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Eligibility criteria, selection of students and Passing Rules and Regulations for the Honors and Minor Degree Program at CCEW, Pune

❖ **Preamble**

Looking to global competitive scenario, engineering students need to have multidisciplinary knowledge. Hence, at CCEW we took it as a major objective to inculcate the contents, practices and processes in view of making the learners enriched and competent enough to satisfy the multidisciplinary requirements for various job profiles and career prospects. In line with AICTE and SPPU guidelines we took this opportunity and decided to allow our students to opt enroll for Honors / Minors Degree Program voluntary w.r.to certain interesting and state-of-the-art Engineering domains by earning certain number of credits.

A. General rules

1) It is not mandatory to any student to opt for Honors or Minors Program. Choice is given to individual students to undertake Honors or Minors programs from the third year engineering (Fifth Semester) to fourth year engineering (Eighth Semester).
2) The registration for Honors/Minors Programme will lead to additional credits to such students.
3) Students can register for either Honors program or Minor program
4) Credits earned through registration and successful completion of the Honors/Minors Programme will not be considered for the calculation of SGPA or CGPA of B.Tech. Program.
5) Students once registered for the programme need to complete all credits assigned for the specific Honors and Minors Programme by the end of Eighth Semester.

B. Eligibility criteria and selection of students for the Honors Degree Program

1) Students with CGPA equal to and above 8 (up to 4th Sem.) are eligible to apply for Honors Degree Programme.
2) For Honors program offered by Computer and E & TC departments , top 60 applicants will be eligible to register for the program
3) For Honors program offered by Instrumentation and control, IT and Mechanical departments , top 30 applicants will be eligible to enroll for the program
4) Honors program will be offered if there are more than 10 applications for the particular program.

C. Eligibility criteria and selection of students for the Minor Degree Program

1) Students from any department are eligible to apply for a Minor degree program.
2) Students with CGPA equal to and above 7 (up to 4th Sem.) are eligible to apply for Minor Degree Programme.

3) For any Minor program, top 30 applicants will be eligible to enroll for the program
4) Minor program will be offered if there are more than 10 applications for the particular program.

D. Passing Rules and Regulations

1) To obtain Passing grade in any course students must get 40% of ESE marks and 40 % of total Marks
2) Grades will be allotted based on ISE and ESE performance.
3) If student fails in any course, she will be allowed to reappear for the re-examination, which will be conducted immediately after the result. If she is not able to obtain passing grade in re-examination, her registration for the program will be cancelled.
4) Opportunity of re-examination will be given only for one course. If student fails in more than one course in the same semester or she fails again after availing opportunity of re-examination, her registration for the program will be cancelled.

Ref.:-

i. **AICTE**:- https://www.aicte-india.org/sites/default/files/APH%202020_21.pdf *[pp. 99-100]*

ii. **SPPU**:- http://collegecirculars.unipune.ac.in/sites/documents/Syllabus2020/Rules%20and%20Regulations%20of%20Honors%20and%20Minors_17.02.2021.pdf

❖ **List of Honors Degree Program**

❖	**Honor Degree Programmes**	**To be offered for discipline**
1	**Industrial Measurement and Automation**	Instrumentation & Control Engineering
2	**Electric Vehicle**	Mechanical Engineering
3	**(a) Data Science** **(b) Wireless Communication** **(c) VLSI Technology**	Electronics and Telecommunications Engineering
4	**Full Stack Development**	Information Technology
5	**Data Science and Machine Learning**	Computer Engineering

❖ **List of Minor Degree Program**

❖	**Minor Degree Programmes**	**To be offered for discipline**
1	**Engineering Management**	All Discipline
2	**Entrepreneurship**	All Discipline
3	**Information Security Management**	All Discipline

Autonomous Program Structure
B.Tech in Instrumentation and Control
with **Honors Degree Programme** in
Industrial Measurement and Automation
Academic Year: 2022-2023 Onwards

Course Code	Semester	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Marks	Credit
			Lecture	Tutorial	Practical	In Semester	End Semester	Oral	Practical		
20HIA501	TY Sem I	Sensor Technology	3	0	0	50	50	0	0	100	3
20HIA502	TY Sem I	Field Instrumentation	3	0	0	50	50	0	0	100	3
20HIA502 L	TY Sem I	Field Instrumentation Lab	0	0	2	0	0	0	50	50	1
20HIA601	TY Sem II	Industrial IoT	3	0	0	50	50	0	0	100	3
20HIA602	TY Sem II	Machine Vision for Automation	3	0	0	50	50	0	0	100	3
20HIA602 L	TY Sem II	Machine Vision for Automation Lab	0	0	2	25	0	0	25	50	1
20HIA801	Final Year Sem II	Batch Automation	3	0	0	50	50	0	0	100	3
20HIA801 L	Final Year Sem II	Batch Automation Lab	0	0	2	25	0	25	0	50	1
		Total	**15**	**0**	**6**	**300**	**250**	**25**	**75**	**650**	**18**
		Grand Total	**21**			**650**					

20HIA501 Sensor Technology

Teaching Scheme:
Lectures: 3 hrs/week

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

Prerequisites: Sensors and Transducers, Industrial Instrumentation

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

Course Outcomes: The students will be able to
1. Identify various steps involved in sensor design
2. Compare to select various sensors for the given application
3. Design the transducer using appropriate modeling technique
4. Prepare the testing and calibration documents of sensor

Unit 1: Introduction to sensor design **(06)**
Common types of sensors and actuators, Overview of analog and digital interfaces, amplifiers, sensor noise

Unit 2: Design considerations and selection criterion **(06)**
Sensor fabrication techniques, process details, and latest trends in sensor fabrication, fiber optics sensors, electromechanical sensors, Solid state chemical sensors, Bio-sensors, Piezo-resistive sensors, characterization of sensors, effect of sensors on process identification, signal conditioning techniques.

Unit 3: Modeling methods **(08)**
Modeling methods of transducer design, developing first principle model, and empirical model based on the data, describe the effect of variables which are related to manufacturing tolerances and environmental effects.

Unit 4: Standards **(06)**
Standards for testing the transducers and calibration procedure and documentation for the calibration process - Case Studies.

Unit 5: Case studies related to **(06)**
Chemical sensors, bio sensors, gas sensors
Discussion on Nano sensors and MEMS applications

Reference Books:
1. E.O. Doebelin, "Measurement Systems", McGraw Hill, Fourth ed., 1990.
2. Sabrie Soloman, "Sensors Handbook", McGraw Hill Publication, First ed., 1998.
3. Smart materials and new technologies, Addington, M. ,Schodek, Daniel L. Architectural Press, 2005.
4. Smart Sensors and Systems, Lin, Y.-L., Kyung, C.-M., Yasuura, H., Liu, Y. [Springer]

20HIA502 Field Instrumentation

Teaching Scheme:
Lectures: 3 hrs/week

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

Pre-requisites: Sensors and transducers, Linear Integrated Circuits, Digital Techniques, Industrial drives and Control

Course Objectives:
1. Compare the working of electrical, hydraulic, pneumatic field devices.
2. Develop signal conditioning circuits
3. Develop electrical, pneumatic hydraulic circuits for given application using various field devices
4. Interfacing of field devices

Course Outcomes: The students will be able to
1. Design process field indicators, process control devices.
2. Select different types of field devices for process control and safety components for the control panel.
3. Interface the field devices to the controller using appropriate components and connections.
4. Develop various motor control circuits, hydraulic, pneumatic circuits for the given application.

Unit 1: Motor control circuits using field devices (06)
Concept of sequencing & interlocking. Motor control circuits like Starting, Stopping, Emergency shutdown, starters, reversing direction of rotation, braking, starting with variable speeds, jogging/Inching.

Unit 2: Design of field indicators (06)
Design of Process parameter indicators like level indicator, temperature indicator pressure indicator, speed indicator weight measurement etc. Design of temperature measuring circuit for RTD, thermocouple with cold junction compensation.

Unit 3: Design of process control field devices (06)
Design of process transmitters, process switches (level, temperature etc), process converters like F/V, current isolator/repeaters, P to I converters, I to PWM, distributors, Pulse I/O converters etc

Unit 4: Interfacing of field devices to PLC and control of actuators (06)
Digital (manual switches (PB, toggle, rotary switch, slide switch, proximity switches), process switches (temperature, pressure, level switches), outputs(solenoid, relay, contactors, lamp, hooter, DCV)), analog, special, remote, IoT enabled field devices. Interfacing PLC to pneumatic circuits. Driving circuits for servomotor, stepper motor

Unit 5: Control panel Instrumentation (06)

Control panel basics, panel safety instruments, panel wiring, electrical power and instrument power requirements and their distribution. Earthing scheme, panel ventilation, cooling and illumination. Wiring accessories- ferrules, lugs, etc.codes and standards used for panel

Unit 6: Process automation using pneumatics and hydraulics (06)

Case studies of process automation using pneumatics and hydraulics components like Job stamping, sorting according to its dimension, box transfer on conveyor belt, sequencing of cylinders, Speed control of pneumatic motor, Can sealing mechanism, etc.

Text Books:

1. Petruzella, "Industrial Electronics", McGraw-Hill
2. Majumdhar, "Pneumatic Instrumentation", TMH
3. Andrew Parr, "Hydraulics and pneumatics: A Technician's and Engineer's guide", Butterworth Heinemann Ltd
4. Dan Sheingold, Editor, Transducer Interfacing Handbook, Analog Devices, Inc., 1980.
5. Manabendra Bhuyan, Intelligent Instrumentation: Principles and Applications, CRC Press Taylor & Francis Group, 2010.
6. "Applied instrumentation in process industries", Andrew & Williams, Gulf Publications.

Reference Books:

1. Pneumatics, Festo Didactic
2. Ramon Pallás Areny, John G. Webster, Sensors and Signal Conditioning, 2nd Edition, John Wiley and Sons, 2000.
3. Thomas L. Floyd, David Buchla, Fundamentals of analog circuits, 2002- Prentice Hall.
4. Ernest O. Doebelin; Measurement System Application and Design; Mc-Graw Hill; 5th Edition,2003.
5. "Instrument Installation Project Management", ISA Publications.
6. "Process control Instrument Engineers Handbook", B. G. Liptak, CRC Press.

20HIA502L Field Instrumentation Lab

Teaching Scheme:
Practical: 2 hrs/week

Examination Scheme:
Practical: 50 Marks
Credit: 1

Pre-requisites: Sensors and transducers, Linear Integrated Circuits, Digital Techniques, Industrial drives and Control

Course Outcomes: The students will be able to
1. Implement the designed process field indicators, process control devices
2. Select different types of field devices for to solve the given problem
3. Interface the field devices to the controller using appropriate components and connections
4. Implement the developed various motor control circuits, hydraulic, pneumatic circuits for the given application.

List of Practical Assignments:
1. Implementation of motor control circuits
2. Design of level indicator
3. Design of temperature measuring circuit with RTD
4. Design of temperature measuring circuit with thermocouple with cold junction compensation
5. Design of process transmitter
6. Design of process converters
7. Interfacing PLC to field devices
8. Interfacing PLC to Pneumatic circuits
9. Implementation of Pneumatic circuits
10. Implementation of hydraulic circuits
11. Study control panel components.
12. Field Visit

Or similar type of practical assignments based on the course contents

20HIA601 Industrial Internet of Things

Teaching Scheme:
Lectures: 3 hrs/week

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

Prerequisites: Basics of IoT, its protocols and networks

Course Objectives:
1. To understand building blocks and components of IIoT
2. To understand various technologies used in IIoT
3. To understand the role of platforms and security in IIoT

Course Outcomes: The students will be able to
1. Identify components and business models of IIoT
2. Compare Technologies used in IIoT
3. Select and justify the method/ protocol for a given application
4. Propose solutions for given problem statement

Unit 1: Introduction to IIoT
Introduction, History, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories
Components of IIOT - Sensors, Interface, Networks, Business Models and Reference Architecture, People & Process, Hype cycle, IOT Market, Trends & future, Real life examples

Unit 2: IIoT and Cyber Manufacturing Systems:
Introduction to Cyber Manufacturing Systems and Cyber Physical Systems, it's concept, architecture, design principles, modeling, challenges, interoperability in Smart Automation of CPS, examples and case studies in various domains

Unit 3: IIoT and Blockchain Technology:
Introduction to Blockchain technology, concept, need, types, architecture, elements, connectivity, challenges and concerns, platforms, applications in FinTech, Supply Chain, Identity Management, military and equivalent.

Unit 4: IIoT and M2M Communication:
Introduction to M2M, concept, need, architecture, models, challenges and concerns, various approaches, applications in Automotive, Smart Telemetry, Building Automation, Industrial Automation, surveillance and equivalent.

Unit 5: Supporting Technologies and platforms for IIoT:
Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis, Digital Twin Technologies and Applications IIOT cloud platforms : Overview of cots cloud platforms, predix, thingworks, azure and

equivalent. Case Studies of implementing Industrial IoT solutions with AWS/ Google Cloud/ Azure/ equivalent. Fog Computing: architecture, models, role in Industrial IoT

Unit 6: Privacy, Security and Governance

Security Basics - Risk, Threat & Vulnerability, Risk Assessment, IIoT Security Framework based on IIC, Basic understanding of various IIoT security standards like NIST 82, IEC 62443, NERC, NIC etc., Hardware based Security

Text Books:

1. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Wiley Publications
2. Bernd Scholz-Reiter, Florian , Michahelles, "Architecting the Internet of Things", ISBN 978-3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer

Reference Books:

1. Hakima Chaouchi, "The Internet of Things Connecting Objects to the Web" ISBN : 978-1- 84821-140-7, Wiley Publications
4. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2nd Edition, Wiley Publications
5. Inside the Internet of Things (IoT), Deloitte University Press
6. Internet of Things- From Research and Innovation to Market Deployment; By Ovidiu & Peter; River Publishers Series
7. Five thoughts from the Father of the Internet of Things; by By Phil Wainewright - Kevin Ashton
8. How Protocol Conversion Addresses IIoT Challenges: White Paper By RedLion.
9. The Internet of Things in the Industrial Sector, Mahmood, Zaigham (Ed.) (Springer Publication)
10. Industrial Internet of Things: Cyber manufacturing System, Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer Publication)
11. Industrial IoT Challenges, Design Principles, Applications, and Security by Ismail Butun (editor)

20HIA602 Machine Vision for Automation

Teaching Scheme:
Lectures: 3 hrs/week

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

Pre-requisites: Sensors and transducers, Industrial drives and Control, Digital Signal Processing

Course Objectives:
1. Describe the fundamentals of image formation.
2. Compare image processing techniques for computer vision for shape and region analysis.
3. Develop an appreciation for various issues in the design of computer vision and object recognition systems
4. Provide the student with programming experience from implementing computer vision and object recognition applications.

Course Outcomes: The students will be able to
1. Identify fundamental steps in image processing.
2. Apply various image enhancement and restoration techniques.
3. Apply image segmentation and representation techniques.
4. Interpret the techniques for image feature extraction.
5. Develop machine vision systems using image processing and image analysis techniques for given applications.

Unit 1: Fundamentals of Machine Vision System (06)
Introduction: Digital Image- Steps of Digital Image Processing Systems-Elements of Visual Perception - Connectivity and Relations between Pixels. Simple Operations- Arithmetic, Logical, Geometric Operations. Mathematical Preliminaries - 2D Linear Space Invariant Systems - 2D Convolution - Correlation 2D Random Sequence - 2D Spectrum.

Unit 2: Image transforms and enhancement (06)
Introduction to the Fourier Transform, The Discrete Fourier Transform, Some properties of the Two Dimensional Fourier Transform, The Fast Fourier Transform, Other Separable Transforms, and The Hotelling Transforms.
Image Enhancement:- Histogram Equalization Technique Background, Enhancement by Point Processing, Spatial Filtering, Enhancement in the Frequency Domain, Generation of Spatial Mask from Frequency Domain Specification, Color Image processing.

Unit 3: Image restoration and construction (06)
Degradation Model, Diagonalization of Circulant and Block Circulant Matrices, Algebraic approach to Restoration, Inverse Filtering, Least Mean Square (Wiener) Filter, Constrained Least Squares Restoration, Interactive Restoration, Restoration in the Spatial Domain, Geometric Transformations.

Unit 4: Image Analysis (06)

Segmentation, detection of discontinuities, edge linking and boundary detection, thresholding, region -oriented segmentation, Representation and description: Representation schemes, descriptors, regional descriptors, pattern and pattern classes, Classifiers.

Unit 5: Image Compression **(06)**

Redundancies, image compression models, elements of information theory, error free compression variable length coding, bit plane coding, lossless predictive coding, lossy compression, predictive coding, transform coding, video compression, image compression standards- JPEG, MPEG.

Unit 6: Applications of Machine Vision **(06)**

Applications of machine vision in Automotive Industries, Manufacturing, Electronics, Printing, Pharmaceutical, Biomedical, Robotics, Agricultural Applications.

Text Books:

1. Gonzalez and Woods, "Digital Image Processing with Matlab", Pearson Education,

Reference Books:

1. Machine Vision: Theory, Algorithms, Practicalities (Signal Processing and its Applications) Hardcover by E. R. Davies
2. Arthur Weeks Jr., "Fundamentals of Digital Image Processing", Prentice-Hall International.
3. Madhuri Joshi, "Digital Image Processing", Prentice-Hall International. ‘
4. A. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.
5. K. R. Castleman, Digital Image Processing, Prentice-Hall International.
6. Pratt William, "Digital Image Processing", John Wiley & Sons
7. Alexander Hornberg, Handbook on Machine Vision (2006), Wiley.
8. Milan Sonka, Vaclav Hlavac, Roger Boyle, Image Processing Analysis and machine Vision (2014), Cengage Learning.

20HIA602L Machine Vision for Automation Lab

Teaching Scheme:
Practical: 2 hrs/week

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

Pre-requisites: Sensors and transducers, Industrial drives and Control, Digital Signal Processing

Course Outcomes: The students will be able to
1. Apply various image filtering techniques including median filtering, and Gaussian smoothing.
2. Implement various image segmentation techniques and edge detection.
3. Classify the given image based on feature extraction.
4. Develop and implement machine vision systems using image processing and image analysis techniques for given applications.

