Animation),

Multimedia presentation and production, Hardware and software requirements of multimedia, Multimedia Applications.

Unit II: Text and Audio **(08)**

Text - Introduction, About Fonts and Faces, Using Text in Multimedia. Font editing and design tools. Text Compression (HUFFMAN, LZ, LZW), File Formats (TXT, DOC, RTF, PDF, PS), Hypertext and Hypermedia. Audio – Introduction, Characteristics of Sound, Elements of Sound system, Digital Audio, Synthesizer, MIDI, Audio File formats, (WAV, VOC, MP3) Audio Processing Software.

Unit III: Understanding and Processing Images **(07)**

Digital Image Representation, Types of Images (monochrome, gray, color), File formats (BMP, TIFF), Image Compression Techniques Fundamentals,

Types-lossless and lossy Compression. Lossless Compression Algorithms-Shannon-Fano
Lossy Compression Algorithm-JPEG

Unit IV: Handling Video Data (07)

Types of video signals, Analog video, Digital video, Video File formats and CODEC (AVI and MPEG), Case study Video Editing Software / Tools.

Unit V: Animation and Virtual Reality (07)

Animation – Introduction, Uses, Types, Principles, Animation on Web, 3D animation, Rendering, Animation Software requirements, Devices, VRML

Unit VI: Introduction to Advances in Multimedia (07)

Introduction, Challenges of Multimedia Information processing Watermarking, Organization, Storage and Retrieval issues, Neural networks for Multimedia processing, Multimedia processors. Introduction to Augmented Reality.

Text Books:

1. Ranjan Parekh, "Principles of Multimedia",TMH, ISBN 0-07-058833-3(2nd Edition,2007)
2. Ralf Steinmetz and Klara Nahrstedt "Multimedia Computing, Communication and Applications", Pearson Education.(8 th impression 2011)
3. Nigel Chapman and Jenny Chapman. Wiley "Digital Multimedia" (2nd Edition).

Reference Books:

1. Ze-Nian Li, Marks S. Drew, "Fundamentals of Multimedia", Pearson Education.
2. Tay Vaughan , 'Multimedia: Making it work', *Tata McGraw-Hill, (*8th edition), (2011)
3. Judith Jeffcoate, 'Multimedia in Practice', *Prentice Hall of India,* (2003)
4. Gonzalez, Woods, "Digital Image Processing" Addison Wesley
5. Mark Nelson "Data Compression Book ", BPB
6. Judith Jeffcoate "Multimedia in Practice":, PHI.

20PECE 801D Artificial Intelligence

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 overview and basics of classic Artificial Intelligence.
2. Understand various intelligent searches and knowledge representation.
3. Understand types of learning used in artificial intelligence.
4. Study applications in Artificial Intelligence.

Course Outcomes:

After completion of the course, students will be able to

1. Build fundamental knowledge of AI, its applications and solve classical AI problems using different AI Techniques
2. Apply intelligent search algorithms on AI problems.
3. Make use of Knowledge Management techniques of AI for reasoning.
4. Make use of various learning techniques to solve the given problem.
5. Examine different topics with various methods of expert system, pattern recognition, natural language processing, nature inspired computing.

Unit I: Introduction to AI (6)

Definitions of Artificial Intelligence, History of Artificial Intelligence, Artificial Intelligence Problems, Present state of AI, Intelligent agents, Topics of Artificial Intelligence: Learning Systems, Knowledge Representation and Reasoning, Planning, Knowledge Acquisition, Intelligent Search, Logic Programming, Soft Computing, Management of Imprecision and Uncertainty, Branches and applications of Artificial Intelligence.

Unit II: Uninformed search and modelling a search problem (7)

Generate-and-Test, Search Techniques: Depth First Search, Breadth First Search, Production Systems: Traveling Salesman Problem, Water-Jug Problem, State Space Representation, State Space Search, Tic-Tac-Toe as a State Space.

Unit III: Heuristic Search Techniques (8)

Best First Search Algorithm, Hill Climbing, Simulated Annealing, A* Algorithm, Problem Reduction, AND–OR Graphs, The AO* Algorithm, Towers of Hanoi Problem, Constraints Satisfaction: crypt-arithmetic problem, mini-max algorithm.

Unit IV: Knowledge Management (7)

Knowledge Management, Types of Knowledge: Declarative Knowledge, Procedural Knowledge, Knowledge Representation, Approaches to Knowledge Representation, Issues in Knowledge Representation, First-order Logic: Basic Predicate Representations, Conversion of WFF to Clause Form, Resolution, Unification, Resolution Examples, Reasoning, monotonic and non-monotonic reasoning.

Unit V: Learning (7)

Types of Learning: Rote Learning, Learning by General Problem Solving, Concept Learning, Learning by Analogy, learning problems and designing the learning systems, Reinforcement learning.

Unit VI: Applications in Artificial Intelligence (7)

Game Playing, Expert Systems, Natural Language Processing, Pattern Recognition, Recommendation system, Nature Inspired Computing.

Text Books:

1. Vinod Chandra S. S., Anand Harendra S., 'Artificial Intelligence and machine learning', PHI, (2014), ISBN 978-81-203-4934-6.
2. Kulkarni P., Joshi P., 'Artificial Intelligence: Building Intelligent Systems', PHI Learning, (2015), ISBN 978-81-203-5046-5.

Reference Books:

1. Peter, Norvig, 'Artificial Intelligence: A Modern Approach', Pearson, (3rd edition), (2014), ISBN-0-13-103805-2.
2. Elaine Rich, Kevin Knight and Nair, 'Artificial Intelligence', Tata McGraw – Hill, (3rd edition), (2012), ISBN-978-0-07-008770-5.
3. Bratko I., 'Prolog Programming for Artificial Intelligence', Pearson Education, (3rd edition), (2004).
4. Tom M. Michell, 'Machine Learning', McGraw Hill Education, Indian edition (2013), ISBN-13: 978-1-25-909695-2.

5. Ethem Alpaydin, 'Introduction to Machine Learning', PHI, (2006), ISBN-81-203-2791-8.

Online/Web/Other References:

1. https://nptel.ac.in/courses/106/105/106105077/
2. https://nptel.ac.in/courses/106/106/106106126/
3. https://onlinecourses.nptel.ac.in/noc19_me71/preview
4. https://onlinecourses.nptel.ac.in/noc20_cs42/preview

20PECE 801E Internet Of Things

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 understand the fundamental concepts, basic design and components in Internet of things(IoT).
2. Understand and design smaller systems for various devices.
3. To understand the various protocols used in IoT.
4. Learn and implement smaller scenarios using programming language.
5. To understand fundamentals of security in IoT and web and cloud based services for IoT.

Course Outcomes:

After completion of the course, students will be able to

1. Understand and recall the Internet of Things with different components and design process.
2. Apply the various things and design a system.
3. Analyse through Knowledge gain and skills to select application layer protocols for seamless integration of various components of an IoT ecosystem.
4. Implement smaller codes with python programming.
5. Recall the fundamentals of security used in IoT with the different services provided in web and cloud.

Unit I: Introduction to Internet of Things (7)

IoT: Definition and characteristics of IoT, Vision of IoT, IoT Ecosystem, IoT Reference Model, Physical Design Model, Logical Design: Functional Block, Communication models, Communication API's, IoT enabling Technologies, IoT Levels and Deployment Templates, Applications of IoT, IoT & M2M.

Unit II: Embedded Devices and Programming for IoT (7)

Transducers, Sensors and Actuators for IoT, Introduction to Arduino, Beagle Bone Black, Raspberry Pi, Python Programming for IoT devices.

Unit III: IoT Protocols (7)

Protocol Classification, Protocols for different Layers: Link layer, network layer, Transport layer and Application Layer: Message Queue Telemetry Transport (MQTT), Extensible Messaging and Presence Protocol (XMPP), Data Distribution Services (DDS), Advanced Message Queuing Protocol (AMQP), Constrained Application Protocol (COAP), Representational State Transfer (REST), Comparison of Protocols.

Unit IV: IoT Platform Design methodology and Case studies for IoT Design (7)

Introduction to IoT platform Design methodology, Steps involved in IoT system Design methodology, Case studies: Home automation, Smart cities, Agriculture.

Unit V: Web of things and Cloud of Things (7)

Four pillars of IoT paradigms, Two Pillars of Web, Cloud of things architecture, Four Deployment Models: Private, Public, Community and Hybrid, Cloud computing paradigm: data collection, Storage and Computing, Gateways used in IoT for Data communication on Cloud, IoT cloud-based Services using Xivel, Nimbits and other platforms, Applications and features of Cloud IoT.

Unit VI: IoT Privacy, Security and Vulnerabilities Solutions (7)

Introduction to security, Vulnerabilities, Security requirements and Threat Analysis, Use and Miuses Cases, IoT Security Tomography and Layered Attacker Model, Identity Management and Establishment, Access control and Secure Message communication, Security Models, Profiles and Protocols for IoT.