List of Practical Assignments:
Students are expected to perform Minimum Eight Experiments

1. Point-to-point transformation- Thresholding an image and the evaluation of its histogram.
2. Enhance an image using image arithmetic and logical operations
3. Geometric transformations- Image rotation, scaling, and translation. Two-dimensional Fourier transform.
4. Two-dimensional Fourier Transform. Harmonic content of an image using the discrete Fourier transform (DFT) and masking with DFT.
5. Ideal filters in the frequency domain- Effects of filtering low and high frequencies in an image.
6. Non-Linear filtering using convolutional masks- Effects of a median filter on an image corrupted with impulsive noise.
7. Entropy as a compression measure- Entropy as a compression measurement to the DPCM compression measure.
8. Edge detection- Edge detectors and their operation in noisy images
9. Open ended assignment: Develop any one Machine Vision System for

i. Tool wear measurement using Machine vision
ii. Inspection system in production line for checking the level of liquid in bottle
iii. Sorting of color pencils
iv. Printed Circuit Board Inspection using Template Matching
v. Implementing polka yoke using machine vision system
vi. Online inspection using machine vision camera

Or similar type of practical assignments based on the course contents

20HIA801 Batch Automation

Teaching Scheme:
Lectures: 3 hrs/week

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

Prerequisite: Process Instrumentation and Control, Industrial Automation

Course Objective:

1. Understand the basics of Batch control system
2. Learn the International standards used for Batch processes
3. Describe the various stages involved in Batch process control

Course Outcomes: The students will be able to

1. Identify the requirements for a batch control system.
2. Define procedural elements that can be effectively used with the equipment entities.
3. Develop phase logic that executes in equipment and that can deal with both normal and abnormal operations
4. Recognize the various control languages that are available
5. Identify the alternative architectures for PLC, DCS and PC-based control systems

Unit 1: Introduction to batch control system **(06)**

Introduction to batch control system, batch control system terminology, characteristics of batch processes, hierarchical batch model, control structure for batch systems.

Unit 2: ISA Standard for batch **(06)**

ANSI/ISA S88 standard: introduction: Scope, definitions, Batch process and equipment: process model (Entity relationship diagram for different levels), physical model, equipment module or control module, enterprise level, Types of control.

Unit 3: Recipe Management system **(06)**

Recipes: Definition, contents, types: General, Site, Master. Procedures, Procedural element relationships, Control recipe procedure/equipment control separation. Recipe management.

Unit 4: Planning and scheduling **(06)**

Production plans and schedules, Production information, mechanisms for allocating resources, Batch history, Batch reports, Modes and states.

Unit 5: Batch Control **(06)**

Batch control activities and functions: Control activities, Control activity model, Information handling, Security, Availability, Archival, Reference tracking, Process and control engineering.

Unit 6: Batch Management system (06)

Batch process management: Manage batches, manage process cell resources, Collection of batch and process cell information, unit supervision, manage unit resources, Execute equipment phases, Personnel and environmental protection

Reference Books:

1. Jim Parshall and L. B. Lamb , Applying S88: Batch Control from a User's Perspective, ISA, 2000.
2. ANSI/ISA–88.01–1995, Batch Control Part 1: Models and Terminology, ISA
3. William M. Hawkins, Thomas G. Fisher, Batch Control Systems: Design, Application, and Implementation, ISA

20HIA801L Batch Automation Process Lab

Teaching Scheme:
Practical: 2 Hrs/week

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

Course Outcomes: The student will be able to
1. Identify various features of DeltaV for Batch process control
2. Identify the alternative architectures for PLC, DCS and PC-based control systems
3. Design sequential logic for batch process control
4. Implement the Batch control logic using SFC programming

List of Practical Assignments:

1. Introduction to DeltaV batch suite
2. Introduction to SFC programming module
3. Design a sequence of operation for given process using SFC
4. Introduction to Phase Logic Module (PLM)
5. Design a sequence of operation for given process using PLM
6. Design a plant hierarchy for a given process
7. Case study of Recipe management system
8. Case study of Batch Process Management

Or similar type of practical assignments based on the course contents

Autonomous Program Structure
B.Tech in **Computer Engineering**
with **Honors Degree Programme** in
DATA SCIENCE AND MACHINE LEARNING
Academic Year: 2022-2023 Onwards

Course Code	Year and Semester	Course Title	Teaching Scheme (hours/week)			Marks	Credits
			ectures	utorial	ractical		
20HDM501	TY Sem I	Statistics for Data science and Machine learning	3	0	0	100	3
20HDM502	TY Sem I	Advanced Data science	3	0	0	100	3
20HDM501L	TY Sem I	Statistics for Data science and Machine learning Lab.	0	0	2	50	1
20HDM601	TY Sem II	Advanced Machine Learning	3	0	0	100	3
20HDM602	TY Sem II	Data Visualization and Business Intelligence	3	0	0	100	3
20HDM601L	TY Sem II	Advanced Machine Learning Lab.	0	0	2	50	1
20HDM801	Final Year Sem II	Deep Learning and applications	3	0	0	100	3
20HDM801L	Final Year Sem II	Deep Learning and applications Lab.	0	0	2	50	1
		Total	15	0	6	650	18
		Grand Total	21			650	18

20HDM501 Statistics for Data Science and Machine Learning

Teaching Scheme
Lectures: 3 Hours / Week

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

Prerequisite: 20CE404 Machine Learning

Course Objectives:-

1. To be able to analyze univariate, bivariate and multivariate data.
2. To be able to apply feature selection, dimensionality reduction
3. To be able to perform Time series analysis, interpolation and extrapolation techniques
4. To be able to apply statistical inference techniques and statistical decision theory to draw conclusion

Course Outcomes:-
Learner should be able to:-

1. Apply univariate, bivariate data analytics techniques.
2. Apply data transformation, feature selection and dimensionality reduction techniques for given multidimensional data.
3. Analyze given time series data.
4. Apply interpolation and extrapolation techniques for data analysis.
5. Apply statistical inference techniques and statistical decision theory for given data.

Course Contents:

Section 1: Univariate and Bivariate Data Analysis

Review of descriptive statistics: Data types, Measure of central tendency, dispersion, skewness, kurtosis. Case studies for descriptive statistics using python. Association of attributes: Difference between correlation and association, consistency of data, methods of association, partial association, illusory association, Simpson's paradox.

Section 2: Operations on Multidimensional data

Feature selection, Dimensionality reduction, data transformation, distance measures, Time series analysis, Interpolation and Extrapolation, Significance of interpolation and extrapolation, methods of interpolation, extrapolation. Case studies using python.

Section 3: Statistical inference and decision theory

Statistical inference and statistical decision theory: Test of hypothesis introduction, parametric and non-parametric test such as t-test, Rank Sum test, Experimental design: randomized blocks, latin squares. Statistical decision theory: Introduction, ingredients to decision problems, optimal decisions. Examples using python.

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.
4) "R programming for beginners", Sandhya Arora, Latest Malik, 1st edition, 2020, University press publication, ISBN 978-93-89211-56-6

Reference Books:

1) "Statistical Data analytic" by Piegorsch W.W., Wiley publication, 2017
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
4) "Data Mining: Concepts and Techniques", Jiawei Han, Micheline Kamber, Jian Pei, , 3rd Edition, 2012, Morgan Kaufmann publishing, ISBN: 978-0-12-381479-1

20HDM502 Advanced Data Science

Teaching Scheme
Lectures: 3 Hours / Week

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

Course Objectives:

1. To be able to apply advanced data science concepts using python.
2. To be able to apply probability and probability distributions concept for given data
3. To be able to analyze and visualize data using python and other tools.

Course Outcomes:

Learner should be able to:-

1. Apply python programming for advanced data science concepts.
2. Apply different concepts of probability for data analysis.
3. Perform exploratory data analysis
4. Perform data visualization for univariate and multivariate data.

Course Contents:

Section 1: Advanced python programming

Quick review of basics of Python programming, data frames, data handling, data cleaning, data integration, data analysis using python, handling SciPy, Sklearn library functions. Basic case studies using these libraries.

Section 2: Probability

Review of basics of probability, Distributions, Conditional probability, Bayes theorem, Hidden Markov Model, Case study and demo with Python.

Section 3: Exploratory data analysis and visualization

Exploratory data analysis and visualization,Visualization before Analysis, Visualizing univariate and multivariate data, Multivariate Glyphs. Case study, Python based examples, Demo with tool like Tableau.

In class hands-on / demonstrations:

Explore and download free data set

(from Indian datasets such as https://data.gov.in/, https://www.ncbi.nlm.nih.gov/, https://dbie.rbi.org.in/, https://data.uidai.gov.in/, http://mospi.nic.in/, https://bhuvan-app3.nrsc.gov.in/, https://www.india.gov.in/, https://surveyofindia.gov.in/,

https://www.meteoblue.com/en/weather/archive/export/india_el-salvador_3585481, https://www.icegate.gov.in/, https://www.gbif.org/dataset/9e7ea106-0bf8-4087-bb61-dfe4f29e0f17)

and perform the following

--data handling with dataframes in python
--data cleaning
--data integration
--Exploratory data analysis
--Visualization of data in different plots using python libraries
--apply conditional probability, HMM concept on given data

Text Books :-

1. "Data Analytics using python", Bharti Motwani, Wiley publication,1st edition, ISBN 978-81-265-0295-0, 2020
2. "Data Science from Scratch", Joel Grus, O'Reilly Media, 2nd edition, ISBN- 9781492041139, 2019
3. **"**Data science fundamentals and practical approaches", Gypsy Nandi, BPB publication, 1st edition, ISBN 978-93-89845-662, 2020

Reference Books:-

1. "Statistics for Machine Learning: Essential statistical concepts for exploring predictive analytics and machine learning using Python and R", Pratap Dangeti, Packt Publishing 2019, ISBN: 978-1789532678
2. "Probability and Statistics for Data Science", Carlos Fernandez-Granda, New York 2017, https://cims.nyu.edu/~cfgranda/pages/stuff/probability_stats_for_DS.pdf
3. "Think Stats: Probability and Statistics for Programmers",Allen B. Downey, Green Tea Press Needham, Massachusetts, 2011, https://greenteapress.com/thinkstats/thinkstats.pdf

20HDM501L Statistics for Data Science and Machine Learning Laboratory

Teaching Scheme
Practical: 2 Hours / Week

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

The large part of Statistics for Data science and Machine Learning laboratory course conduction is to develop small case studies, mini projects using built in free datasets from kaggle, data.gov.in, ncbi.nlm.nih.gov, imagenet, etc, analyze and represent the results and data using different tools and technologies. Data will be used i.e. data cleaning/transformation/integration/reduction will be done and that data will be subsequently used to perform advanced statistical operations. Students will be encouraged to publish their findings in the form of research papers. Students will be motivated to explore the existing data set, build the code for/using statistical methods.
Faculty members are encouraged to expand problems with variations. Assignments can be framed and expanded in such a way that it explores concepts, logic of solution and real life applications. Students will be encouraged to solve open problems in different domains. Faculty will appropriately adopt assignments on similar lines as the examples shown here.

Suggestive List of Assignments

Explore and download free data sets (from Indian datasets such as https://data.gov.in/, https://www.ncbi.nlm.nih.gov/, https://dbie.rbi.org.in/, https://data.uidai.gov.in/, http://mospi.nic.in/, https://bhuvan-app3.nrsc.gov.in/, https://www.india.gov.in/, https://surveyofindia.gov.in/, https://www.meteoblue.com/en/weather/archive/export/india_el-salvador_3585481, https://www.icegate.gov.in/, https://www.gbif.org/dataset/9e7ea106-0bf8-4087-bb61-dfe4f29e0f17) and perform the following on the cleaned and integrated dataset (Using R/python).

--Descriptive data analysis for univariate data such as medical data.
--Data analysis of two dimensional data / multidimensional using correlation and regression etc and predict data value. Data set can be of nutrition, medical, real estate data etc.
--Apply data Feature selection, Dimensionality reduction, data transformation, distance measures techniques on multivariate data
--Perform time series analysis on given time series data such as sales, daily temperature, stock data set.
--Apply statistical inference techniques such as t-test, rank sum test on given data such as cars dataset.
--Perform simpson's paradox on given data. Expenditure data set can be used as an example.
--Develop a data analysis case study for readily available dataset using the statistical techniques studied.

20HDM601 Advanced Machine Learning

Teaching Scheme
Lectures: 3 Hours / Week

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

Prerequisite: 20CE404 Machine Learning

Course Objectives:

1. To be familiar with Tensorflow/keras/python and advanced machine learning algorithms.
2. To gain advanced knowledge of support vector machines, naive bayes, decision tree algorithms.
3. To get exposure to applying Artificial neural networks for non linearly separable patterns.
4. To apply methods of ensemble learning.

Course Outcomes:

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

1. Make use of basic functions of tensorflow/keras/python for machine learning algorithms and design of support vector machine
2. Apply Naive bayes classification algorithm for given problem
3. Experiment with methods of ensemble learning and advanced decision tree for given data.
4. Solve non linearly separable problems using artificial neural networks.

Course Contents:

Section 1: TensorFlow, Keras and Support vector machine

ML using TensorFlow , keras/ Basic functions. Installation of TensorFlow/keras and its features.
Introduction to Support Vector Machines(SVM), Optimal Hyperplane for Linearly Separable and Nonseparable Patterns, Maximizing margin, Non linear pattern classification, Kernel trick, Design of Support Vector Machines.

Section 2: Naive Bayes Classification

Introduction to Naive Bayes, Bayes theorem, Bayes theorem and concept learning, ML for predicting probabilities, Naive Bayes classifier, Types of bayesian classifier, Bayesian belief networks, Expectation Maximization (EM) algorithm.

Section 3: Ensemble learning

Introduction, Decision Tree, Entropy, Information gain, Gini Index , Different types of ensemble learning methods, bagging , boosting, stacking, Random Forests.

Section 4: Advanced Artificial neural networks

Artificial neural networks, Non linear separability, XOR problem, back propagation algorithm.

Text Books:

1. "Hands-On Machine Learning with Scikit-Learn and TensorFlow", Aurélien Géron, O'Reilly Media, 2nd edition, ISBN 9781492032649, 2019
2. "Machine learning", Peter Flach, cambridge university press, 6th edition, ISBN 978-1-316-50611-0, 2018
3. "Machine learning using python", Pradhan, U. Dinesh Kumar, Wiley publication, 1st edition, ISBN 978-81-265-7990-7, 2019
4. "Machine learning", S. Sridhar, M.Vijayalakshmi, 1st Edition, Oxford university press, 2021, ISBN 978-0-19-012727-5

Reference Books:

1. "Introduction to machine learning", Ethem Alpaydın, MIT press, 3rd edition, ISBN 978-81-203-5078-6, 2014
2. "Machine learning in python", Michael Bowlers, Wiley publication, 1st edition, ISBN 978-81-265-5592-5, 2015
3. "Practical Machine Learning with Python":A Problem-Solver's Guide to Building Real-World Intelligent Systems, Dipanjan Sarkar, Raghav Bali, Tushar Sharma, Apress publication, ISBN: 978-1-4842-3206-4, 2018
4. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", 3 rd Edition, 2012, Morgan Kaufmann publishing, ISBN: 978-0-12-381479-1

20HDM602 Data Visualization and Business Intelligence

Teaching Scheme
Lectures: 3 Hours / Week

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

Course Objectives:

1. Develop familiarity with Business Intelligence concepts
2. Gain knowledge about analysis of data and visualization
3. Get exposure to latest trends and case studies in BI

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

1. Apply decision making knowledge to a application from business perspective
2. Analyze the data and generate appropriate representation
3. Visualize the given data by following ethical guidelines
4. Make use of latest trends and case studies in BI to a given scenario

Section I: Business intelligence

Decision making and Decision Support Systems, Business Intelligence Concepts, BI life cycle, Business Performance Management Systems, BI and data science

Section II: Data Visualization

Design principles of data visualization, best practices, choosing an effective visual, managing clutter, dissecting model visuals, Popular tools, data visualization using tools like R, Tableau, Importance of ethics in data visualization, ethical dimensions and general guidelines about visualization, Data visualization in business.

Section III: Case studies and trends

Case studies related to storytelling with data, Geographic visualizations (eg.Uber), Demographic comparison (eg. Voters and their inclinations), visualization of Urban data , self-service BI, Predictive /Advanced analytics, Mobile BI

In class hands-on / demonstrations:

-Hands on previously explored datasets for visualization using open source BI tools such as Jaspersoft, BIRT (Business intelligence and Reporting tools)

Text Books:

1. "Storytelling with data" , cole nussbaumer knaflic, Wiley Publications , 2019, ISBN 978-1119621492

2. "Data science for Business", Foster Provost et al., O'reilly Publications, 2013,ISBN 978-1449361327
3. "Decision Support And Business Intelligence Systems",Turban, Sharda, Pearson Publications, 2013, ISBN 978-8131761090

Reference Books:

1. "Business analytics for managers" , Laursen G.H.N. , Thorlund J., 2nd Edition, Wiley publication, 2016, ISBN: 978-1-119-29858-8
2. "Business Intelligence for Dummies" Swain Schepus, Wiley Publication, 2008, ISBN 978-0-470-12723-0
3. "Decision Support Systems in the 21st Century", George Marakas, 2002, ISBN-978-8120323766
4. "Real-World Decision Support Systems Case Studies", Jason Papathanasiou et al., Springer, 2016, ISBN 978-3-319-43916-7

20HDM601L Advanced Machine Learning Laboratory

Teaching Scheme
Practical: 2 Hours / Week

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

The large part of Advanced Machine Learning laboratory course conduction is to develop small case studies, mini projects using built in free datasets from kaggle, data.gov.in, ncbi.nlm.nih.gov, imagenet, etc, analyze and represent the results and data using different tools and technologies. Data will be used in an prograssive way i.e. data cleaning/transformation/integration/reduction done in earlier lab will be subsequently used to build ML Model and model comparison/evaluation will also be done. Build models can be utilized in the decision making process through business intelligence. Students will be encouraged to publish their findings in the form of research papers. The large part of the laboratory component will be devoted to implement the advanced concepts of Machine learning and data science along with the real world applications.

Faculty members are encouraged to expand problems with variations and increased complexities. Assignments can be framed and expanded in such a way that it explores concepts, logic of solution and real life applications. Students will be encouraged to solve open problems in different domains. Faculty will appropriately adopt assignments on similar lines as the examples shown here.

Suggestive List of Assignments

Implementation of the following Machine Learning algorithms using Tensorflow and Keras/R/python library on previously cleaned and integrated dataset and also evaluate the performance of the implemented ML Model.

Reference Data sets which can be used are (from Indian datasets such as https://data.gov.in/, https://www.ncbi.nlm.nih.gov/, https://dbie.rbi.org.in/, https://data.uidai.gov.in/, http://mospi.nic.in/, https://bhuvan-app3.nrsc.gov.in/, https://www.india.gov.in/, https://surveyofindia.gov.in/, https://www.meteoblue.com/en/weather/archive/export/india_el-salvador_3585481, https://www.icegate.gov.in/, https://www.gbif.org/dataset/9e7ea106-0bf8-4087-bb61-dfe4f29e0f17)

--Support vector machine for data classification using IRIS or breast cancer dataset as example.