Text Books:

1. Arshdeep Bagha, Vijay Madisetti, 'Internet of Things – A Hands-on-approach', Universities Press (2014).

2. Srinivasa K.G., Siddesh G.M., Hanumantha Raju R., 'Internet of Things',Cengage Publication
3. Rajkamal, 'Internet Of Things: Architecture and Design Principles' McGraw Hill Education (India) Private Limited.

Reference Books:

1. Ovidiu Vermesan, Peter Friess, 'Internet of Things – Converging Technologies for Smart Environments and Integrated Ecosystems', River Publishers.
2. Honbo Zhou, 'The Internet of Things in the Cloud', CRC Press(2013).
3. Peter Waher, 'Learning Internet of Things', Packt Publishing (2015).

Online/Web/Other References:

1. https://onlinecourses.nptel.ac.in/
2. https://www.edx.org/learn/iot-internet-of-things
3. https://alison.com/course/internet-of-things-and-the-cloud
4. https://online.stanford.edu/courses/xee100-introduction-internet-things

20PECE 801LA Introduction to Natural Language Processing Laboratory

Teaching Scheme

Practical: 2 Hours / Week

Examination Scheme

In Semester: 25 Marks
Oral : 25 Marks
Credits: 1

Prerequisite:

Course Objectives:

To facilitate the learner to

1. develop problem solving abilities for natural language processing
2. apply algorithmic strategies while solving problems
3. develop time and space efficient algorithms

Course Outcomes:

After completion of the course, students will be able to

1. Develop programs for natural language processing applications.
2. Design test cases to solve problems for pervasiveness,embedded security and NLP applications.

Suggestive List of Assignments

Group A

1. Write a program using Scala/ Python/ C++ using Eclipse to correct the spelling of English paragraphs.

Group B (Any two)

Using Programming language Python and Natural Language Tool Kit (NLTK) perform following

1. Apply Simple language processing for 10 phonetics Indian languages (Marathi or mother-tongue)
2. Lab on sentiment analysis
3. Lab on Cross Lingual information retrieval
4. Lab on document summarization

Group C

1. Study and implementation of research paper in Multidisciplinary NLP using open source tool.

20PECE 801LB User Experience Design Laboratory

Teaching Scheme

Practical: 2 Hours / Week

Examination Scheme

In Semester: 25 Marks
Oral : 25 Marks
Credits: 1

Prerequisite:

Course Objectives:

To facilitate the learner to

1. Understand users' needs, experiences, behaviours and goals.
2. Learn how visual perception affects the viewing experience
3. Explain Why you made design decisions, through presentations of assignments

Course Outcomes:

After completion of the course, students will be able to

1. Discover the techniques used for understanding of users, what they need, what they value, their abilities, and also their limitations
2. Design innovative and user friendly interfaces for mobile and web applications.
3. Criticize existing interface designs, identify areas of improvement and then create better services and products to make user experience better.
4. Discover the industry-standard tools and specific project deliverables in UI/UX

Suggestive List of Assignments

1. Design user persona for the users of selected product / system and Conduct a contextual inquiry for selected product / system.
2. Heuristic evaluation on a computer prototype developed by your classmates.
3. Design of User interface for the system using various interaction styles.
4. Design appropriate icons pertaining to a given domain. (Eg. Greeting cards)
5. Design a Mobile App/Website that can help people to sell their handmade products in metro cities

6. Improve Instagram with a new, innovative feature, which stands out from other image apps.
7. Redesign a page from the job portal you like (preferably a complex screen). Justify your selection and the changes/design you made. Document your design process on Notion.
8. ATM machine/KIOSK screen design for rural people
9. Tool exploration Adobe XD, Figma

20PECE 801LC Multimedia Systems Laboratory

Teaching Scheme

Practical: 2 Hours / Week

Examination Scheme

In Semester: 25 Marks
Oral : 25 Marks
Credits: 1

Prerequisites: Data Structures Laboratory - 20CE 305
Programming Skills Development-I Laboratory -20CE 306

Course Objectives:

To facilitate the learner to

1. To explore authoring tools and animation tools
2. To learn and understand Text compression.
3. To understand the operations performed on audio, video and image files.
4. To develop presentation package using multimedia concepts.
5. To learn and implement virtual reality scene.

Course Outcomes:

After completion of the course, students will be able to

1. Apply basic knowledge of multimedia systems.
2. Implement analyze text compression algorithm
3. Implement operations on audio, video and image file formats.
4. Develop virtual scene using virtual reality tools.
5. Develop multimedia application.