--Naive Bayes algorithm such as gaussian naive bayes, bernoulli naive bayes, multinomial naive bayes etc using Purchase/shopping data set as example.

--Expectation Maximization (EM) algorithm.

--Decision tree algorithm using birth weight data set as example.

--Random Forest algorithm using IRIS data set as example.

--Ensemble techniques such as bagging, boosting on breast cancer dataset as example..

--Back propagation algorithm for XOR logic gate or using any non linear separable data.

--Develop a mini project using data science and Machine learning for readily available dataset using the advanced machine learning and statistical analysis techniques studied.

20HDM801 Deep Learning and Applications

Teaching Scheme
Lectures: 3 Hours / Week

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

Prerequisite: 20CE404 Machine Learning

Course Objectives:

1. To be familiar with Deep learning algorithms and applications.
2. To get exposure to Convolutional Neural Networks
3. To gain advanced knowledge of Recurrent Neural Networks and LSTM for given data.
4. To get exposure to Deep learning algorithms in NLP Applications .
5. To gain advanced knowledge of Pretrained networks and advanced deep neural networks.

Course Outcomes:

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

1. Make use of deep learning concepts and Popular open source libraries
2. Apply Convolutional Neural Networks algorithm for given problem
3. Experiment with concepts of Recurrent Neural Networks and LSTM for given data.
4. Experiment with Deep learning algorithms in NLP Applications .
5. Experiment with Pretrained networks and advanced deep neural networks

Course Contents:

Section 1: Basics of Deep learning and Convolutional Neural Networks

Linear Algebra, Artificial intelligence, machine learning, and deep learning, mathematical building blocks of neural networks, binary classification, a multiclass classification, Confusion Matrix for multi class classifiers. Understanding convolutional neural networks (convnets), Using a pre trained convnet, Visualizing what convnets learn

Section 2: Deep learning for sequential data and Recurrent Neural Networks

Working with text data, One-hot encoding of words and characters, Using word embeddings, Understanding recurrent neural networks, Understanding the LSTM and GRU layers, Deep Learning in Question Answering over Knowledge Base, Deep Learning in Machine Comprehension, Deep Learning in Sentiment Analysis

Section 3: Deep Learning for Complex Problems and Aututoencoders

Text generation with Long short term memory (LSTM) , Generative Adversarial Networks Generative recurrent networks, Text processing with LSTM, Generating images with autoencoders, Deep Learning for Board Games

Text Books:

1. "Deep Learning: A Practical Approach Using Python", François Chollet, ISBN : 13-9781617294433, MANNING publishing, Ist edition, 2021

2. "Python Deep Learning, Next generation techniques to revolutionize computer vision, AI, speech and data analysis", Valentino Zocca, Gianmario Spacagna, Daniel Slater, Peter Roelants, , Packt Publishing, Ist edition, 2017, ISBN: 13- 978-1786464453

3. "Deep Learning for Natural Language Processing", Jason Brownlee, 2017 Jason Brownlee. All Rights Reserved. Edition: v1.1 (eBook), ISBN : 9789352136094

4. "Deep Learning in Natural Language Processing", Li Deng , Yang Liu, Springer Nature, 2018, ISBN 978-981-10-5208-8 (eBook)

Reference Books:

1. "Deep Learning Using Python", S Lovelyn Rose, L Ashok Kumar, D Karthika Renuka, Wiley Publisher, 2019, ISBN: 13- 978-812657991
2. "Deep Learning", Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press Ltd., 2017, ISBN: 9780262035613
3. "Deep Learning – A Practitioner's approach", Josh Patterson and Adam Gibson, O'Reilly Publication, 1st edition , 2017 ISBN : 9789352136049

Web resources:

https://d2l.ai/d2l-en.pdf: Dive into Deep Learning Release 0.16.5, Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola Jun,

http://ling.snu.ac.kr/class/AI_Agent/deep_learning_for_nlp.pdf: Deep Learning for Natural Language Processing, Jason Brownlee.

20HDM801L Deep Learning and Applications Laboratory

Teaching Scheme
Practical: 2 Hours / Week

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

The laboratory work for the Deep Learning and Applications (DLA) course includes implementation of deep neural network models for various applications. Students will work on image data and sequential data in the assignment. Students are encouraged to do variation in data for the assignments. Students will experiment with values of parameters/ hyper parameters and parameters in models for better accuracy. DLA aspirants will select a deep neural network model and data of their interest implemented in earlier assignments to write one paper as a part of the last assignment. In this assignment they are expected to do literature study from similar domains and compare their results with already existing research done by other researchers.

Suggestive List of Assignments

Benchmark Datasets for Research:
https://www.kaggle.com/sudalairajkumar/novel-corona-virus-2019-dataset
- **https://www.kaggle.com/imdevskp/corona-virus-report**
- **https://data.humdata.org/dataset**
- **https://ieee-dataport.org/open-access/corona-virus-covid-19-tweets-dataset**
- **https://data.world/datasets/covid-19Datasets**
- **https://github.com/datasets/covid-19**
- **https://www.dimensions.ai/news/dimensions-is-facilitating-access-to-covid-19-research/**
- **https://www.sirm.org/category/senza-categoria/covid-19/**
- **https://dev.to/anujgupta/google-s-25-million-datasets-a-perfect-gift-for-aspiring-datascientists-3ekh**
- **https://github.com/CSSEGISandData/COVID-19**
- **https://www.kaggle.com/manoj9april/imbd-sentiment-classification-dataset**
- **https://www.kaggle.com/c/digit-recognizer/data**

--Experiment with Data representations for neural networks:Manipulating tensors, tensor operations
--Training a convnet from scratch on a small dataset
--Experiment with pre trained convnet to visualizing what convnets learn: Implement CNN for given data : Classification of characters
–Implement model for word embeddings using IMDB data, train and evaluate
--Implement RNN for given data: Speech recognition or similar application
--Experiment with Pretrained networks/ autoencoders
--Prepare paper for: work with online/ real time data and any DL technique

Autonomous Program Structure
B.Tech in Information Technology
with **Honors Degree Programme** in
FULL STACK DEVELOPMENT
Academic Year: 2022-2023 Onwards

Course Code	Year And Semester	Course Title	Teaching Scheme Hours /Week			Marks	Credit
			Lecture	Tutorial	Practical		
20HFS501	TY Sem I	User Experience	3	0	0	100	3
20HFS502	TY Sem I	Front-End Technology	3	0	0	100	3
20HFS502L	TY Sem I	Full stack Development Lab 1	0	0	2	50	1
20HFS601	TY Sem II	Server Side Technology	3	1	0	100	4
20HFS601L	TY Sem II	Full stack Development Lab 2	0	0	4	50	2
20HFS801	Final Year Sem II	Full Stack Integration	3	0	0	100	3
20HFS801L	Final Year Sem II	Full stack Development Lab 3	0	0	4	50	2
		Total	**12**	**1**	**10**	**550**	**18**
		Grand Total	**23**			**550**	**18**

20HFS501 User Experience

Teaching Scheme:

Lectures: 3 hours/week

Tutorial :--

Examination Scheme:

In-Semester: 50 Marks

End-Semester: 50 marks

Credits: 3

Prerequisites: Object Oriented Technology

Course Objectives:

Familiarize students with

1. Foundations of User Experience.
2. Understanding of the guidelines and principles related to user-centered design
3. The importance of User Experience research.
4. Trending applications where User Experience plays a key role

Course Outcomes:

Students will be able to:

1. Identify the user's perspective to provide a design solution.
2. Make use of UX research to arrive at a solution for a given problem.
3. Interpret user experience with the usage of different methods.
4. Recommend a suitable design for a real-life application. .

Unit – I Introduction to User Experience (UX) 7

Defining User Experience, Understanding UX, The elements of engaging UX, The Disciplines of User Experience, UX from the Business Perspective, Focusing on the user, Perception Bias, Aspects of Product Experience, UX Psychology, Contextual enquiry, Interviews, journey mapping

Unit – II Building Empathy 8

User Research, Building Upon the Foundations of User Research, Empathy Mapping, Modeling Personas, Demographics, User stories, Scenarios and Case studies

Unit – III UX Research 9

Research methods: qualitative, quantitative, Competitive research, Triangulation approach, exploratory approach, explanatory approach, Affinity mapping, Ethnography, usability testing: usability labs, cognitive walkthroughs, longitudinal diary studies

Unit – IV UX Design 9

Importance of UX Design, Design thinking process: 5 steps of design thinking, Layout designs: ratios and perspectives, Wireframing: versioning of wireframes, pencil sketches, digital lo fidelity, digital hi fidelity, Prototyping: static high fidelity, functional clickable versions, Mood boards, Iconography (which icons to use and where), typography (which fonts to use and how to use)

Unit – V UX User experience domain trending topics 9

Accessibility design, Age focused UX design, UX for AI bots and chatbots, Designing for curiosity, UX for social media, UX information architecture, UX for Virtual reality, UX for transportation and sustainable energy domain, UX for augmented reality, UX for calling and virtual work platforms, Ethics in UX

Text Books

1. Westley Knight, **"**UX for Developers: How to Integrate User-Centered Design Principles into Your Day-to-Day Development Work"**,** *Apress* (1st South Asian Edition), (2019)
2. David Benyon "Designing Interactive Systems: A comprehensive guide to HCI, UX and interaction design", Pearson Education Limited, Third Edition (2014)

Reference Books

1. Dave Lull, "Discussions in User Experience: Healthcare for User Frustration", *Apress*
2. Jeff Johnson, "Designing with the Mind in Mind".
3. Edward Stull, "UX Fundamentals for Non-UX Professionals", *Apress*
4. Alan Cooper, Robert Reimann, and Dave Cronin, "About Face 3: The Essentials of Interaction Design", Wiley Publishing, Inc.
5. Jeff Johnson, "Designing with the Mind in Mind: Simple Guide to Understanding User Interface Design Guidelines", Elsevier. ISBN 978-0-12-411556-9.
6. Jonathan Anderson, John McRee, Robb Wilson, and the Effective UI Team, "Effective UI", O'Reilly
7. Elizabeth Goodman, Mike Kuniavsky, Andrea Moed, "Observing the User Experience, Second Edition_ A Practitioner's Guide to User Research"
8. Jesmond Allen, James Chudley, "Smashing UX Design_ Foundations for Designing

Online User Experiences", Wiley Publication

20HFS502 Front End Technologies

Teaching Scheme:

Lectures: 3 hours/week

Tutorial :-

Examination Scheme:

In-Semester: 50 Marks

End-Semester: 50 marks

Credits: 3

Prerequisites: Basic understating of programming languages

Course Objectives:

Familiarize students with

1. Structuring and designing the web page.
2. Scripting the web page for better communication.
3. Front end technologies like HTML, JavaScript.
4. Framework technologies like react

Course Outcomes:

Students will be able to:

1. Apply concepts of markup language for a given problem.
2. Make use of scripting language to provide solutions for web applications.
3. Decide solutions for frontend development.
4. Choose an appropriate technology for a given problem.

Unit – I HTML **7**

HTML-Introduction, HTML-Basic Formatting Tags, HTML-Grouping Using Div Span, HTML-Lists, HTML-Images, HTML-Hyperlink, HTML-Table, HTML-Table, HTML-Form, HTML-Headers, HTML-Miscellaneous, HTML 5.

Dynamic HTML: Introduction of DHTML, CSS of DHTML, Event Handling, Data Binding, Browser Object Models.

Unit – II CSS **8**

Introduction, Syntax, Selectors, Color Background Cursor, CSS2-Text Fonts, CSS2-Lists Tables, Pagination in table, cache for client-side applications, CSS2-Box Model, CSS2-Display Positioning, CSS Floats, CSS 3, Media Queries,

Bootstrap:

Why Bootstrap, CSS over Bootstrap, How to use Bootstrap, Bootstrap grid system, bootstrap responsive, Bootstrap classes, components, Bootstrap as a cross platform.

Unit – III Java Script **9**

Introduction to JavaScript, Java Script Language Basics and Objects, Events, Strings, Numbers, Math, Arrays, Boolean, Comparisons, Conditions, Switch, Loops, Type Conversion, RegExp, Hoisting, Strict Mode, Functions, Objects, Forms, HTML DOM, BOM

Unit – IV Introduction to React JS **9**

What is react? React components, transforming LSX into JavaScript Obstacles and Roadblocks, working with the Files, Declaring Variables in ES6, ES6 Objects and Arrays, ES6 Modules, Imperative Versus Declarative function programming

Unit – V Pure React **9**

Page Setup, The Virtual DOM, React Elements, React DOM, Children, Constructing Elements with Data, React Components, DOM Rendering, Factories.

React with JSX: react elements as JSX, Babel, Redux, React Redux, session management and REST calls through React

Text Books

1. "Web Technologies Black Book: HTML, JavaScript, PHP, Java, JSP, XML and AJAX" by Kogent Learning Solutions Inc.
2. "jQuery Mobile Web Development Essentials", Raymond Camden, Andy Matthews, 3rd edition
3. "Learning React", Alex Banks and Eve Porcello.

Reference Books

1. Dr. Hiren Joshi, Web Technology and Application Development, DreamTech, ISBN: 978-93-5004-088-1
2. Steven M. Schafer, "HTML, XHTML and CSS", Fourth Edition, Wiley India Edition. ISBN: 978-81-265-1635-3
3. Kogent Learning Solutions Inc., "HTML 5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery) "2Ed.
4. Laura Lemay, Rafe Colburn, Jennifer Kyrnin, "Mastering HTML, CSS & Javascript Web Publishing"

20HFS502L Full Stack Development Laboratory- 1

Teaching Scheme:

Practical: 2 hours/week

Examination Scheme:

In-Semester: 25 Marks

Practical: 25 marks

Credits: 1

Prerequisites: Basic understating of programming languages

Course Objectives:

Familiarize students with

1. Structuring and designing the web page.
2. Scripting the web page for better communication.
3. Front end technologies like HTML, JavaScript.
4. Framework technologies like react

Course Outcomes:

Students will be able to:

1. Design given problem using HTML and CSS.
2. Apply scripting language to provide solutions for web applications.
3. Decide solutions for frontend development.
4. Develop application using the required technologies.

Part A:

Assignment 1:

Create interactive web pages using HTML, CSS and Bootstrap. Choose any domain for designing web pages.

Assignment 2:

i) Write a Java script program to create a simple calculator.

ii) Write a JavaScript program to check empty fields of registration form and validate the fields of registration form.

Assignment 3:

i) Create React App package to instantiate a directory to hold and run the calculator app.

ii) Create React weather app that can display a 5-day weather forecast with all the basic functions, including city name, current weather icon, temperature, humidity, wind speed, etc. It must display the recording of high and low temperatures of each day, including images for sunny/ rainy/ cloudy/ snowy weather conditions.

Part B:

Develop a web application using front end technologies in any domain

Text Books

1. "Web Technologies Black Book: HTML, JavaScript, PHP, Java, JSP, XML and AJAX" by Kogent Learning Solutions Inc.
2. "jQuery Mobile Web Development Essentials", Raymond Camden, Andy Matthews, 3rd edition
3. "Learning React", Alex Banks and Eve Porcello.

Reference Books

1. Dr. Hiren Joshi, Web Technology and Application Development, DreamTech, ISBN: 978-93-5004-088-1
2. Steven M. Schafer, "HTML, XHTML and CSS", Fourth Edition, Wiley India Edition. ISBN: 978-81-265-1635-3
3. Kogent Learning Solutions Inc., "HTML 5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery) "2Ed.
4. Laura Lemay, Rafe Colburn, Jennifer Kyrnin, "Mastering HTML, CSS & Javascript Web Publishing"

E learning References:

1. https://www.w3schools.com/html/default.asp
2. https://www.w3schools.com/css/default.asp
3. https://codersera.com/blog/reactjs-projects-for-beginners/
4. https://www.w3schools.com/bootstrap
5. https://www.w3schools.com/js/default.asp

6. https://www.w3schools.com/html/default.asp

20HFS601 Server Side Technology

Teaching Scheme:

Lectures: 3 hours/week

Tutorial: 1 Hour/Week

Examination Scheme:

In-Semester: 50 Marks

End-Semester: 50 marks

Credits: 4

Prerequisites: Basic Knowledge of JavaScript, Object Oriented Programming

Course Objectives:

Familiarize students with

1. Technical concepts behind Server side technology
2. Structure an Server side technology based application in modules
3. Buffers, Streams, and Pipes
4. Building a web application and API

Course Outcomes:

Students will be able to:

1. Structure a server side technology based application in modules
2. Manage packages, frameworks and events for server side technology
3. Build a web Server to develop web application
4. Establish database access

Unit – I Introduction **7**

Traditional Web Server Model, What is Node JS?, advantages,Node.js Process Model, Installation of Node.js, Working in REPL, Node JS Console, Asynchronous and non-blocking I/O

Unit – II Modules and package manager **7**

Node JS modules: Functions, Buffer, Module, Module Types, Core Modules, Local Modules, Module. Exports, Node Package Manager (NPM): introduction to NPM, package installations, handling dependency in package.json

Unit – III Web server development and file system 7

Creating web server, Handling http requests, Sending requests File system: Fs.readFile, Writing a File, Writing a file asynchronously, Opening a file, Deleting a file, Other IO Operation

Unit – IV Events and Framework 7

Events: classes, returning emitters, inheriting events, Express Framework: route Configuration, working with express, serving static files, Working with middle ware

Unit – V Database connectivity 7

Introduction to different data storage: JSON, MongoDB, parameters to choose correct database for full stack, setting up connection string, Configuration, performing CRUD operations, Commands for CRUD operations

Unit – VI Template Engines 7

Two-way data binding, appending dynamic data to the webpage, view engines and their syntax, Why Template Engine, introduction to Jade, introduction to Vash, Examples

Text Books

1. Alex Young et.al, "Node.js in Action", Second Edition, Dreamtech press publication, ISBN: 978-93-86052-04-9, 2017
2. Ethan Brown, "Web Development with Node and Express: Leveraging the JavaScript Stack", 2nd Edition, O'Reilly Media, ISBN: 978-1492053514, 2019
3. Kristina Chodorow, "MongoDB: The definitive Guide", Second Edition, O'Reilly Media, ISBN:978-93-5110-269-4, 2013

Reference Books

1. Greg Lim, "Beginning Node.js, Express & MongoDB Development Paperback", ISBN: 978-1078379557, 2019
2. Jonathan Wexler, "Get Programming with Node.js" ISBN: 9781617294747, February 2019 Kogent Learning Solutions Inc., "HTML 5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery) "2Ed.
3. Laura Lemay, Rafe Colburn, Jennifer Kyrnin, "Mastering HTML, CSS & Javascript Web Publishing"

20HFS601L Full Stack Development Laboratory -2

Teaching Scheme:

Practical: 4 hours/week

Examination Scheme:

In-Semester: 25 Marks

Practical: 25 marks

Credits: 2

Prerequisites: Basic Knowledge of JavaScript, Object Oriented Programming

Course Objectives:

Familiarize students with

1. Implementation concepts behind Server side technology
2. Structure an Server side technology based application in modules
3. Buffers, Streams, and Pipes
4. Building a web application and API

Course Outcomes:

Students will be able to:

1. Create modules
2. Manage node packages, frameworks and events
3. Build a web Server to develop web application
4. Establish database access

Design and implement a small mini project using following concepts of Server side technology

1.Creating Modules
2. Packages, framework and events
3.Building web server for web application
4. Establishing connectivity with backend

Text Books

1. Alex Young et.al, "Node.js in Action", Second Edition, Dreamtech press publication, ISBN: 978-93-86052-04-9, 2017
2. Ethan Brown, "Web Development with Node and Express: Leveraging the JavaScript Stack", 2nd Edition, O'Reilly Media, ISBN: 978-1492053514, 2019
3. Kristina Chodorow, "MongoDB: The definitive Guide", Second Edition, O'Reilly Media, ISBN:978-93-5110-269-4, 2013

Reference Books

1. Greg Lim, "Beginning Node.js, Express & MongoDB Development Paperback", ISBN: 978-1078379557, 2019
2. Jonathan Wexler, "Get Programming with Node.js" ISBN: 9781617294747, February 2019 Kogent Learning Solutions Inc., "HTML 5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery) "2Ed.
3. Laura Lemay, Rafe Colburn, Jennifer Kyrnin, "Mastering HTML, CSS & Javascript Web Publishing"

20HFS801 Full Stack Integration

Teaching Scheme:

Lectures: 3 hours/week

Examination Scheme:

In-Semester: 50 Marks

End-Semester: 50 marks

Credits: 3

Prerequisites: Front end and backend technologies

Course Objectives:

Familiarize students with

1. Web development environment
2. Database design and implementation in web development
3. Mobile app development
4. Deployment process on server

Course Outcomes:

Students will be able to:

1. Apply intermediate and advanced web development techniques.
2. Create visualizations in accordance with UI/UX theories
3. Implement mobile app development
4. Deploy a fully functioning website on a server

Unit – I Prepare web development environment and database design **7**

Deciding required tools & IDE, defining the stack, installing and using MongoDB, setting up modules, client and server-side configuration.

Unit – II Database implementation **7**

CRUD operations, Web tokens, Prepare storage structure, variables & scripts, Mongoose and MongoDB connectivity, CRUD API, Users and operations

Unit – III GUI Development **7**

Storage structure, required layer for development, add dependencies, Set home page, Set theme, integration of backend, setting the server.

Unit – IV Mobile App development **7**

Introduction to react native, rendering lifecycle, JSX, styling components, making environment ready, create a mobile app, using android, running the app, make the app interactive using data and images.

Unit – V Components for mobile & Styles **7**

HTML elements and native components, user interface, buttons, navigation, list, styling in react native, style objects, positioning

Unit – VI Cloud based Web Services **7**

Introduction to Cloud based web services, cloud computing, cloud services, identity and access management, Web services for various mobile application platform

Text Books

2. Shama Hoque, "Full stack REACT Projects", Packt Publications. ISBN: 9781788835534
3. Bonnie Eisenman, "Learning React Native", O'Reilly Media, Inc. ISBN: 8781491989142

Reference Books

1. Allen B. Downey, "Amazon web services for mobile developers", Sybex Publications, ISBN: 9781119377856

20HFS801L Full Stack Development Laboratory -3

Teaching Scheme:
Practical: 4 hours/week

Examination Scheme:
In-Semester: 25 Marks
Practical: 25 marks
Credits: 2

Prerequisites: Front end and backend technologies

Course Objectives:

Familiarize students with

1. Web development environment
2. Database design and implementation in web development
3. Mobile app development.
4. Web development process on cloud

Course Outcomes:

Students will be able to:

1. Apply modern web development tools.
2. Design interactive user interface.
3. Develop an application using mobile platform
4. Deploy an interactive web site using cloud technology.

Design and implement a small mini project using following concepts of full stack Integration

1. Database environment
2. GUI development
3. Mobile app development.
4. Deployment on local web server like Tomcat
5. AWS or similar cloud service.

Text Books

1. Shama Hoque, "Full stack REACT Projects", Packt Publications. ISBN: 9781788835534
2. Bonnie Eisenman, "Learning React Native", O'Reilly Media, Inc. ISBN: 8781491989142

Reference Books

4. Allen B. Downey, "Amazon web services for mobile developers", Sybex Publications, ISBN: 9781119377856

Autonomous Program Structure
B.Tech in Electronics and Telecommunication
Honors Degree Programme in
DATA SCIENCE
Academic Year: 2022-2023 Onwards

Course Code	Year and Semester	Course Title	Teaching Scheme Hours /Week			Marks	Credit
			Lecture	Tutorial	Practical		
20HDS501	TY Sem-I	Introduction to Data Science	3	0	0	100	3
20HDS502	TY Sem-I	Statistics for Data Science	3	0	0	100	3
20HDS501L	TY Sem-I	Data Science Lab	0	0	2	50	1
20HDS601	TY Sem-II	Deep Learning	3	0	0	100	3
20HDS602	TY Sem-II	Web Data Mining	3	0	0	100	3
20HDS601L	TY Sem-II	Deep learning Lab	0	0	2	50	1
20HDS801	Final Year Sem-II	Big Data Analytics	3	0	0	100	3
20HDS801L	Final Year Sem-II	Big Data Analytics Lab	0	0	2	50	1
		Total	**15**	**0**	**6**	**650**	**18**
		Grand Total	**21**			**650**	**18**

20HDS501 INTRODUCTION TO DATA SCIENCE

Teaching Scheme

Lectures: 3 Hours / Week

Examination Scheme

ISE: 50 Marks

ESE: 50 Marks

Credits: 3

Course Objectives:

1. To provide the knowledge and expertise to become a proficient data scientist
2. Demonstrate an understanding of statistics and machine learning concepts that are vital for data science
3. Write Python codes to perform statistical analysis
4. Evaluate data visualizations based on their design and use for communicating stories from data

Course Outcomes:

After completion of the course, students will be able to

CO1 Explain how data is collected, managed, and stored for Data Science

CO2 Explain the significance of exploratory data analysis (EDA) and analyze the data

CO3 Apply feature generation approaches and feature selection algorithms

CO4 Apply effective data visualization tools

CO5 Discuss privacy and ethical issues in Data Science

Unit I: Introduction to Data Science (08)

Introduction to Data Science, Different Sectors using Data science, Purpose, and Components of Python in Data Science.

Unit II: Data Analysis (09)

Data Analytics Process, Knowledge Check, Exploratory Data Analysis (EDA), EDA-Quantitative techniques, EDA- Graphical Techniques, Data Analytics- Conclusion, and Predictions.

Unit III: Feature Generation and Selection (09)

Feature Generation and Feature Selection (Extracting Meaning from Data), Motivating applications: user (customer) retention, Feature Generation (brainstorming, the role of domain

expertise, and place for imagination), Feature Selection algorithms.

Unit IV: Data Visualization (08)

Data Visualization- Basic principles, ideas, and tools for data visualization, Examples of inspiring (industry) projects, Exercise: create your own visualization of a complex dataset.

Unit V: Applications of Data Science (08)

Applications of Data Science, Data Science and Ethical Issues, Discussions on privacy, security, ethics, A look back at Data Science- Next-generation data scientists.

Text Books:

1. U. Dinesh Kumar, "**Business Analytics: The Science of Data-Driven Decision Making**", *John Wiley & Sons*, (1st Edition), (2017).
2. Davy Cielen, Arno D. B. Meysman, Mohamed Ali, "**Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools**", *Manning Publications*, (2016).
3. Joel Grus, "**Data Science from Scratch**", *Shroff Publisher/O'Reilly Publisher Media*, (2nd Edition), (2019).
4. Annalyn Ng, Kenneth Soo, "**Numsense! Data Science for the Layman**", *Shroff Publisher*, (2018).

Reference Books:

1. Cathy O'Neil and Rachel Schutt, "**Doing Data Science, Straight Talk From The Frontline**", *O'Reilly Publisher*, (1st Edition), 2013.
2. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman, "**Mining of Massive Datasets**" v2.1, *Cambridge University Press*, (2014).
3. Jake VanderPlas, "**Python Data Science Handbook**", *Shroff Publisher/O'Reilly Publisher Media,* (2016).
4. Philipp Janert, "**Data Analysis with Open Source Tools**", *Shroff Publisher/O'Reilly Publisher Media,* (2010).

Online Resources:

1. NPTEL Course: **"Data Science for Engineers"** https://onlinecourses.nptel.ac.in/noc22_cs28/preview
2. NPTEL Course: **"Essential of Data Science with R"** https://nptel.ac.in/courses/111/104/111104146/
3. https://ocw.mit.edu/courses/sloan-school-of-management/15-071-the-analytics-edge-spring-2017/visualization/

20HDS502 STATISTICS FOR DATA SCIENCE

Teaching Scheme

Lectures: 3 Hours / Week

Examination Scheme

ISE: 50 Marks

ESE: 50 Marks

Credits: 3

Prerequisite: 20BSEC301 Calculus and Probability

Course Objectives:

1. To explain axioms, rules in probability and distribution models.
2. To learn various statistical measures.
3. To explore hypothesis tests.
4. To illustrate multivariate analysis

Course Outcomes:

After completion of the course, students will be able to

CO1 Interpret the fundamental concepts of probability and probability distribution models

CO2 Compute mean, variation, skewness on given data

CO3 Apply hypothesis tests for data science

CO4 Interpret regression, correlation analysis, forecasting

Unit I: Probability and Distribution Models (10)

The axiomatic definitions of probability, Conditional probability and independent event, Multiplication rule, Bayes' Theorem, Probability distribution - Discrete Variable, Continuous Variable.

Unit II: Statistical Measures (11)

Measures of Central Tendency: Arithmetic Mean, Weighted Arithmetic Mean, Median, Geometric and Harmonic Mean, Measurement of Variation: Quartile, Average and Standard Deviations, Coefficient Variation, Measurement of Skewness.

Unit III: Tests of Hypothesis (10)

Tests of Hypothesis, z-test, t-test, Hypothesis Concerning Variations, ANOVA, Chi-square tests, Goodness of Fit Test.

Unit IV: Multivariate Analysis (11)

Correlation Analysis, Forecasting, Linear Regression, Principal Component Analysis, Discriminant Analysis, Factor Analysis, Bayesian Inference.

Text Books:

1. Ronald E. Walpole, Raymond H. Myers, **"Probability and Statistics for Engineers and Scientists",** *Pearson Education,* (9th Edition), (2012).
2. P. Z. Peebles**, "Probability, Random Variables and Random Signal Principles",** *Tata McGraw-Hill,* (4thEdition), (2013)**.**
3. R. Panneerselvam, **"Research Methodology"**, *PHI Learning Private Limited,* (2ndEdition), (2014).

Reference Books:

1. Rohatgi A. K., Md. E. Saleh**, "Introduction to Probability and Statistics",** *Wiley Publication Pvt. Ltd*., (3rdEdition), (2015).
2. Nina Zumel, John Mount, "**Practical Data Science with R**", *Wiley & Sons*,(April 2014).
3. Hadley Wickham, Garret Grolemund, "**R for Data Science**", *Shroff Publisher/ O'Reilly Publisher,* (2016).

Online Resources:

1. NPTEL Course: **"Probability and Statistics"** https://nptel.ac.in/courses/111/105/111105090/
2. NPTEL Course: **"Essential of Data Science with R"** https://nptel.ac.in/courses/111/104/111104146/

20HDS501L DATA SCIENCE LAB

Teaching Scheme

Practical: 2 Hours/ Week

Examination Scheme

ESE: 50 Marks

Credits: 1

Course Objectives:

1. Write Python/R codes to perform data preparation, manipulation, and statistical analysis
2. Implement data visualization methods
3. Apply hypothesis tests on data and draw conclusions

Course Outcomes:

After completion of the course, students will be able to

CO 1 Perform exploratory data analysis (EDA) on different datasets

CO 2 Create effective visualization of given data

CO 3 Perform statistical analysis for given data

CO 4 Conduct hypothesis tests and analyze the data

List of Experiments:

1. Write a program in Python/R to perform exploratory data analysis on a given .csv dataset
2. Perform data visualization by plotting the various distributions for given data sets.
3. Calculate measures of central tendency for a set of data.
4. Verify the ANOVA test for a set of data.
5. Apply Chi-Square test to given data.
6. Analyze multivariate data using PCA.

20HDS601 DEEP LEARNING

Teaching Scheme

Lectures: 3 Hours / Week

Examination Scheme

ISE: 50 Marks

ESE: 50 Marks

Credits: 3

Prerequisite: 20EC403 Machine Learning with Python

Course Objectives:

1. To introduce basic concepts and learning algorithms of Artificial Neural Networks
2. To become familiar with feedforward and recurrent neural networks
3. To build Convolutional Neural Network (CNN) model and elaborate effects of hyperparameters on its performance
4. To get a detailed insight into deep learning algorithms and their applications to solve real-world problems

Course Outcomes:

After completion of the course, students will be able to

CO1 Explain basic concepts of neural networks and its learning algorithms

CO2 Calculate feature map dimensions and learnable parameters in Convolutional Neural Network (CNN)

CO3 Analyze effects of hyperparameter tuning on the performance of L-layer deep networks and interpret results

CO4 Solve image recognition and classification problems using pre-trained CNN architectures

CO5 Compare recurrent neural networks, their types for sequence data processing and explain gradient issues

CO6 Design deep neural network architectures to solve real-world problems

Unit I: Basics of Artificial Neural Network (09)

Biological neuron, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron learning algorithm, Linear separability, Activation functions, Feedforward networks: Multilayer Perceptron, Gradient Descent, Backpropagation.

Unit II: Deep Neural Networks (09)

Deep feedforward networks, Architecture design, Gradient based learning, Vanishing and exploding gradients, Regularization, Optimization methods (AdaGrad, AdaDelta, RMSProp, Adam, NAG) for training deep models, Hyperparameters.

Unit III: Convolutional Neural Networks (09)

Building blocks of Convolutional Neural Network (CNN), Convolution operation and layer, Kernels, and Filters, Pooling layer, Stacking of layers, Cross-validation, Data augmentation, Transfer learning, Modern CNN architectures: AlexNet, VGGNet, GoogleNet, ResNet.

Unit IV: Sequence Modeling (09)

Recurrent Neural Network (RNN), Types of RNN, Bidirectional RNNs, Backpropagation through time (BPTT), Vanishing Gradients with RNNs, Gated Recurrent Unit (GRU), Long Short-Term Memory (LSTM).

Unit V: Applications of Deep Learning (06)

Applications of CNN: Object recognition, Image classification.

Applications of RNN: Speech, language, and text processing.

Text Books:

1. Laurene Fausett, **"Fundamentals of Neural Networks: Architectures, Algorithms and Applications"**, *Pearson Education*, (1st Edition), (2008).
2. S. N. Sivanandan and S. N. Deepa, **"Principles of Soft Computing"**, *Wiley India*, (2nd Edition), (2011).
3. Ian Goodfellow, Yoshua Bengio and Aaron Courville, **"Deep Learning"**, *MIT Press*, (1st Edition), (2016).
4. Josh Patterson and Adam Gibson, **"Deep Learning- A Practitioner's Approach"**, *O'Reilly Media*, (1st Edition), (2017).

Reference Books:

1. Francois Chollet, **"Deep Learning with Python"**, *Manning Publications*, (2018).
2. Phil Kim, **"MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence"**, *Apress*, (2017).

Online Resources:

1. NPTEL Course: **"Fuzzy Logic and Neural Networks"**
   https://onlinecourses.nptel.ac.in/noc21_ge07/preview
2. NPTEL Course: **"Deep Learning"**
   https://onlinecourses.nptel.ac.in/noc21_cs76/preview

20HDS602 WEB DATA MINING

Teaching Scheme

Lectures: 3 Hours / Week

Examination Scheme

ISE: 50 Marks

ESE: 50 Marks

Credits: 3

Course Objectives:

1. Understand the concepts of data mining
2. Understand and implement classical models and algorithms in data mining
3. Characterize the kinds of patterns that can be discovered by association rule mining, classification, and clustering
4. Develop skills in selecting the appropriate data mining algorithm for solving practical problems

Course Outcomes:

After completion of the course, students will be able to

1. Explain the functionality of the various data mining components
2. Appreciate the strengths and limitations of various data mining models
3. Describe different methodologies used in data mining
4. Compare different approaches of data mining with various technologies

Unit I: Basics of Data Mining (09)

Introduction to internet and WWW, Data Mining Foundations, Association Rules, and Sequential Patterns, Basic Concepts of Association Rules, Apriori Algorithm, Frequent Itemset Generation, Association Rule Generation, Data Formats for Association Rule Mining, Mining with multiple minimum supports, Extended Model, Mining, Rule Generation.

Unit II: Sequential Patterns (08)

Mining Class Association Rules, Basic Concepts of Sequential Patterns, Mining Sequential Patterns on GSP, Mining Sequential Patterns on Prefix Span, Generating Rules from Sequential Patterns.

Unit III: Information Retrieval (09)

Concepts of Information Retrieval, IR Methods, Boolean Model, Vector Space Model, and Statistical Language Model, Relevance Feedback, Evaluation Measures, Text and Web Page Pre-processing, Stop word Removal, Stemming, Web Page Pre-processing, Duplicate Detection, Inverted Index and Its Compression, Inverted Index, Search using Inverted Index, Index Construction, Index Compression, Latent Semantic Indexing, Singular Value Decomposition, Query and Retrieval, Web Search, Meta Search, Web Spamming.

Unit IV: Social Network Analysis (08)

Link Analysis, Social Network Analysis, Co-Citation and Bibliographic Coupling, Page Rank Algorithm, HITS Algorithm, Commodities Discovery, Problem Definition, Bipartite Core Commodities, Maximum Flow Commodities, Email Commodities, Web Crawling, A Basic Crawler Algorithm – Breadth-First Crawlers, Preferential Crawlers, Implementation Issues – Fetching, Parsing, Stop word Removal, Link Extraction, Spider Traps, Page Repository, Universal Crawlers, Focused Crawlers, Topical Crawlers, Crawler Ethics, and Conflicts.