Preamble:
20PECE 801 lab would be for understanding and applying the Apply basic knowledge of multimedia systems and implementation of some real-world simple applications.Assignment statements are in brief and should be implemented in JAVA/Python programming language.
Group A assignments are on text compression,Audio,study of authoring tool,animation tools.
Group B assignments are on designing Media player, storing and displaying audio visual information.
Group C assignment is on application developement.

Suggestive List of Assignments

Group A : (Mandatory)

1	Text Compression using Huffman Code.
2	Parsing WAV file and display headers. Merge one file with another and play the output file
3	Read and display BMP file header. Write a program to convert gray BMP file to black and white BMP file
4	Study of authoring tool – (e.g. Director 8), to create presentation using multimedia files.
5	Study of 3D Animator – (e.g. 3D Studio), to create 3D world

Group B: (Any Two)

1	Designing Media player using Java to play files – WAV, VOC, MIDI, AVI files etc.
2	Understanding audio visual information stored in AVI file format and displaying the same as a sequence of images/frames on the screen.
3	Creation of virtual scene using VRML

Group C

1	Developing presentation package which will enable to integrate text, image and sound media (trivialized version of Power Point like application development package) Create a web interface for displaying images from your image database

20PECE 801LD Artificial Intelligence Laboratory

Teaching Scheme

Practical: 2 Hours / Week

Examination Scheme

In Semester: 25 Marks

Oral: 25 Marks

Credits: 1

Prerequisite:

Course Objectives:

To facilitate the learner to

1. Experiment Artificial Intelligence concepts from syllabus.
2. Experiment AI searches like A*, Min-max algorithm.
3. Understand monotonic and non-monotonic knowledge representation.
4. Experiment classification and clustering algorithms.

Course Outcomes:

After completion of the course, students will be able to

1. Implement various uninformed searching techniques.
2. Implement various Heuristic searching techniques.
3. Apply Knowledge Management techniques to implement Expert system.
4. Implement unification for the given expression.

Suggestive List of Assignments

Group A : (Mandatory)

1. Implement DFS/BFS for graph problem.
2. Implement simple water jug problem using DFS or BFS.
3. Implement Best first search algorithm
4. Implement A* algorithm for graph problem

Group B: (Any Two)

1. Implement A* algorithm for 8 puzzle problem
2. Write a program to implement Min-max algorithm for game playing
3. Implement Unification algorithm

Group C

1. Represent knowledge using AIML/Prolog by implementing small expert system

20PECE 801LE Internet Of Things Laboratory

Teaching Scheme

Practical: 2 Hours / Week

Examination Scheme

In Semester: 25 Marks

Oral: 25 Marks

Credits: 1

Prerequisite:

Course Objectives:

To facilitate the learner to

1. Understand various development boards used for Internet of Things (IoT).
2. Learn and understand the fundamentals of sensor-based applications.
3. Implement and solve the problems using high level language.
4. Develop mini applications on IoT boards with proper design.

Course Outcomes:

After completion of the course, students will be able to

1. Implement Internet of Things on various development boards.
2. Design the minimum system for sensor based application.
3. Solve the problems related to the primitive needs using IoT.
4. Develop IoT application for distributed environment

Suggestive List of Assignments

Group A : (Mandatory)

1. Study of Raspberry-Pi, Beagle board, Arduino and other micro controller (History & Elevation)
2. Study of different operating systems for Raspberry-Pi /Beagle board. Understanding the process
   of OS installation on Raspberry-Pi /Beagle board.
3. Write an application to read the environment temperature. If temperature crosses a threshold
   value, the application indicated user using LEDSs

4. Understanding the connectivity of Raspberry-Pi /Beagle board circuit with IR sensor. Write an
   application to detect obstacle and notify user using LEDs.
5. Understanding and connectivity of Raspberry-Pi /Beagle board with camera. Write an application to capture and store the image.