Unit V: Sentiment and Text Classification (08)

Opinion Mining, Sentiment Classification, Classification based on Sentiment Phrases, Classification Using Text Classification Methods, Feature-based Opinion Mining and Summarization, Problem Definition, Object feature extraction, Comparative Sentence, and Relation Mining, Opinion Search and Opinion Spam. Web Usage Mining, Data Collection and Preprocessing, Sources and Types of Data, Key Elements of Web Usage Data Pre-processing, Data Modeling for Web Usage Mining, Discovery and Analysis of Web Usage Patterns, Session and Visitor Analysis, Cluster Analysis and Visitor Segmentation, Association and Correlation Analysis, Analysis of Sequential and Navigation Patterns.

Text Books:

1. Soumen Chakrabarti, **"Mining the Web: Discovering Knowledge from Hypertext Data"**, *Morgan Kaufmann Publishers*, (1st Edition), (2002).
2. Bing Liu, **"Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data"**, *Springer Publications*, (2nd Edition), (2011).
3. Jiawei Han, Micheline Kamber, **"Data Mining: Concepts and Techniques"**, *Elsevier Publications*, (2ndEdition), 2010.

Reference Books:

1. Anthony Scime, **"Web Mining: Applications and Techniques"**, *Idea Group Publisher*, 2005.
2. Kowalski, Gerald, Mark T Maybury, **"Information Retrieval Systems: Theory andImplementation"**, *Kluwer Academic Press*, (2nd Edition), 1997.
3. Parteek Bhatia, **"Data Mining and Data Warehousing Principles and Practical Techniques"**, *Cambridge University Press*, (2019)

Online Resources:

1. NPTEL Course: **"Data Mining"**
   https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs12/
2. MIT Open Courseware: **"Data Mining"**
   https://ocw.mit.edu/courses/sloan-school-of-management/15-062-data-mining-spring-2003/lecture-notes/

20HDS601L DEEP LEARNING LAB

Teaching Scheme

Practical: 2 Hours / Week

Examination Scheme

ESE: 50 Marks

Credits: 1

Course Objectives:

1. To implement Artificial Neural Networks (ANN), Convolutional Neural Networks (CNN), and Recurrent Neural Networks (RNN)
2. To get familiar with deep learning frameworks and Python libraries used for Deep Learning
3. To apply ANN, CNN, and RNN algorithms to solve real-world problems

Course Outcomes:

After completion of the course, students will be able to

CO1 Apply neural network learning methods and transfer learning for classification/regression applications

CO2 Select a suitable Convolutional Neural Network architecture and hyperparameters to solve real-world image classification, object recognition problems

CO3 Develop an algorithm for text processing and time series prediction using Recurrent Neural Networks and Long Short-Term Memory

CO4 Analyze the performance of Deep Learning models based on different evaluation metrics

List of Experiments:

1. Introduction to Python libraries (Keras, TensorFlow) for deep learning.
2. Write a program to implement a Perceptron learning algorithm.
3. Write a program to perform classification using Backpropagation.
4. Develop an algorithm and write a program for image classification using a Convolutional Neural Network.
5. Write a program to implement image recognition using transfer learning.
6. Develop an algorithm and write a program for image classification using a Convolutional Neural Network.
7. Develop an algorithm and write a program to predict the stock prices based on historic data using Long Short-Term Memory/ Gated Recurrent Unit.
8. Develop an algorithm and write a program for text pre-processing and text summarization using Recurrent Neural Network.

20HDS801BIG DATA ANALYTICS

Teaching Scheme

Lectures: 3 Hours / Week

Examination Scheme

ISE: 50 Marks

ESE: 50 Marks

Credits: 3

Course Objectives:

1. To understand the concepts, challenges, and techniques of Big Data and Big Data Analytics
2. To introduce the concepts of Hadoop, MapReduce framework, and "R" for Big Data Analytics
3. To teach students to apply skills and tools to manage and analyze Big Data

Course Outcomes:

CO1 Design and manage a Big Data application using Hadoop technology framework

CO2 Collect, manage, store, query and analyze various forms of Big Data using Map-Reduce and other Big Data tools

CO3 Apply Big Data Analytics tools for business decisions and strategy definition

CO4 Implement solutions to some of the open Big Data problems using R

CO5 Compare various Data Analytic Methods and trends

Unit I: Introduction to Big Data and DBMS (08)

Database Management Systems, structured data, SQL, Big data overview, characteristics of Big Data, applications of Big Data, Unstructured data, NoSQL, advantages of NoSQL, Comparative study of SQL and NoSQL.

Unit II: Big Data Architecture: Hadoop (08)

Challenges enabling real-time big data processing, Hadoop – Introduction, building blocks of Hadoop, Installing and configuring Hadoop.

Unit III: MapReduce Fundamentals (09)

Components of Hadoop, HBASE, HIVE, MapReduce Working, the Mapper and Reducer, Input Formats and Output Formats, Introduction to HBASE, Sqoop, Spark.

Unit IV: Data Analytics Lifecycle (09)

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, Operationalize, Case Study: Global Innovation Network And Analysis (GINA).

Unit V: Big Data Visualization and Tools (08)

Open-source Tools / Techniques / Languages, Dashboard design, Case studies.

Text Books:

1. Vignesh Prajapati, "**Big Data Analytics with R and Hadoop**", *Packt Publishing*, (November 2013).
2. EMC Education Services (ed.),"**Data Science and Big Data Analytics"**, *Wiley*, (1st Edition), (January 2015).
3. Abraham Silberschatz, Henry Korth, S. Sudarshan, "**Database Systems Concepts**", *McGraw Hill Education (India) Pvt Ltd*, (6th Edition), (December 2013).

Reference Books:

1. Arvind Sathi, "**Big Data Analytics: Disruptive Technologies for Changing the Game**", *MC Press*, (November 2012).
2. Viktor Mayer-Schonberger, Kenneth Cukier, "**Big Data: A Revolution that will transform how we live, work, and think**", *Hodder and Stoughton*, (October 2013).
3. J. Hurwitz, Alan Nugent, Fern Halper, Marcia Kaufman, "**Big Data for Dummies**", *John Wiley & Sons, Inc.* (1st Edition), (April 2013).
4. Tom White, "**Hadoop: The Definitive Guide**", *O'Reilly*, (3rd Edition), (June 2012).

Online Resources:

NPTEL Course: "**Big Data Computing**"

https://nptel.ac.in/courses/106/104/106104189/

20HDS801L BIG DATA ANALYTICS LAB

Teaching Scheme

Practical: 2 Hours / Week

Examination Scheme

ESE: 50 Marks

Credits: 1

Course Objectives:

1. Learn the creation of a relational database management system and extract data using query language
2. Understand and use the NoSQL database
3. Study of various data analysis and visualization tools like Excel, Tableau.

Course Outcomes:

After completion of the course, students will be able to

CO1 Build a database and apply queries

CO2 Extracting data from a tool into a database and access through code

CO3 Build and analyze data using NoSQL database

CO4 Analyse and Visualize data using tools

List of Experiments:

1. Install SQLite /MySQL, create a database and write at least 10 SQL queries and execute them.
2. Connect the Excel File to MySQL via Python. Write a Python Program to connect the Excel Dataset to MySQL. Create a database in MySQL and add the Excel data in that database. Perform different SQL Queries on created Database
3. Installation and configuration of NOSQL (MongodB)
4. Installation and configuration of SQL with PHP
5. Perform data analysis and visualization using Tableau
6. Implement Quick Analysis in Excel

Autonomous Program Structure
B.Tech in Electronics and Telecommunication
Honors Degree Programme in
WIRELESS COMMUNICATION
Academic Year: 2022-2023 Onwards

Course Code	Year and Semester	Course Title	Teaching Scheme Hours /Week			Marks	Credit
			Lecture	Tutorial	Practical		
20HWC501	TY Sem-I	Mathematics for Communication systems	3	0	0	100	3
20HWC502	TY Sem-I	Advances in Digital Communications	3	0	0	100	3
20HWC502L	TY Sem-I	Advances in Digital Communications Lab	0	0	2	50	1
20HWC601	TY Sem-II	Smart Antennas for 5G Communications	3	0	0	100	3
20HWC602	TY Sem-II	Machine Learning for Wireless Communication	3	0	0	100	3
20HWC602L	TY Sem-II	Wireless Communication Lab	0	0	2	50	1
20HWC801	Final Year Sem-II	5G and Future Wireless Technologies	3	0	0	100	3
20HWC801L	Final Year Sem-II	5G and Future Wireless Technologies Lab	0	0	2	50	1
		Total	**15**	**0**	**6**	**650**	**18**
		Grand Total	**21**			**650**	**18**

20HWC501 Mathematics for Communication System

Teaching Scheme

Lectures: 3 Hours / Week

Examination Scheme

In Semester: 50 Marks

End Semester: 50 Marks

Credits: 3

Prerequisite: 20BS01: Linear Algebra and univariate calculus

20BSEC301: Calculus and Probability

Course Objectives:

1. To interpret the types and operations on matrices and various methods of solving systems of linear equations
2. To recognize the concepts of vector space, linear independence, basis, dimension and its applications
3. To describe probability and distribution models
4. To describe random process for communication system

Course Outcomes:

After completion of the course, students will be able to

CO1 Explain and apply transformations of matrices methods to solve the systems of linear equations

CO2 Explore vector spaces linear independence, basis, dimension, Matrix factorizations and its applications.

CO3 Interpret and Apply Probability Distribution for a communication system.

CO4 Formulate and solve communication problems involving random processes.

Unit I: Vector Spaces (10)

Vector spaces, Linear combination of vectors, Linear dependence, Basis and dimensions, finite-dimensional vector spaces, Linear Transformations. Norms and normed vector spaces, Inner products, and inner product spaces.

Unit II: Matrix Algebra (10)

Matrix factorizations, LU factorization, unitary matrices, and QR factorization. Eigenvalues and Eigenvectors, Linear dependence of Eigenvectors, diagonalization of a matrix. Singular value decomposition, pseudo inverses, and Singular Value Decomposition (SVD).

Unit III: Probability and Random Variables (09)

Probability, Conditional Probability, Probability, Conditional Probability, Concept of a Random Variable, Expected values for discrete and continuous random variables, Probability Density Function (PDF) vs Cumulative Distribution Function (CDF).

Unit IV Random Process (09)

Auto Correlation, Cross-Correlation, Stationary and wide sense stationary random process, Gaussian random process, Poisson random process.

Text Books:

1. Gilbert Strang, **"Linear Algebra and its Applications"**, *Cengage Learning*, (4th Edition), (2008)
2. Howard A, Chris R, **"Elementary Linear Algebra Applications Version"**, *Wiley-India*, (11th Edition), (2017).
3. A. Papoulis and S. Unnikrishnan Pillai, **"Probability, Random Variables and Stochastic Processes"**, *McGraw Hill*, (4th Edition), (2008).

Reference Books:

1. David Tse, Pramod Viswanath, **"Fundamentals of Wireless Communications"**, *Cambridge University Press*, (1stEdition), (2005).
2. Goldsmith, A., **"Wireless Communications"**, *Cambridge University Press*, (1stEdition), (2005).

Online Resources:

1. NPTEL Course "**Applied Linear Algebra for Signal Processing, Data Analytics and Machine Learning**",

   https://nptel.ac.in/courses/108/104/108104174/
2. NPTEL Course "**Applied Linear Algebra**",
   https://nptel.ac.in/courses/108/106/108106171/

20HWC502 ADVANCES IN DIGITAL COMMUNICATION

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 explain techniques and tools required for 4G and 5G Communications
2. To Investigate MIMO technology that offers a considerable increase in data bandwidth without any extra transmission power and Spatial modulation for achieving spectral and energy efficiency
3. To explain Channel estimation to provide information about the distortion of the transmission signal and the equalizers to remove the fading effect to restore originally transmitted signal.
4. To explain OFDM systems to mitigate the frequency selective fading in a multipath channel.
5. To explore LDPC and Turbo Codes for error correction capability in large block sizes transmitted via very noisy channels.

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

CO1 Interpret MIMO technology which offers a considerable increase in data bandwidth without any extra transmission power
CO2 Interpret Space–time coding techniques and diversity in channel estimation
CO3 Interpret Channel estimation which provides information about the distortion of the transmission signal and the equalizers to remove the fading effect to restore originally transmitted signal
CO4 Explain OFDM systems to mitigate the frequency selective fading in a multipath channel
CO5 Interpret and apply LDPC and Turbo Codes for error correction in large block sizes transmitted via very noisy channels

Unit I: MIMO System (08)

Introduction to MIMO Wireless Communications, MIMO System Model, Capacity limits of MIMO systems - Single user, multi-user, multi-cell, Precoding design - Transmit channel side information, A transmitter structure: Encoding structure, Linear precoding structure, Precoding design criteria.

Unit II: Space-Time Coding for Wireless Communications (08)

Space-time coding principles: space-time code design criteria, Space-time trellis codes (STTC), Space-time block codes (STBC), Diversity embedded space-time codes, Applications in channel estimation, Integration of equalization and decoding, Adaptive techniques.

Unit III: Channel Estimation and Equalization (08)

Channel Estimation, Linear equalization, Decision -feedback equalization, reduced complexity ML detectors, Iterative equalization, and decoding - Turbo equalization. Adaptive linear equalizer, adaptive decision feedback equalizer, Recursive least square algorithms for adaptive equalization.

Unit IV: Orthogonal Frequency Division Multiplexing (OFDM) (08)

OFDM Principles, PAPR Reduction Techniques, OFDM Time and Frequency Domain Synchronization, Multiuser OFDM Systems, OFDM based standards (LTE, WiMAX, WiFi, 802.22, multiband UWB).

Unit V: Error Correction Codes (08)

Turbo Codes - Turbo Encoding and Decoding Algorithm, Example of Turbo Encoding and Decoding, Hardware Implementation of Turbo Encoding and Decoding, Low-Density Parity-Check Codes -LDPC Encoding and Decoding Algorithms, Example of LDPC Encoding and Decoding, Hardware Implementation of LDPC Encoding and Decoding. Introduction to Polar codes.

Text Books:

1. E. Biglieri, R. Calderbank, A. Constantinides, A. Goldsmith, A. Paulraj, and H. V. Poor, **"MIMO Wireless Communications**", *Cambridge University Press*, (1st Edition), (2007).
2. Raed Mesleh, Abdel hamid Alhassi, "**Space Modulation Techniques",** *Wiley* (1stEdition), (2018).
3. Kim, Haesik, **"Wireless communications systems design",***Wiley*, (1st Edition), (2015).
4. Aditya K. Jagannatham, **"Principles of Modern Wireless Communications Systems"**, *McGraw Hill Education (India) Private Limited*, (1st Edition), (2016).

Reference Books:

1. Bernard Sklar, "**Digital Communications fundamentals and Applications**", *Prentice Hall P T R*, (2nd Edition), (2009).
2. Rakhesh Singh Kshetrimayum, "**Fundamentals of MIMO Wireless Communications**", *Cambridge University Press*, (1st edition), (2017)
3. Tao Jiang, Lingyang Song, Yan Zhang, "**Orthogonal Frequency Division Multiple Access Fundamentals and Applications"**, *Auerbach Publications*, (1st edition), (2019).
4. Claude Berrou, **"Codes and turbo codes**", *Springer-Verlag Paris*, (1st edition), (2010).

Online Resources:

NPTEL Course "**Bayesian/ MMSE Estimation for Wireless Communications MIMO/ OFDM Cellular and Sensor Networks**" https://nptel.ac.in/courses/117/104/117104126/
NPTEL Course "**LDPC and POLAR codes in 5G standard**", https://nptel.ac.in/courses/117/106/108106137/

20HWC502L ADVANCES IN DIGITAL COMMUNICATION LAB

Teaching Scheme

Lectures: 2 Hours / Week

Examination Scheme

ESE : 50 Marks

Credits: 1

Course Objectives:

1. To Investigate MIMO technology with Transmit Diversity vs. Receive Diversity
2. To explain Channel estimation space-time block coded system
3. To explain OFDM modulator and demodulator
4. To explore LDPC and Turbo Codes for error correction capability

Course Outcomes:

After completion of the course, students will be able to

CO1 Simulate MIMO technology with Transmit Diversity vs. Receive Diversity

CO2 Estimate the BER performance for a space-time block coded system

CO3 Design OFDM modulator and demodulator with MIMO.

CO4 Design Error correcting codes

List of experiments

1. To compare Transmit Diversity vs. Receive Diversity in Multiple-Input-Multiple-Output (MIMO) system by simulating coherent binary phase-shift keying (BPSK) modulation over flat-fading Rayleigh channels .
2. To estimate the BER performance for a space-time block coded system using two transmit and two receive antennas (Alamouti-coded 2*2 system).
3. Orthogonal Space-Time Block Coding using four transmit antennas (4*1 system) using a half -rate code.
4. To use an OFDM modulator and demodulator with MIMO.
5. To simulate Parallel Concatenated Convolutional Coding: Turbo Codes with LTE Specifications (Simulink).
6. To simulate LDPC (Low-Density Parity-Check) and BCH coding scheme used in Digital Video Broadcasting standard (DVB-S.2) (Simulink).

20HWC601 SMART ANTENNA FOR 5G COMMUNICATIONS

Teaching Scheme

Lectures: 3 Hours / Week

Examination Scheme

In Semester: 50 Marks

End Semester: 50 Marks

Credits: 3

Prerequisite: 20EC601: Wave theory and Antenna

Course Objectives:

1. To explain the basics of adaptive antenna arrays and Smart antennas
2. To explain the architecture and applications of smart antennas
3. To describe and analyze various processing techniques used for Smart antennas
4. To analyze design parameters of MIMO antennas

Course Outcomes:

After completion of the course, students will be able to

1. Interpret adaptive antenna arrays and Smart antennas
2. Describe the architecture and compare types of smart antennas
3. Apply and analyze processing techniques used for Smart antennas
4. Explain MIMO systems and analyze design parameters of MIMO antennas

Unit I: 5G Concepts and Antenna Requirements (08)

5G Objectives and Usage Scenarios, 5G Activities, Channel Access Method/Air Interface, 5G Policy, 4G/5G Radio Access Network, Spectrum Analysis and Regulations for 5G, Antenna requirements at 5G and future wireless networks.

Unit II: Introduction to Smart Antennas (08)

Introduction to Smart Antennas, Architecture of a Smart Antenna System: Transmitter and Receiver, Types of Smart Antennas, Benefits and Drawbacks of Smart Antennas, Applications of Smart Antennas.

Unit III: Smart Antenna Configurations (12)

Fixed Sidelobe Cancelling, Retrodirective Arrays, Beamforming, Adaptive Arrays, Butler Matrix, Spatial Filtering with Beamformers, Switched Beam Systems, Multiple Fixed Beam System, Uplink Processing, Diversity Techniques, Angle Diversity, Maximum Ratio Combining, Adaptive Beamforming, Fixed Multiple Beams versus Adaptive Beamforming, Downlink processing.