Group B: (Any Two)

1. Understanding and connectivity of Raspberry-Pi /Beagle board with a Zigbee module. Write a network application for communication between two devices using Zigbee.
2. Using Thinker cad program Arduino for various small systems.
3. Simulator assignments on Beagle Bone Black
   a. Write an application using Beagle board to control the operation of stepper motor.
   b. Write an application using Beagle board to control the operation of a hardware simulated traffic signal.
   c. Write an application using Beagle board to control the operation of a hardware simulated lift elevator.
4. Assignments on Cloud of Things:
   a. Write a server application to be deployed on Raspberry-Pi /Beagle board. Write client applications to get services from the server application.
   b. Create a small dashboard application to be deployed on cloud. Different publisher devices can publish their information and interested application can subscribe.
   c. Create a simple web interface for Raspberry-Pi/Beagle board to control the connected LEDs remotely through the interface.
5. Use AWS/ IBM Bluemix/ Contineo/ platform - Develop applications on these platforms

Group C

Design a smart system for IoT using your own choices for:
Development board, Sensors, IoT Level, protocol, development platform, operating system etc.
Sample Mini Project Statements:

1. Develop a Real time application like smart home with following requirements: When

user enters into house the required appliances like fan, light should be switched ON. Appliances should also get controlled remotely by a suitable web interface. The objective of this application is student should construct complete Smart application in group.

2. Develop a Real time application like a smart home with following requirements: If anyone comes at door the camera module automatically captures his image send it to the email account of user or send notification to the user. Door will open only after user's approval.

20PECE 802A Operation Research

Teaching Scheme
Lectures: 3 Hours /week

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

Prerequisite: Discrete Mathematics (20CE 303)

Course Objectives:
To facilitate the learners to :

1. Identify and characterize situations in which Linear Programming technique can be applied.
2. Derive feasible and optimal solution for Transportation and Assignment Problem.
3. Apply various methods to select and execute various optimal strategies of decision making and to win the game
4. Understand Queuing system model.

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

1. Apply Linear Programming technique for Operations Research problem
2. Solve Transportation and Assignment Problem
3. Evaluate different methods to compute value of game and decision making
4. Make use of Queuing theory to solve problems

Unit 1: Introduction to Operations Research (06)
A Quantitative Approach to Decision Making, History, Definitions, Features, Approach to Problem Solving. Overview of models and Modelling, Advantages of Model Building, Methods and Methodology, Advantages, Opportunities, features of solutions and Applications of Operations Research.

Unit 2: Linear Programming (08)
Structure of linear programming model, advantages, limitations, application areas, General mathematical model, Guidelines of model formulation, examples of linear programming model formulation, Graphical and Simplex method of Linear Programming.

Unit 3: Transportation and Assignment Problem (07)
Introduction, Mathematical formulation of transportation and assignment problem, initial basic feasible solution, testing for optimality, Modified distribution method, methods of solving assignment problem, unbalanced transportation and assignment problem. Case study : Dispatch model of Amazon and Swiggy

Unit 4: Decision Theory **(07)**

Introduction, steps in decision making, Types of decision making environments, Decision making under Uncertainty, Decision making under Risk.

Unit 5: Game Theory **(07)**

Introduction, Two-person Zero-Sum Games, Pure Strategy (Games with Saddle Point), Mixed Strategy (Games without Saddle point), The rules of Dominance.

Unit 6: Queuing Theory **(07)**

Introduction, The structure of queuing system, Performance measure of queuing system, Probability distributions in queuing systems, Classification of queuing models, Single server M/M/1:∞/FCFS exponential service queuing model.

Text books:

1. J K Sharma, 'Operations Research: Theory and Applications', Trinity Press, (5th Edition),(2013), ISBN: 978-9350-59336-3.
2. P Sankara Iyer, 'Operations Research', Sigma Series, Tata McGraw Hill Publication Private Limited, (4 th Reprint), (2012), ISBN: 978-0-07-066902-4.

Reference Books:

1. S D Sharma, 'Operations Research', Kedar Nath Ram Nath Publication, (15th Edition),(2009), ISBN: 978-81-224-2288-7.
2. Gupta Prem Kumar and Hira D.S., 'Problems in Operations Research', S Chand Publication, (2012), ISBN: 978-8121909686.
3. Hamdy A. Taha, 'Operations Research', Pearson Education, (8 th Edition), (2012), ISBN: 978-81-317-1104-0.

20PECE 802B Distributed 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. To know the emerging trends in Distributed Systems.
2. To have thorough knowledge of Networks & Communication in Distributed Systems.
3. To integrate distributed objects, remote invocation, synchronization, processes and processors of Distributed Systems.
4. To have systematic knowledge of distributed file system, shared memory and security in Distributed Systems.