Unit IV: MIMO Antennas (10)

Introduction, Multiple-Antenna MS Design, RAKE Receiver Size, Mutual Coupling Effects, Dual-Antenna Performance Improvements, Downlink Capacity Gains, Principles of MIMO systems: SISO, SIMO, MISO, MIMO, Hybrid antenna array for mmWave massive MIMO: Massive Hybrid Array Architectures, Hardware Design for Analog Subarray.

Text Books:

1. C. A. Balanis& P. I. Ioannides, "**Introduction to Smart Antennas***", Morgan &Claypool Publication*, (1st Edition), (2014)
2. Frank B. Gross, '**Smart antenna with MATLAB'**, *McGraw-Hill*, (2nd Edition), (2015)

Reference Books:

1. Ahmed El Zooghby, '**Smart Antenna Engineering'**, *Artech house inc*, (1st Edition) (2005)
2. Lal Chand Godara, **"SMART ANTENNAS**", *CRC press*, (1st Edition), (2004)

Online Resources:

1. **NPTEL Course "Advanced Antenna Theory", https://nptel.ac.in/courses/117/107/117107035/**

20HWC602 MACHINE LEARNING FOR WIRELESS COMMUNICATION

Teaching Scheme

Lectures: 3 Hours / Week

Examination Scheme

In Semester: 50 Marks

End Semester: 50 Marks

Credits: 3

Prerequisite: 20EC403 Machine Learning with Python, 20EC402 Analog and Digital Communication

Course Objectives:

1. To interpret machine learning algorithms for spectrum access
2. To explain Channel Allocation algorithms in Spectrum sharing
3. To explain deep learning algorithms for optimizing coverage and channel capacity
4. To describe machine learning algorithms for optimizing energy efficiency, modulation, and coding

Course Outcomes:

After completion of the course, students will be able to

CO1 Design machine learning algorithms for spectrum access

CO2 Interpret Channel Allocation algorithms in Spectrum sharing

CO3 Design deep learning algorithms for optimizing coverage and channel capacity

CO4 Apply machine learning algorithms for optimizing energy efficiency, modulation, and coding

Unit I: Machine Learning for Spectrum Access and Sharing (10)

Online Learning Algorithms for Opportunistic Spectrum Access: The Network model, Performance Measures of the Online Learning Algorithms, the objective, Random, and Deterministic Approaches. Learning Algorithms for Channel Allocation: The Network Model, Distributed Learning, Game-Theoretic, and Matching Approaches.

Unit II: Deep Learning-Based Coverage and Capacity Optimization (08)

Machine Learning Techniques for Autonomous Network Management: Reinforcement Learning

and Neural Networks, Application to Mobile Networks. Data-Driven Base-Station Sleeping Operations by Deep Reinforcement Learning, Dynamic Frequency Reuse through a Multi-Agent Neural Network Approach.

Unit III: Machine Learning for Optimal Resource Allocation (08)

Network Capacity and Densification, Decentralized Resource Minimization, System Model: Heterogeneous Wireless Networks, Load Balancing. Resource Minimization Approaches: Optimized Allocation, Feature Selection and Training.

Unit IV: Machine Learning in Energy Efficiency Optimization (09)

Self-Organizing Wireless Networks, Traffic Prediction and Machine Learning, Cognitive Radio and Machine Learning.

Unit V: Machine Learning–Based Adaptive Modulation and Coding (AMC) Design (05)

Overview of ML-Assisted AMC, SL-Assisted AMC: k-NN-Assisted AMC, SVM-Assisted AMC, RL-Assisted AMC.

Text Books:

1. Fa-Long Luo," **Machine Learning for Future Wireless Communications**", *John Wiley and Sons*, (1st Edition), (2020)

2. K. K. Singh, A. Singh, K. Cengiz, Dac-Nhuong Le, "**Machine Learning and Cognitive Computing for Mobile Communications and Wireless Networks**", *Wiley*, (1st Edition), (2020)

Reference Books:

1. Ruisi He, Z Ding, "**Applications of Machine Learning in Wireless Communications**", *IET Telecommunication series 81*. (2019)

Online Resources:

1. NPTEL Course "**Machine Learning for Engineering and Science Applications**"

   https://nptel.ac.in/courses/106/106/106106198/

20HWC602L WIRELESS COMMUNICATION LAB

Teaching Scheme

Lectures: 2 Hours / Week

Examination Scheme

ESE: 50 Marks

Credits: 1

Course Objectives:

1. To explain designing of micro strip patch antenna and phased arrays
2. To explain the effect of mutual coupling between antenna elements in adaptive antenna arrays.
3. To investigate channel allocation in spectrum accessing and sharing
4. To explore channel estimation techniques

Course Outcomes:

After completion of the course, students will be able to

CO1 Design and simulate rectangular micro strip patch antenna and phased arrays

CO2 Analyze the effect of mutual coupling between antenna elements on the performance of adaptive antenna arrays

CO3 Simulate Channel allocation for cognitive radio networks

CO4 Design optimization of cellular networks

List of experiments

1. Design and simulation of rectangular micro strip patch antenna with a particular frequency band, dielectric constant and substrate thickness.
2. Design and simulation of phased antenna arrays.
3. Analyze the effect of mutual coupling between antenna elements in adaptive antenna arrays.
4. Simulate the performance of detectors by plotting the receiver operating characteristics (ROC).

5. Implement channel allocation for Cognitive Radio networks.
6. Implementation of channel estimation techniques.
7. Optimization of cellular networks for channel allocation.

20HWC801 5G AND FUTURE WIRELESS TECHNOLOGY

Teaching Scheme

Lectures: 3 Hours / Week

Examination Scheme

In Semester: 50 Marks

End Semester: 50 Marks

Credits: 3

Prerequisite:

Prerequisite: 20EC402 Analog and Digital Communication, 20EC602 Computer Network and Security

Course Objectives:

1. Infer the 5G and LTE access technology
2. Interpret the New Radio architecture
3. Correlate the Transport and physical layer signalling
4. Apply key technologies of 5G NR (New Radio), the global 5G standard for a new radio access network

Course Outcomes:

After completion of the course, students will be able to

CO1 Compare and contrast LTE and New Radio

CO2 Describe the radio-access network protocols

CO3 Illustrate the downlink and uplink physical-layer functionality

CO4 Apply key technologies of 5G NR to services, spectrum, and deployments

Unit I: Introduction to 5G Standardization (06)

Overview of wireless channel, Introduction to 5G, Overview of Standardization and Regulation, Spectrum For 5G, RF Exposure Above 6 GHz.

Unit II: An Overview of LTE and New Radio (NR) Access Technology (07)

LTE Evolution, License-Assisted Access, Densification, Small Cells, And Heterogeneous

Deployments, Higher-Frequency Operation and Spectrum Flexibility, Transmission Scheme, Bandwidth Parts, And Frame Structure, Interworking and LTE Coexistence.

Unit III: Architecture of an NR Radio Access Network (07)

Overall System Architecture, 5G Core Network, Radio-Access Network, Quality-Of-Service Handling Radio Protocol Architecture User-Plane Protocols, Control-Plane Protocols.

Unit IV: Transport-Channel Processing (08)

Overview Channel Coding. Rate Matching and Physical-Layer Hybrid-ARQ Functionality, Multi-Antenna Precoding, Resource Mapping, Downlink Reserved Resources.

Unit V: Physical Channel Signalling (06)

Physical Downlink Control Channel, Basic PUCCH Structure, Resources and Parameters for PUCCH Transmission, Uplink Control Signalling on PUSCH, Retransmission Protocols.

Unit VI: Technology and Services for Future Communication Platforms (07)

Mobile Clouds, Mobile Cloud Enablers, The Mobile User Domain, SON Evolution for 5G Mobile Networks.

Text Books:

1. Erik Dahlman, Stefan Parkvall and Johan Skold, **"5G NR: The Next Generation Wireless Access Technology",***Academic Press*, (2nd Edition) (2020).
2. Jonathan Rodriguez, **"Fundamentals of 5G Mobile Networks",**W*iley,*

   (1st Edition), (2015).

Reference Books:

1. HarriHolma, Antti Toskala, Takehiro Nakamura, "**5G Technology: 3GPP New Radio",** *Wiley & Sons* (1st Edition), (2019).
2. Ali Zaidi, Fredrik Athley, Jonas Medbo, Ulf Gustavsson, Giuseppe Durisi, "**5G Physical Layer: Principles, Models and Technology Components",** *Academic Press,* (1st Edition), (2018).

Online Resources:

1. NPTEL Course, "**Evolution of Air Interface towards 5G**",

   https://nptel.ac.in/courses/108/105/108105134/

20HWC801L 5G AND FUTURE WIRELESS TECHNOLOGY LAB

Teaching Scheme

Lectures: 2Hours / Week

Examination Scheme

ESE-50 Marks

Credits: 1

Prerequisite:
20EC402 Analog and Digital Communication, 20EC602 Computer Network and Security

Course Objectives:

1. To understand 5G new radio network
2. To Describe 5G channel models
3. To model and simulate NR physical layer
4. To explain waveforms and air interfaces

Course Outcomes:

After completion of the course, students will be able to

1. Analyse 5G waveforms for physical layer
2. Generate NR uplink and downlink waveforms
3. Measure channel throughput and reliability
4. To evaluate performance of traffic pattern for a given protocol

List of Experiments:

1. Generate a 5G NR uplink vector waveform with physical uplink shared channel (PUSCH) and sounding reference signal (SRS) for a baseband component carrier.

2. Configure and generate a 5G NR downlink vector waveform for a baseband component carrier.

3. Measure the physical downlink shared channel (PDSCH) throughput of a 5G New Radio (NR) link.

4. NR Cell Performance Evaluation with Physical Layer Integration.

5. Model a 5G New Radio (NR) cell with multiple-input multiple-output (MIMO) antenna configuration and evaluates the network performance.

6. Generate and Visualize FTP Application Traffic Pattern.

Autonomous Program Structure
B.Tech in Electronics and Telecommunication
Honors Degree Programme in
VLSI TECHNOLOGY
Academic Year: 2022-2023 Onwards

Course Code	Year and Semester	Course Title	Teaching Scheme Hours /Week			Marks	Credit
			Lecture	Tutorial	Practical		
20HVL501	TY Sem-I	Digital CMOS Circuit Design	3	0	0	100	3
20HVL502	TY Sem-I	Physical IC Design	3	0	0	100	3
20HVL502L	TY Sem-I	Digital CMOS Circuit Design Lab	0	0	2	50	1
20HVL601	TY Sem-II	System Verilog for Verification	3	0	0	100	3
20HVL602	TY Sem-II	CMOS Analog and Mixed Circuit Design	3	0	0	100	3
20HVL601L	TY Sem-II	System Verilog for Verification Lab	0	0	2	50	1
20HVL602L	TY Sem-II	CMOS Analog Circuit Design Lab	0	0	2	50	1
20HVL801	Final Year Sem-II	Design for Testability	3	0	0	100	3
		Total	**15**	**0**	**6**	**650**	**18**
		Grand Total	**21**			**650**	**18**

20HVL501 DIGITAL CMOS CIRCUIT DESIGN

Teaching Scheme

Lectures: 3 Hours / Week

Examination Scheme

ISE: 50 Marks

ESE: 50 Marks

Credits: 3

Prerequisite: Digital Electronics

Course Objectives:

1. To provide knowledge of circuit models for analysis of digital CMOS circuits and interconnect.
2. To explain implementation technique necessary to realize CMOS circuits/ Sub-systems using various CMOS logic structures.
3. To explain Computation methods required for circuit characterization and performance estimation.
4. To make them understand various CMOS processes and emerging nanometers-scale technologies

Course Outcomes:

After completion of the course, students will be able to

CO1 Analyze MOS and CMOS based logic circuit.

CO2 Analyze the performance parameter of CMOS logic circuit.

CO3 Design moderately sized CMOS circuits/ sub-systems for various CMOS Logic structures.

CO4 Describe the fundamentals of BiCMOS logic circuits

Unit I: Fundamentals of CMOS Logic (07)

Types and principles of MOSFETs. MOS Inverters, Static and Dynamic characteristics, Resistive, Depletion and Enhancement load NMOS inverters, the basic CMOS inverter, voltage transfer characteristics, logic threshold, Noise margins. Second order effects in MOSFETs. Dynamic behaviour, transition time, Propagation Delay, Power Consumption.

Unit II: CMOS Layout Fundamentals (07)

Technology scaling, MOS Circuit Layout, Stick diagrams, Layout design rules, MOS device layout,

Inverter layout, CMOS-circuits layout, Circuit Compaction, Euler's Rule.

Unit III: Static and Dynamic Logic (07)

Combinational MOS Logic Design, Static MOS design, Complementary MOS, Ratioed logic, Pass Transistor logic, Transmission gate logic and circuits. Dynamic MOS design, Dynamic logic families and their performance.

Unit IV: CMOS Memory (08)

MOS Memory design, Design of ROM, SRAM and DRAM cells, Sequential MOS Logic Design, Static and dynamic latches, flip flops & registers.

Unit V: Bi-CMOS Logic (07)

Introduction to low power design, Input and Output Interface circuits. BiCMOS Logic Circuits, Introduction, Basic BiCMOS Circuit behavior, Switching Delay in Bi-CMOS Logic circuits**.**

Text Books:

1. S.M. Kang & Y. Leblibici, **"CMOS Digital Integrated Circuits-Analysis & Design"**, *McGraw-Hill*, (3rdedition), (2003).
2. Jan M. Rabaey, Anantha P.Chandrakasan, BorivojeNikolić, **"Digital Integrated Circuits: A Design Perspective"**, *Pearson Education*, (2nd Edition), (2003).

Reference Books:

1. Neil Weste& K. Eshraghian,**"Principles of CMOS VLSI Design: A Systems Perspective"**, *McGraw Hill Pub*., (1985).
2. Douglas Pucknell, Kamran Eshraghian, **"Basic VLSI Design"**, *PHI*., (3rd Edition), (2013).

Online Resources:

1. **https://onlinecourses.nptel.ac.in/noc20_ee29/preview**
2. https://onlinecourses.nptel.ac.in/noc20_ee05/preview

20HVL502 PHYSICAL IC DESIGN

Teaching Scheme

Lectures: 3 Hours / Week

Examination Scheme

ISE: 50 Marks

ESE: 50 Marks

Credits: 3

Prerequisite: Digital Electronics

Course Objectives:

1. To explain fundamentals of ASIC and SoC Design.
2. To introduce design flow of physical IC design.
3. Identify the issues at various stages of VLSI physical design.
4. To explore low power design techniques.

Course Outcomes:

After completion of the course, students will be able to

CO1 Describe design flow, components of ASIC and SoC Design

CO2 Analyze the techniques and algorithms for floor planning, routing and placement of cells in physical IC Design.

CO3 Analyze clock tree synthesis and timing constraints

CO4 Describe low power design techniques and algorithms.

Unit I: Introduction to ASIC (06)

Types of ASICs, ASIC Design flow, Programmable ASICs - Antifuse, SRAM, EPROM, and EEPROM based ASICs. Programmable ASIC logic cells and I/O cells. Programmable interconnects. Latest Version - FPGAs and CPLDs and Soft-core processors.

Unit II: System-On-Chip Design (06)

SoC Design Flow, Platform-based and IP based SoC Designs, Basic Concepts of Bus-Based

Communication Architectures, On-Chip Communication Architecture Standards, Low-Power SoC Design

Unit III: Partitioning, Floorplanning and Placement (08)

Introduction, partitioning at different levels, partitioning techniques: constructive and iterative improvement, Floor planning and Placement : Floor-planning and placement differences, Design style specific issues, Floor planning and placement algorithms

Unit IV: Routing and Clocking (08)

Routing: Introduction, Types of Routing, Grid Routing, Global Routing, Detailed Routing, Power and Ground Routing, Interconnect Modeling and Layout Compaction, Clock Design**,** Clock Routing**,** Static Timing Analysis and Timing Closure.

Unit V: Low Power Design techniques (08)

Techniques to reduce dynamic power and static power, clock gating, supply voltage reduction, leakage reduction techniques, gate level design for low power, architecture level techniques for low power, algorithmic level techniques for low power

Text Books:

1. M.J.S. Smith,**"Application Specific Integrated Circuits",***Pearson*, (2003).
2. D. Gajski, S. Abdi, A. Gerstlauer, G. Schirner, **"Embedded System Design: Modeling, Synthesis and Verification"***Springer*, (2009).
3. S.Pasricha and N.Dutt,**"On-Chip Communication Architectures System on Chip Interconnect"**,*Morgan Kaufmann*,(2008).

Reference Books:

1. H.Gerez, **"Algorithms for VLSI Design Automation",***John Wiley*, (1998).
2. J..M.Rabaey, A. Chandrakasan and B.Nikolic, **"Digital Integrated Circuit Design Perspective"**, *PHI*, (2nd Edition), (2003).
3. D. A.Hodges, **"Analysis and Design of Digital Integrated Circuits",***McGraw-Hill Higher Education*, (3rd Edition),(2004).
4. Hoi-Jun Yoo, Kangmin Leeand Jun Kyong Kim, **"Low-Power NoC for High-Performance SoC Design"**, *CRC Press*, (1st Edition), (2008).

Online Resources:

1. **https://www.youtube.com/playlist?list=PLCmoXVuSEVHlEJi3SwdyJ4EICffuyqpjk**

20HVL501 DIGITAL CMOS CIRCUIT DESIGN

Teaching Scheme	**Examination Scheme**
Practical: 2 Hours / Week	ESE: Oral :50 Marks
	Credits: 1

Course Objectives:

1. To explain implementation technique necessary to realize CMOS circuits/ Sub-systems using CMOS process.
2. To design layout for Digital circuit using given CMOS Process.
3. To use software for simulation of layout.

Course Outcomes:

After completion of the course, students will be able to

CO1 Model digital components in given CMOS process to estimate their performance.

CO2 Design the layout of digital circuits using given CMOS process.

CO3 Simulate the layout of digital circuits in given CMOS process

CO4 Analyze and compare the performance of digital circuits to estimate their performance.