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

1. Apply fundamental concepts of Distributed system to understand working of Distributed Systems
2. Apply communication mechanisms and synchronization algorithms in Distributed Systems
3. Apply consensus mechanism**,** replication techniques and consistency model in Distributed Systems
4. Explore trends and applications of Distributed Systems

Unit I: Introduction **(6)**
Introduction, Examples of distributed systems, Challenges, benefits, transparency, System Models: Physical models, Architectural Models, Fundamental Models, case study-world wide web

Unit II: Communication and messaging **(8)**
Types of Communication, Remote Procedural Call- Remote Method Invocation. Message Oriented Communication: Simple Transient Messaging with Sockets, Message Oriented middleware, Brewer's CAP algorithm

Unit III: Time, coordination and agreement **(8)**
Physical Clocks, Clock Synchronization Algorithms. Logical Clocks–Lamport's Logical clocks, Vector Clocks. Mutual Exclusion: Overview, Centralized Algorithm, Distributed Algorithm, Token-Ring Algorithm, Decentralized Algorithm, Election Algorithms: Bully Algorithm, Ring Algorithm

Unit IV: Consensus **(6)**

Distributed consensus: Consensus in asynchronous systems, Consensus in synchronous systems, Paxo‟s algorithm, Failure detectors. Distributed Transactions: Classification of transactions.

Unit V: Consistency and Replication (8)

Introduction: Reasons for Replication, Replication as Scaling Technique, replica management, architectures, consistency model and protocols, replica placement, Brewer's CAP algorithm, Introduction to Distributed File Systems, File Service Architecture. Case study: HDFS,

Unit VI: Trends and Applications in Distributed Systems (6)

Trends in distributed system, Map Reduce: Paradigm, Applications, Introduction to Spark, Introduction to Kafka, Peer to Peer Systems in Cloud Computing bit torrent, Grid Computing, Overview of security techniques in distributed systems, Blockchain.

Text Books:

1. George Coulouris, Jean Dollimore, Tim Kindberg, & Gordon Blair, "Distributed Systems – Concept and Design", 5th Edition, Publisher: Pearson, ISBN – 978-13-214301-1.
2. Pradeep K Sinha, "Distributed Operating System", Publisher: PHI. ISBN – 978-81-203-1380-4.
3. Sukumar Ghosh, "Distributed Systems - An Algorithmic approach".

Reference Books:

1. A.D. Kshemkalyani, M. Singhal, "Distributed Computing: Principles, Algorithms, and Systems" ISBN: 9780521189842, Cambridge University Press, March 2011.
2. Nancy Lynch, "Distributed Algorithms" Morgan Kaufmann Publishers, ISBN-13:978-1-55860-348-6
3. Maarten van Steen, Andrew S. Tanenbaum, "Distributed System", Third edition, version 3

Online/Web/Other References:

1. Prof. Rajiv Misra, Distributed System, https://nptel.ac.in/courses/106/106/106106168/#
2. Prof. Rajiv Misra, Cloud computing and Distributed System
3. Prof. Rajiv Misra, Distributed System, https://nptel.ac.in/courses/106/104/106104182/

20PECE 802C Information Retrieval

Teaching Scheme

Lectures: 3 Hours / Week

Examination Scheme

In Semester: 50 Marks

End Semester: 50 Marks

Credits: 3

Course Objectives:

To facilitate the learner with

1. Concepts of information retrieval
2. Indexing techniques and information retrieval system
3. Text classification and vector space classification
4. The latest trends in information retrieval

Course Outcomes:

After completion of the course, students will be able to

1. Model the working of information retrieval search system
2. Analyze search strategies used in Information retrieval system
3. Design techniques for information retrieval system
4. Understand the latest trends in information retrieval

Unit I: Introduction to Information Retrieval (7)

Information retrieval process, Indexing, Processing Boolean queries, Term vocabulary and postings lists, document delineation and character sequence decoding, determining vocabulary of terms.

Unit II: Scoring, term weighting and vector space model (7)

Parametric and zone indexes, Term frequency and weighting, Vector space model for scoring, variant tf-idf functions, Components of an Information retrieval system.

Unit III: Text classification -Naive Bayes and Vector space classification (7)

Naive Bayes text classification, Bernoulli model, Properties of Naive Bayes, Feature selection, document representation and measures of relatedness in vector spaces, Rocchio classification, KNN, Linear vs Non linear classifiers, Classification with more than two classes, the bias variance tradeoff

Unit IV: Evaluation in Information Retrieval (7)

Information retrieval system evaluation, standard test collections, Evaluation of unranked retrieval sets, evaluation of ranked retrieval sets, Assessing relevance, System quality and user
utility, results snippets.

Unit V: Web search basics and Link Analysis (7)

Web characteristics, advertising as the economic model, The search user experience, Index size and estimation, Near duplicates and shingling, Web crawling and indexes, distributing indexes, connectivity servers. The web as a graph, Page rank, Hubs and authorities

Unit VI: Trends in Information Retrieval (7)

Case study: Google analytics, Search engine optimization, Ranking algorithms,Recommendation systems, Collaborative Filtering

Text Books:

1. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schutze, Introduction to Information Retrieval, Cambridge University Press. 2008.

Reference Books:

1. Grigoris Antoniou and Frank van Harmelen, A semantic Web Primer, Massachusetts

Online/Web/Other References:

1. http://nlp.stanford.edu/IR-book/information-retrieval-book.html

20PECE 802D Parallel Computing

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 various aspects of the Parallel processing.
2. Familiarize with the fundamental concepts, techniques of parallel computing.
3. Identify advanced computer architectures, parallel algorithms.
4. Evaluate the performance measures of different parallel communication operations.
5. Identify mapping of applications to high-performance computing systems.
6. Understand the advanced trends and techniques in High Performance Computing.

Course Outcomes:

After completion of the course, students will be able to

1. Build the knowledge of different parallel architectures.
2. Identify the different techniques to design parallel solution of the given application.
3. Apply an efficient parallel algorithm to solve a given problem.
4. Compare the advanced techniques in High Performance Computing.

Unit I: Introduction to parallelism **(07)**

Need of Parallel Architectures, Parallel Application, Communication Architecture, Shared Address Space, Message Passing, Parallel Architectures, Trends in Microprocessor Architecture, Superscalar Processing, Dichotomy of Parallel Platforms

Unit II: Principles of Parallel Algorithm Design **(07)**

Concept of Decomposition, Tasks, Dependency Graphs, Granularity, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing,Interconnection Networks for Parallel Computers.

Unit III: Basic Communication Operations and Programming Using the Message Passing Paradigm **(07)**

Communication Costs in Parallel Machines, One-to-All Broadcast and All-to-One Reduction operations, All-to-All Broadcast and Reduction, All-Reduce Operations, Scatter and Gather,
All-to-All Personalized Communication, Circular Shift Operation, Principles of Message Passing

Unit IV: Advanced Parallel Algorithms **(07)**

Dense matrix algorithms- Matrix Vector Multiplication, Matrix Matrix Multiplication, Sorting -Issues in Sorting on Parallel Computers, Bubble Sort and its Variants, Quicksort, Bucket and Sample Sort, Parallel Depth-First Search, Parallel Best-First Search

Unit V: Programming Shared Address Space Platforms **(07)**

Thread Basics, The POSIX Thread API, The OpenMP Programming Model, Specifying Concurrent Tasks in OpenMP, Synchronization Constructs in OpenMP, Data Handling in OpenMP, OpenMP Library Functions, Evolution of Multicore solution, CUDA Hardware,
Managing GPU memory, CUDA Kernel Function. Cache Coherence in Multiprocessor Systems.

Unit VI: Recent Trends in Parallel Processing **(07)**

Introduction to Petascale Computing, GPU accelerated Deep Learning, High Performance Computing in Data Analytics, Quantum Computing, Energy Efficient Parallel Computing, Parallelization tools.

Case study : Health care & Life Science, Oil & Gas,Telecommunication and smart cities.

Text Books:

1. Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, 'Introduction to Parallel Computing', Addison-Wesley (India)(Second edition)(2006) , ISBN:0-201-64865-2.
2. David Culler Jaswinder Pal Singh, 'Parallel Computer Architecture: A hardware/Software Approach ', Morgan Kaufmann Publishers (India)(1999) , ISBN 978-1-55860-343-1.

Reference Books:

1. Kai Hwang, 'Scalable Parallel Computing', McGraw Hill (1998) , ISBN:0070317984.
2. Shane Cook, 'CUDA Programming: A Developer's Guide to Parallel Computing with GPUs', Morgan Kaufmann Publishers Inc.(2013) ISBN: 9780124159884.
3. Jason sanders, Edward Kandrot, ' CUDA by Example ', Addison-Wesley , ISBN-13: 978-0-13-138768-3.

Online/Web/Other References:

1. https://nptel.ac.in/courses/106/102/106102114
2. CDAC- Parallel Computing and High Performance Computing

20PECE 802E Introduction to Blockchain

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 the underlying blockchain technology.
2. Learn and Explore blockchain platforms such as Ethereum, Hyperledger to build blockchain applications.
3. Understand use of cryptocurrency and smart contract.
4. Understand use of blockchain in various domains like supply chain management, healthcare, IoT etc.