List of Experiments:

1. Design the layout for CMOS combinational circuit.
2. Design the layout for CMOS circuit using transmission gates.
3. Design the layout for CMOS sequential circuit.
4. Design the layout for CMOS 1-bit SRAM Cell.
5. Mini-Project

20HVL601 SYSTEM VERILOG FOR VERIFICATION

Teaching Scheme

Lectures: 3 Hours / Week

Examination Scheme

ISE: 50 Marks

ESE: 50 Marks

Credits: 3

Prerequisite: Knowledge of Digital Electronics, Verilog hardware description language

Course Objectives:

1. To introduce verification methologies for IC
2. To explore System Verilog for design and verification of Digital Systems
3. To introduce OOPs features for writing testbenches
4. To elaborate randomization, assertions, functional coverage and code coverage in System Verilog

Course Outcomes:

After completion of the course, students will be able to

CO1	Describe fundamental of verification in chip design
CO2	Apply the System Verilog capabilities for RTL design and synthesis
CO3	Use the System Verilog features and capabilities for design verification
CO4	Apply OOP's and Advanced OOP's concept for more effective and efficient verification

Unit I: Verification Fundamentals (07)

The Verification Process, The Verification Plan, The Verification Methodology, Basic Testbench Functionality, Directed Testing, Methodology Basics, Constrained-Random Stimulus, Functional Coverage, Testbench Components, Layered Testbench, Building a Layered Testbench, Simulation Environment Phases, Maximum Code Reuse, Testbench Performance.

Unit II: Fundamentals of System Verilog (08)

Built-in Data Types, Fixed-Size Arrays, Dynamic Arrays, Queues, Associative Arrays, Linked Lists, Array Methods, Choosing a Storage Type, Creating New Types with typedef, Creating User-Defined Structures,

Enumerated Types, Constants, Strings, Expression Width, Net Types,

Procedural Statements, Tasks, Functions, and Void Functions, Task and Function, Routine Arguments, Returning from a Routine, Local Data Storage, Time Values.

Unit III: OOP and Testbenches (07)

OOP Terminology, Creating New Objects, Object Deallocation, Using Objects, Static Variables vs. Global Variables, Class Routines, Defining Routines Outside of the Class, Scoping Rules, Using One Class Inside Another, Understanding Dynamic Objects, Copying Objects, Public vs. Private,

Building a Testbench, Separating the Testbench and Design, Interface Construct, Stimulus Timing, Interface Driving and Sampling, System Verilog Assertions.

Unit IV: Randomization, Threads and Inter-Process Communication (07)

Randomization in System Verilog, Constraint Details, Controlling Multiple Constraint Blocks, In-line Constraints, pre_randomize and post_randomize Functions, Common Randomization Problems, Iterative and Array Constraints, Random Control, Random Generator.
Working with Threads, Interprocess Communication, Events, Semaphores, Mailboxes, Building a Testbench with Threads and IPC.

Unit V: Functional Coverage and Advanced OOP (07)

Introduction to Inheritance, Factory Patterns, Type Casting and Virtual Methods, Composition, Inheritance, and Alternatives, Copying an Object, Callbacks.

Coverage Types, Functional Coverage Strategies, Anatomy of a Cover Group, Triggering a Cover Group, Data Sampling, Cross Coverage, Coverage Options, Parameterized Cover Groups, Analyzing Coverage Data.

Text Books:

1. Chris Spear, **"System Verilog for Verification"**, *Springer*, (2nd Edition), (2008).
2. Donald Thomas, **"Logic Design and Verification using System Verilog",**(2nd Edition), (2008).

Reference Books:

1. Pong P.Chu, **"FPGA Prototyping by System Verilog Example",** *Wiley*,(2nd Edition), (2018).
2. Jinck Bergeron, **" Writing Testbenches using System Verilog"**, *Springer*, (1st Edition), (2016).

Online Resources:

1. **https://www.chipverify.com/systemverilog/systemverilog-tutorial**
2. https://verificationguide.com/systemverilog/systemverilog-tutorial/

20HVL602 CMOS ANALOG AND MIXED SIGNAL CIRCUIT DESIGN

Teaching Scheme

Lectures: 3 Hours / Week

Examination Scheme

ISE: 50 Marks

ESE: 50 Marks

Credits: 3

Prerequisite:

Course Objectives:

1. To explore MOS capabilities for Analog circuit design
2. To utilize MOS transistor for designing analog sub-circuits
3. To explore MOS based amplifier typologies
4. To explain Mixed-signal circuits used in signal processing

Course Outcomes:

After completion of the course, students will be able to

CO1 Analyze the low frequency, high frequency MOS models and calculate various parameters

CO2 Design MOS based analog sub-circuits and calculate performance parameter

CO3 Analyze MOS based amplifier structure and calculate performance parameter

CO4 Describe mixed signal sub-circuits

Unit I: Introduction to Analog VLSI (07)

Analog integrated circuit design, Circuit design consideration for MOS, challenges in analog circuit design, Recent trends in analog VLSI circuits, Analog MOSFET Modelling: MOS transistor, Low frequency MOSFET Models, High frequency MOSFET Models, Temperature effects in MOSFET, Noise in MOSFET.

Unit II: CMOS Analog Sub-Circuits (07)

Current Source, current Sinks, MOS Diode/Active resistor, Basic current mirrors, Advance current mirror, Current and Voltage references, Bandgap references.

Unit III: CMOS Amplifiers (07)

Performances matrices of amplifier circuits, Common source amplifier, Common gate amplifier, Cascode amplifier, Frequency response of amplifiers and stability of amplifier.

Unit IV: CMOS Differential Amplifier (07)

Differential signaling, source coupled pair, Current source load, Common mode rejection ratio, CMOS Differential amplifier with current mirror load.

Unit V: CMOS Operational Amplifier (08)

Block diagram of Op-amplifier, characteristics of Op-Amplifier, Analysis of two stage Op-Amplifier, Frequency response of Op-Amplifier, CMOS Op-amp applications: Op-amp as a comparator, ADC, DAC.

Text Books:

1 P.E. Allen and D.R.Holberg, **"CMOS Analog Circuit Design",***Oxford University Press,* (3rd Edition), (2012).

2 R.Gregorian and G.C.Temes, **"Analog MOS Integrated Circuits for Signal Processing",***John Wiley and Sons*,(1986).

Reference Books:

1. B. Razavi, **"Design of Analog CMOS Integrated Circuits",***Tata McGraw-Hill* , (2nd Edition), (2002).
2. R.J.Baker, H. W. Li, D. E. Boyce,**"CMOS Circuit Design, Layout, and Simulation",** *PHI,* (2nd Edition), (2006).

Online Resources:

1. **https://onlinecourses.nptel.ac.in/noc21_ee51/preview**

20HVL601L SYSTEM VERILOG FOR VERIFICATION

Teaching Scheme

Practical: 2 Hours / Week

Examination Scheme

ESE: Oral :50 Marks

Credits: 1

Course Objectives:

1. To explore System Verilog for design and verification of Digital Systems
2. To explain OOPs features for writing testbenches
3. To elaborate randomization, assertions, functional coverage and code coverage in System Verilog
4. To demonstrate the software features available in lab for design Verification

Course Outcomes:

After completion of the course, students will be able to

CO1 Use the features and capabilities of the System Verilog for verification

CO2 Create and configure reusable, scalable, and robust test-benches using System Verilog

CO3 Use OOP's features to develop a complete verification environment

CO4 Integrate System Verilog components to create layered test bench structure

List of Experiments:

1. Verification of the combinational circuit.
2. Verification of the sequential circuit
3. Verification of the Finite state Machine based circuit.
4. Verification of the single port RAM .
5. **Mini-Project**

20HVL602L CMOS ANALOG AND MIXED SIGNAL CIRCUIT DESIGN LAB

Teaching Scheme

Practical: 2 Hours / Week

Examination Scheme

ESE: Oral :50 Marks

Credits: 1

Course Objectives:

1. To explore MOS capabilities for Analog circuit design
2. To utilize MOS transistor for designing analog sub-circuits
3. To exploreMOS SPICE Model
4. To design and simulate analog integrated circuits using given CMOS process

Course Outcomes:

After completion of the course, students will be able to

CO1 Model analog components in CMOS process to estimate their performance in circuits

CO2 Design and simulate the analog sub-circuits using given CMOS process

CO3 Design and simulate the amplifier circuits using given CMOS process

CO4 Analyze and compare the performance of CMOS circuits

List of Experiments:

1. Design the MOS based current mirror circuit
2. Design the bandgap referenced circuit.
3. Analyze the performance of CMOS differential amplifier for various load.
4. Analyze the performance of two stage Op-Amp circuits.
5. **Mini-Project**

20HVL801 DESIGN FOR TESTABILITY

Teaching Scheme

Lectures: 3 Hours / Week

Examination Scheme

ISE: 50 Marks

ESE: 50 Marks

Credits: 3

Prerequisite: Knowledge of Digital Electronics

Course Objectives:

1. To explain need of testability
2. To explore test methodologies for computational and sequential circuits
3. To elaborate testing mechanism for CMOS circuits
4. To explore BIST and modern testing techniques

Course Outcomes:

After completion of the course, students will be able to

CO1 Use the concepts of testing to design a better yield in IC design.

CO2 Analyze the various test generation methods for static & dynamic CMOS circuits.

CO3 Analyze the design for testability methods for combinational & sequential circuits

CO4 Use the BIST techniques for improving testability.

Unit I: Basics of Testing **(07)**

Fault models, Combinational logic and fault simulation, Test generation for Combinational Circuits, Current sensing based testing, Classification of sequential ATPG methods, Fault collapsing and simulation.

Unit II: Universal Test Sets **(07)**

Pseudo-exhaustive and iterative logic array testing, clocking schemes for delay fault testing. Testability classifications for path delay faults. Test generation and fault simulation for path and gate delay faults.

Unit III: CMOS testing **(07)**

Testing of static and dynamic circuits, Fault diagnosis, Fault models for diagnosis, Cause- effect diagnosis and Effect-cause diagnosis.

Unit IV: Design for testability **(07)**

Scan design, Partial scan, use of scan chains, boundary scan, DFT for other test objectives, Memory Testing.

Unit V: Built-in self-test **(08)**

Pattern Generators, Estimation of test length, Test points to improve testability, Analysis of aliasing in linear compression, BIST methodologies, BIST for delay fault testing.

Text Books:

1. *N. Jha & S.D. Gupta,* ***"Testing of Digital Systems",****Cambridge,(2003).*
2. W. W. Wen, **"VLSI Test Principles and Architectures Design for Testability",***Morgan Kaufmann Publishers,*(2006).

Reference Books:

1. Michael L. Bushnell &Vishwani D. Agrawal, **"Essentials of Electronic Testing for Digital, memory & Mixed signal VLSI Circuits",***Kluwar Academic Publishers*, (2000).
2. P. K. Lala, ***"Digital circuit Testing and Testability",****Academic Press*, (1st Edition), (1997).
3. M. Abramovici, M. A. Breuer, and A.D. Friedman, ***"Digital System Testing and TestableDesign",****Computer Science Press*, (1990).

Online Resources:

1. **https://onlinecourses.nptel.ac.in/noc20_ee76/preview**

Autonomous Program Structure of
B. Tech. in Mechanical Engineering with
Honors Degree Program in

ELECTRIC VEHICLES

Academic Year: 2023 Onwards

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Total Marks	Credit
		Lecture	Tutorial	Practical	In Sem	End Sem	Practical	Oral		
20HEV501	E V System Design and Architecture	3	0	0	50	50			100	3
20HEV502	Energy Storage System for EV	3	0	0	50	50		0	100	3
20HEV502L	Energy Storage System for EV Lab	0	0	2	0	0	50		50	1
20HEV601	Vehicles Dynamics and Traction Systems	3	0	0	50	50			100	3
20HEV602	EV Motor Drive and Power Train	3	0	0	50	50		0	100	3
20HEV602L	EV Motor Drive and Power Train Lab	0	0	2	0	0	50		50	1
20HEV801	Sensors and Controls in EV	3	0	0	50	50		0	100	3
20HEV801L	Sensors and Controls in EV Lab	0	0	2	0	0	50	0	50	1
	Total	**15**	**0**	**6**					**650**	**18**
	Grand Total	**21**								

20HEV501 **EV System Design, Architecture and Integration**

Pre-requisite Basics of Electrical and Mechanical Engineering

Unit-I Introduction to hybrid and electric vehicles:
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, Energy devices & combinations, Duty Cycles in Indian cities; performance, Sustainability assessment, Industry Activity and Market Reaction, HEV market drivers and technology trends, Customer related issues, HEV technology readiness levels. Vehicle Based HEV Performance specifications.

Unit 3 Modelling of electrical and mechanical sub systems: 8
Systems Modelling and Simulation, Modelling methodologies for HEV energy management. Control strategies for energy management and driveability. High voltage architecture options within HEVs and component selection.

Unit 4 EV Systems Integration: 8
Vehicle Development Process Overview, Hybrid Components, and Architectures: Major components in hybrid Power Train, Controls Integration, Component sizing, and integration tradeoffs, System Design and Development Considerations, Vehicle integration (ex. performance, drivability, NVH), Power Train integration,

Unit 5 Verification, Validation and Standards: 8
Component test considerations, System test considerations, Fleet testing, Hybrid and electric vehicle component characteristics and key design attributes, Various standards related to EV

Total Lecture hours: 36 hours

Text Books:

1. Iqbal Husain, Electric and Hybrid Vehicles –Design Fundamentals, CRC Press
2. Mehrdad Ehsani, Yimin Gao, Sebastian E.Gsay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Celll vehicles-Fundamentals - Theory and Design", CRC Press
3. Bosch' Automotive Handbook, 8 th Edition

20HEV502 Energy Storage System for EV

Pre-requisite

Chemistry, Thermodynamics

Course Objectives:

Course prepares students to

1. To calculate energy storage requirements for vehicle application
2. To understand various battery chemistry
3. To select and design LI battery thermal management system
4. To analyze a supercapacitor storage system
5. To select hydrogen fuel cell for an application

Course Outcomes:

Students will be able to

1. To calculate energy storage requirements for vehicle application
2. To understand various battery chemistry
3. To select and design LI battery thermal management system
4. To analyze a supercapacitor storage system
5. To select hydrogen fuel cell for an application

Unit 1 Fundamental: **8**

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 2 Battery Chemistry: **8**

Nickel-Iron Battery Nickel–Cadmium, Ni-MH, Accumulators with Nonaqueous Electrolyte Lithium-Metals, Lithium-Metal Polymer Cells, Lithium-Ion Accumulator Lithium–Iron Phosphate (LFP) Cells, Lithium-ion Polymer (Li-Po) Cells, Lithium–Titanate Cells (LTO), Large Size Accumulators, Sodium–Sulfur (NaS) Battery, Vanadium Redox Flow Battery (VRB), Chemical Reactions of the VRB Battery.

Unit 3 BMS, Packing and Charging: **7**

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 4 Supercapacitors: **7**

Materials and Construction, Basic Model, Specific Behavior of Supercapacitors, Design of a Super-capacitive Bank, Series and Parallel Connections, Power Capability, Charging and Discharging Procedure of Supercapacitors, Energy Efficiency and Power Availability Thermal Aspects

Unit 5 Hydrogen Fuel Cells: 6

Hydrogen Generation and Storage of Hydrogen, Conversion from Hydrogen to Electricity, Low and Medium Temperature Fuel Cells: AFC, PEMFC, AND PAFC, High-Temperature Fuel Cells: MCFC AND SOFC.

Total Lecture hours: 36 hours

Text Books:

1. Energy Storage by Robert A. Huggins, Springer Publication
2. Energy storage (A new approach) by Ralph Zito Wiley Publication
3. Handbook of Energy Audit, Albert Thumann P.E. CEM, William J. Younger CEM, The Fairmont Press Inc., 7th Edition.
4. Energy Management Handbook, Wayne C. Turner, The Fairmont Press Inc., 5th Edition,Georgia
5. . Energy Storage Systems, Alfred Rufer, CRC Press

20HEV502L Energy Storage System for EV Lab

Pre-requisite

Course Objectives:

Course prepares students

1. **To determine characteristics of battery cell and pack experimentally**
2. **To integrate BMS with battery pack**
3. **To simulate battery storage systems**

Course Outcomes:

Students will be able

1. **Determine characteristics of battery cell and pack experimentally**
2. **Integrate BMS with battery pack**
3. **Simulate battery storage systems**

1	To determine electrical and thermal characteristics of LI battery cell
2	To determine electrical and thermal characteristics of LI battery pack
3	To integrate LI battery pack with battery management system
4	To determine cooling performance of active and cooling systems for battery
5	To determine electrical amd thermal characteristics of supercapacitor
6	Demonstration of PEM hydrogen cell
7	Simulation of equivalent circuit model with MATLAB
8	Simulation of Lithium Ion battery pack on MATLAB Simulink

20HEV601 Vehicles Dynamics and traction systems

Pre-requisite Rigid Body Dynamics, Theory of Machines, Applied Mechanics

Course Objectives:

Course prepares students to

1. To understand the dynamics of a vehicle
2. To analyze forces on tires and select tires
3. To analyze the stability of a vehicle
4. To apply principles of vibration to select a suspension system

Course Outcomes:

Students will be able to

1. To understand the dynamics of a vehicle
2. To analyze forces on tires and select tires
3. To analyze the stability of a vehicle
4. To apply principles of vibration to select a suspension system

Unit 1 Introduction to vehicle dynamics: 6

Dynamics of the motor vehicle, Vehicle fixed coordinates system; Earth fixed coordinates system, Details of vehicle systems, wheel angles, and Typical data of vehicles.

Unit 2 Tires - 8

Types, axis system, mechanics of pneumatic tires-tire forces Tire forces and moments, Tire structure, Longitudinal, and Lateral force at various slip angles, rolling resistance, Tractive and cornering property of tire. Ride property of tires. Conicity and Ply Steer, Tire models, Estimation of tire-road friction.

Unit 3 Longitudinal dynamics: 8

Forces and moments on the vehicle, Equation of motion, Tire forces, rolling resistance, weight distribution, Tractive effort and Power available from the engine, Calculation of Maximum acceleration Braking torque, Braking Force, Brake Proportioning, Braking Efficiency, Stopping Distance, Prediction of Vehicle performance. ABS, stability control, Traction control.

Unit 4 Lateral Dynamics: 6

Steering geometry, Types of steering systems, Fundamental condition for true Rolling, Development of lateral forces. Steady state handling characteristics. Yaw velocity, Lateral Acceleration, Curvature response & directional stability.

Unit 5 Vertical Dynamics - 8

Human response to vibrations, Sources of Vibration, Suspension systems, Functions of the suspension system. Body vibrations: Bouncing and pitching. Doubly conjugate points. Body rolling. Roll center and roll axis, Stability against body rolling.