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

1. Apply fundamental concepts of blockchain to understand the working of blockchain.
2. Make use of blockchain platforms such as Ethereum, Hyperledger to build blockchain applications.
3. Make use of Cryptocurrency and Smart Contract in real world applications.
4. Explore applications of Blockchain in domains like supply chain management, healthcare, IoT etc.

Unit I: BLOCKCHAIN FUNDAMENTALS (6)

Basics of Blockchain-Architecture, features, Types (Public, Private, Hybrid), working of blockchain, distributed ledger, wallets, Hash, Consensus mechanism and Mining, Smart contract, cryptocurrency.
Blockchain Technology: Applications, opportunity & challenges.

Unit II: CRYPTOGRAPHY and CONSENSUS MECHANISM (7)

Use of Cryptography in Blockchain, symmetric key and asymmetric-key cryptography algorithms, hash functions, SHA-256, digital signature,merkel trees.

Importance of consensus in transactions. Consensus Mechanisms ex. Proof of Work (PoW), Proof of Stake (PoS), PBFT(Practical Byzantine Fault Tolerance), DBFT(Delegated Byzantine Fault Tolerance).

Unit III: BLOCKCHAIN FRAMEWORKS **(7)**

Blockchain Platforms like Ethereum and Hyperledger. Demo of Blockchain Tools.
Create nodes on your personal Ethereum blockchain, create accounts, unlock accounts, mine, transact, transfer Ethers, and check balances.

Unit IV: SMART CONTRACT **(7)**

Introduction, what is smart contract,Working of Smart contract,Challenges. Types of smart contracts, Smart Contracts in Ethereum Blockchain, EVM in relation with Smart Contracts and Gas Price, Demo of Running and Debugging Smart Contracts in Remix (Detailed), Writing smart contracts using Solidity & JavaScript, Deploy and Debug Smart Contract using appropriate tool.

Unit V: CRYPTOCURRENCY **(8)**

Introduction, Cryptocurrency Basics, wallets, Types of Cryptocurrency. Crypto-economics and Cryptocurrency Transactions, Valid and Invalid Transactions, Cryptocurrency Wallets, Buying Cryptocurrency Wallets , Withdrawal Cryptocurrency Wallets. Mining Blockchain.

Bitcoin, Ethereum basic crypto primitives: Hash, Digital Signatures, Hashchain to Blockchain, Basic consensus mechanisms Ethereum Vs Bitcoin. working of Bitcoin System, Decentralized Cryptocurrency and its use cases. Bitcoin Wallets. Cryptocurrency safety issues.

Unit VI: BLOCKCHAIN APPLICATIONS AND TRENDS **(7)**

Community, Politics, and Regulation. Stakeholders, Roots of Bitcoin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy. Technical, Business, Cultural, Ethical, and Regulatory Challenges, Regulating and mitigating illegal behaviour(s).
Blockchain Applications like healthcare, Supply Chain Management, Finance, Digital ID's. Real Time Use Cases and Applications in Blockchain.

Blockchain in Financial Service(Payments and Secure Trading, Compliance and Mortgage, Financial Trade).
Blockchain in Government: Advantages, Use Cases. Future trends in blockchain, industry impact. Impact of blockchain on Business.

Text Books:

1. Chandramouli Subramanian, Asha A George, Abhilash K A, Meena Karthikeyan, "Blockchain Technology", Universities Press 2020, ISBN 9789389211634
2. Melanie Swa, "Blockchain", O'Reilly, 2015, ISBN: 9781491920497
3. Bikramaditya Singhal, Gautam Dhameja, Priyanshu Sekhar Panda, "Beginning Blockchain", Apress, First South Asian Edition 2018, ISBN 978-1-4842-3444-0.

Reference Books:

1. Narayanan, Bonneau, Felten, Miller and Goldfeder, "Bitcoin and Cryptocurrency Technologies – A Comprehensive Introduction", Princeton University Press, 2016 ISBN: 9780691171692
2. Thompson, 'Blockchain: The Blockchain for Beginnings, Guide to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform, 2017, ISBN: 1546772804
3. Tiana Laurence, Blockchain For Dummies, 2nd edition, Wiley, 2019, ISBN: 978-1-119-55513-1
4. Primavera De Filippi, Aaron Wright, "Blockchain and the Law", Harvard University Press, ISBN-13: 978-0674976429

Online/Web/Other References:

1. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric
2. Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html
3. Prof. Sandip Chakraborty, Dr. Praveen Jayachandran, "Blockchain Architecture Design And Use Cases"[MOOC], NPTEL: https://nptel.ac.in/courses/106/105/106105184/

4. Blog.blockchain.com, https://blog.blockchain.com/category/tutorials/

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/