Total Lecture hours: 36 hours

Text Books:

1. Thomas D. Gillespie, "Fundamentals of Vehicle Dynamics", 2013, Society of Automobile Engineers Inc., ISBN: 978-1560911999
2. J. Y. Woung , "Theory of Ground Vehicles", John Willey & Sons, NY.
3. Rajesh Rajamani , "Vehicle dynamics and control", Springer publication.
4. J. G. Giles , "Steering, Suspension & Tyres", Ilete Books Ltd., London.
5. W. Steed , "Mechanics of Road Vehicles", Ilete Books Ltd. London.
6. P. M. Heldt , "Automotive Chassis", Chilton Co. NK.
7. Reza N Jazar , "Vehicle Dynamics : Theory and Application", Springer publication.
8. Automobile Mechanics, "Crouse/Anglin",TATA Mcgraw-Hill.
9. William H. Crouse., "Automotive Mechanics", Tata McGraw Hill Publishing House
10. Joseph Heitner, "Automotive Mechanics", C.B.S Publishers And Distributors
11. Hans Hermann Braess, Ulrich Seiffen, "Handbook of Automotive Engineering ", SAE Publications

20HEV602 EV Motor Drives and Power train

Pre-requisite Theory of Machines, Basics of Electrical Engineering

Course Objectives:

Course prepares students to

1. To calculate motor power ratings for an EV application
2. To select an appropriate type of motor
3. To design a control system for electric drive
4. To analyze and design components of a power train
5. To test and validate given power train

Course Outcomes:

Students will be able to

1. To calculate motor power ratings for an EV application
2. To select an appropriate type of motor
3. To design a control system for electric drive
4. To analyze and design components of a power train
5. To test and validate given power train

Unit 1 Fundamentals: 6

General architecture and requirement of EV, load characteristics, energy sources, principle of electromechanical energy conversion, motors and generator operation.

Unit 2 Types of 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 3 Control of Electric Drives: 8

Microcontrollers/DSP based control strategies, PI control, cascade control, scalar and vector control, power electronics-based control of electric motors

Unit 4 Components of Power Train: 8

Auxiliary Inverter, HV-LV DC-DC converter, Traction Inverter, Gear Trains, Integration of power train components

Unit 5 Simulation and Testing of Power Train: 8

Integrated clutch and electric motor design, Range extender system design, Vehicle system simulation (thermal, mechanical and control systems) using MATLAB, Testing of electrified powertrain vehicle systems, including regulatory tests, cold, hot, altitude, NHC, durability.

Total Lecture hours:36 hours

Text Books:

1. Chang Liang Xia,"Permanent Magnet Brushless Dc Motor Drives and Controls" Wiley 2012.
2. Rashid M.H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India,

   Third Edition, New Delhi, 2011.
3. Bimal K Bose, " Modern Power Electronics and AC Drives", Pearson Education, Second

   Edition, 2003.
4. Dubey. G.K., " Thyristorised power controllers", New age International, New Delhi, 2002.
5. Bhimbhra P.S., " Power Electronics", Khanna Publishers, New Delhi, 2005
6. Miller. T. J. E., "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon

   Press, Oxford, 1989.
7. Kenjo. T and Nagamori. S, "Permanent Magnet and Brushless DC Motors", Clarendon Press,

   Oxford, 1989.
8. Kenjo. T, "Stepping Motors and their Microprocessor Control", Clarendon Press, Oxford,
9. Robert .L.Boylsted,and Louis Nashelsky, "Electronic Devices and Circuit Theory", Pearson Education,9th edition,2009.
10. David A Bell, "Fundamentals of Electronic Devices and Circuits", Oxford University Press, 2009.
11. Roy Choudhury and Shail Jain, "Linear Integrated Circuits", 2nd Edition, New Age

    International Publishers, 2003

20HEV602L EV Motor Drives and Power train

Pre-requisite

Course Objectives:

Course prepares students

1. **To select a motor for given loads**
2. **To determine characteristics of electric motor under various loading drive cycles**
3. **To integrate various components of a power train**
4. **To simulate control system for drives using simulink**

Course Outcomes:

Students will be able

1. **Select a motor for given loads**
2. **To determine characteristics of electric motor under various loading drive cycles**
3. **To integrate various components of a power train**
4. **To simulate control system for drives using simulink**

1	To determine performance characteristics of DC motors under various drive cycles
2	To determine performance characteristics of AC motors under various drive cycles
3	To assemble and integrate various components of an EV powertrain
4	To control a motor (AC/DC) with various control strategies
5	To determine performance of regenerative brake
6	To simulate performance of drive train with SIMULINK/SIMMECHANICS
7	To determine performance of gear trains (epicyclic) for different drive cycles
8	Demonstration of power electronics components of EV drive train

20HEV801 **Sensors and Controls in Electric Vehicles**

Pre-requisite

Mathematics, Elements of Electrical and Electronics

Course Objectives:

Course prepares students

1. To understand modern sensor technology
2. To select a suitable type of sensor for EV application
3. To apply an appropriate control strategy for EV
4. To simulate controller on MATLAB
5. To understand MCU hardware-software and AUTOSAR

Course Outcomes:

Students will be able

1. Understand modern sensor technology
2. Select a suitable type of sensor for EV application
3. Apply an appropriate control strategy for EV
4. Simulate controller on MATLAB
5. Understand MCU hardware-software and AUTOSAR

Unit 1 Basics of Sensor Technology: 6

Strain gauge, LVDT, Piezoelectric, Hall Effect sensors, magnetoresistive, Optical displacement sensors, Ultrasonic Sensors, Encoders, Lidars, Laser-based Sponsors, Proximity sensors, tachometers, optical tachometer, Tactile sensors

Unit 2 Sensors in Electric Vehicles: 8

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.

Unit 3 Fundamentals of Control: 6

Feedback, tracking, regulator system, feed-forward system. Basic Concepts of control systems like Transfer function, Modelling Pole and zero, Analysis in time, and Frequency Domain. The basic concept of PID controller, and tuning methods.

Unit 4 Controls in Electric Vehicles: 6

Traction control, Body and chassis control, Onboard/Offboard charger control, Battery Management system control, Auxiliary power system and its control, Examples of control with MATLAB Simulink Control Toolbox.

Total Lecture hours: 36 hours

Text Books:

1. Katsuhiko Ogata, "Modern Control Engineering" 5th edition, Prentice Hall of India Private Ltd., New Delhi, 2010.
2. Nagrath I J and Gopal.M., "Control Systems Engineering", 5th edition, New Age International (P)Ltd.,Publishers 2008.
3. M. Gopal, "Control Systems: Principles and Design", 3rd Edition, McGraw,Hill, 2008.
4. Benjamin C Kuo, "Automatic Control system", Prentice Hall of India PrivateLtd., New Delhi, 2009
5. R.C. Dorf and R.H. Bishop, "Modern Control Systems", 12th Edition, Prentice, Hall, 2010
6. Sawhney.A.K, "A course in Electrical and Electronic Measurement and Instrumentation", Dhanpat Rai & Sons, New Delhi, 2008.
7. Albert D Halfride & William D Cooper, "Modern Electronic instrumentation and Measurement techniques", Prentice Hall of India Pvt Ltd., 2007.
8. Stout MB, "Basic Electrical Measurements", Prentice Hall of India Pvt Ltd., 2007.
9. Rajendra Prasad, "Electrical Measurements & Measuring instruments", C Publishers, 4th Edition, 2004.
10. Cooper W.D & Hlefrick A.D., "Electronic Instrumentation & Measurement Technique", III Edition, Prentice Hall of India – 1999

20HEV801L Sensors and Controls in Electric Vehicles Lab

Pre-requisite

Course Objectives:

Course prepares students

1. To integrate sensors with mechanical and electrical systems
2. To process sensor output with MCUs
3. To simulate sensor and controls with MATLAB hardware support

Course Outcomes:

Students will be able

1. Integrate sensors with mechanical and electrical systems
2. Process sensor output with MCUs
3. Simulate sensor and controls with MATLAB hardware support

1	To integrate various sensors with electrical and mechanical systems
2	Demonisation of various development boards (STM32 discovery kit, NXP development board, TI development board)
3	To record and process sensor output by integrating it with ARM processor based MCUs
4	To simulate PID controller with MATLAB control toolbox
5	To integrate MCU with MATLAB using hardware support toolbox
6	To perform sensor data processing with DAQ
7	To demonstrate control functions in an EV
8	To demonstrate AUTOSAR based ECU integration with an EV

Autonomous Program Structure

of **Minor Degree Programme** in

INFORMATION SECURITY MANAGEMENT

Academic Year: 2022-2023 Onwards

Course Code	Course Title	Teaching Scheme Hours /Week			Marks	Credit
		Lecture	Tutorial	Practical		
20MIM501	Introduction to Information Security Management	3	0	0	100	3
20MIM502	Information Security Governance	3	1	0	100	4
20MIM601	Information Security Incident Management	3	0	0	100	3
20MIM602	Data Privacy	3	1	0	100	4
20MIM801	Information Security Risk Management and Compliance	3	1	0	100	4
	Total	**12**	**3**	**0**	**500**	**18**
	Grand Total	**15**			**500**	**18**

20MIM501 Introduction to Information Security Management

Teaching Scheme:
Lectures: 3 hours/week
Tutorial: None

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

Prerequisites: None

Course Objectives:

Familiarize students with

5. Foundational concepts of information security .
6. Relationship between assets, vulnerabilities, threats, and risks
7. Incident identification, reporting
8. Understand the basic rules and principles for protecting privacy and personal information

Course Outcomes:

Students will be able to:

5. Identify concepts relating to organizational information security policy, governance mechanisms, applicable legislation and compliance requirements & security frameworks.
6. Review the processes of risk identification, evaluation and assessment
7. Specify methods for incident classification and categorization
8. Apply different privacy and protection mechanisms

Unit – I Information Systems Security 6 Hours

Information Systems Security - Risks, Threats, and Vulnerabilities, What Is Information Systems Security?

Tenets of Information Systems Security - Confidentiality, Integrity, Availability, Authentication, Authorization, Access control, Non-repudiation.

What Is a Malicious Attack? - Birthday Attacks, Brute-Force Password Attacks, Spoofing, Man-in-the-Middle, Eavesdropping, Social Engineering etc. Introduction to security standards & frameworks.

Unit – II Introduction to Information Security Governance 6 Hours

What is governance, information security governance, Responsibilities and Functional Roles, Security architecture.

Unit – III Introduction to Information Security Risk Management 6 Hours

Risk, Asset, Threat, The Importance of Risk Management, Outcomes of Risk management, Risk Management Process, NIST Risk Assessment Methodology, Business Continuity Management.

Unit – IV Introduction to Information Security Program Management 6 Hours

Importance of the Information Security Program, Outcomes of Information Security Program Management, Information Security Framework Components

Unit – V Introduction to Information Security Incident Management 6 Hours

Incident, signs of incidents, grading incidents, Incident Management Process Model, Incident Management Resources - policies & Standards, Incident Management Procedures.

Unit – VI Introduction to Data Privacy **6 Hours**

Security vs Privacy, Anonymization design principles, encryption, de-identifications, obfuscation, deobfuscation

Text Books

3. David Kim, Michael G. Solomon, "Fundamentals of Information Systems Security", Jones & Bartlett Learning.
4. Thomas R. Peltier, "Information Security Fundamentals", CRC Press.
5. Andy Taylor, David Alexander, Amanda Finch and David Sutton, "Information Security Management Principles", BCS Learning and Development Ltd.

Reference Books

9. Thomas Peltier & Justin Peltier, "Complete Guide to CISM Certification", Auerbach Publications.
10. Gwen Bettwy, Mark Williams, and Mike Beevers, "Prepare for the ISACA Certified Information Security Manager".

20MIM502 Information Security Governance

Teaching Scheme:
Lectures: 3 hours/week
Tutorial: 1 hours/Week

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

Prerequisites: None

Course Objectives:

Familiarize students with

5. Principles of information security governance
6. Security metrics – concepts and Application
7. Security architecture
8. Risk management

Course Outcomes:

Students will be able to:

5. Identify the importance and functions of Governance, Risk Management, and Compliance in information security program management
6. Identify concepts relating to organizational information security policy, governance mechanisms, applicable legislation and compliance requirements for information security.
7. Describe best practices in risk management including the domains of risk assessment and risk treatment.
8. Analyze risk management processes and procedures to ensure compliance with applicable security, privacy laws and regulations

Unit – I Governance Overview **4 Hours**

What Is It?, Basics. Origins of Governance. Governance Definition. Information Security Governance. Outcomes of Effective Security Governance. Defining Information, Data, Knowledge. Value of Information.

Unit – II Needs of Security Governance **8 Hours**

Benefits of Good Governance. Aligning Security with Business Objectives. Providing the structure and framework to optimize allocations of limited resources. Providing assurance that critical decisions are not based on faulty information. Ensuring accountability for safeguarding critical assets. Increasing trust of customers and stakeholders. Increasing the company's worth. Reducing liability for information inaccuracy or lack of due care in protection. Increasing predictability and reducing uncertainty of business operations. A Management Problem.

Unit – III Legal and Regulatory Requirements **4 Hours**

Security Governance and Regulation. ROLES & RESPONSIBILITIES**:** The Board of Directors. Executive Management. Security Steering Committee. CISCO – The case study

Unit – IV Strategic Metrics **6 Hours**

Governance Objectives. Strategic Direction. Ensuring Objectives are Achieved. Risks Managed Appropriately. Verifying Resources are Used Responsibly. Information Security Outcomes**:** Defining Outcomes. Strategic alignment. Risk Management. Business process assurance / convergence. Value delivery. Resource management. Performance measurement. Sample strategy development.

Unit – V Security Governance Roadmap 8 Hours

Security Architecture. Managing Complexity. Providing a Framework & Road Map. Simplicity & Clarity through Layering & Modularization. Business Focus beyond the Technical Domain. Objectives of Information Security Architectures. SABSA Framework for Security Service Management. SABSA Development Process. SABSA Lifecycle. SABSA Attributes. COBIT. Capability Maturity Model. ISO/IEC 27001/ 27002. ISO 27001. ISO 27002.Other Approaches. National information security Task Force.

Unit – VI Risk Management Roadmap 8 Hours

Risk Management Responsibilities. Managing Risk Appropriately. Determining Risk Management Objectives. Recovery Time Objectives. CURRENT STATE. Current State of Security. Current State of Risk Management. Gap Analysis - Unmitigated Risk. CMM.

Text Books

4. Krag Brotby , "Information Security Governance: A Practical Development and Implementation Approach", Wiley
5. Andrej Volchkov, "Information Security Governance Framework and Toolset for CISOs and Decision Makers", Auerbach

Reference Books

1. Wim Van Grembergen, Steven Dehaes, "Implementing Information Technology Governance: Models, Practices and Cases", IGI
2. Wim Van Grembergen, "Strategies for Information Technology Governance", Idea Group
3. F.W. McFarlan, R.D. Austin, J. Usuba and M. Egawa, "Secom-Managing Information Security in a Risky World", Harvard Business School

20MIM601 Information Security Incident Management

Teaching Scheme:
Lectures: 3 hours/week
Tutorial: None

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

Prerequisites: None

Course Objectives:

Familiarize students with

5. Threats, Vulnerabilities, Attack vector
6. Incident identification, reporting
7. Incident investigation cycle
8. Disaster recovery mechanisms

Course Outcomes:

Students will be able to:

5. Describe incident management concepts
6. Specify methods for incident classification and categorization
7. Analyze the impact of information security incidents
8. Build response strategies for various types of information security incidents

Unit – I Incident **4 Hours**

Threat analysis, activity modeling, Attack vectors, What is an Incident?, signs of incidents, grading incidents. Incident Management Process Model - Handling-Response, Incident Response Roles and Responsibilities, Incident Response Process, emergency incident response process

Unit – II Incident Timelines **6 Hours**

Incident reporting, legal issues, notification, assessment, investigation.

Unit – III Incident Types and Priorities **4 Hours**

Incident categories, Incident prioritization. Incident privacy & investigations

Unit – IV Incident Investigation **6 Hours**

Email security incidents, application level incidents, network & mobile incidents.

Unit – V Post Incident Management **8 Hours**

Corrective action after incident, costs, mitigating future incidents, brief introduction to problem management (Event $\longrightarrow$ Incident $\longrightarrow$ Problem).

Unit – VI Disaster Recovery Management **8 Hours**

Disaster recovery - Preparation disaster recovery plan, test (simulation, table-top, etc.)

Text Books

4. Matthew W. A. Pemble, Wendy F. Goucher, "The CIO's Guide to Information Security Incident Management", CRC Press.
5. Joe Stenzel, "CIO Best Practices Enabling Strategic Value with Information Technology", John Wiley & Sons.

Reference Books

5. Paul Cichonski, Tom Millar, Tim Grance, Karen Scarfone, "Computer Security Incident Handling Guide", NIST.

20MIM602 Data Privacy

Teaching Scheme:
Lectures: 3 hours/week
Tutorial: 1 hours/Week

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

Prerequisites: None

Course Objectives:

Familiarize students with

5. General background of privacy
6. Understanding of the basic rules and principles for protecting privacy and personal information
7. Roles and responsibilities of employees to prevent the happening of these data breaches
8. Data privacy management

Course Outcomes:

Students will be able to:

5. Apply anonymous design principles & tracking mechanisms
6. Apply different privacy and protection mechanisms
7. Develop and implement effective data protection policies and procedures
8. Explore the impacts of emerging technologies on the future of privacy, protection, and law

Unit – I Introduction to Data Privacy **4 Hours**

Security vs Privacy, What is data privacy & why it is important. Privacy-as-Trust, Anonymization design principles. Threats to privacy

Unit – II Methods of Tracking and De-identification **8 Hours**

Breaking users' privacy: packet sniffing, First-party data collection; third-party data collection: how ad networks work; surveillance by ISPs. Tracking users: cookie tracking, ads. Understanding privacy threat models.

Unit – III Static Data Anonymization **4 Hours**

Classification of privacy preserving methods, group based anonymization, Threats to anonymized data

Unit – IV Privacy Protections: Technical and Otherwise **8 Hours**

Encryption, Tor, Differential privacy, Privacy policies, Control objectives, privacy control objectives, control frameworks, encryption, de-identifications, event monitoring

Unit – V Privacy Regulations **8 Hours**

Data governance, data classification, data persistence, data protection policies, Case study – GDPR - processing under GDPR, GDPR enforcement, Personal Data Protection Bill (PDP)

Unit – VI Data Privacy Future and Challenges 4 Hours

Privacy issues in specific areas of application, e.g. e-commerce, healthcare, official statistics, social networks, cyber physical systems.

Text Books

4. Sanjay Sharma, "Data Privacy and GDPR Handbook", Wiley.
5. Lei Chen, Hassan Takabi, Nhien-An Le-Khac, "Security, Privacy, and Digital Forensics in the Cloud", Wiley.

Reference Books

1. Nataraj Venkataramanan, Ashwin Shriram, "Data Privacy Principles and Practice", CRC Press.
2. "Guide to the General Data Protection Regulation (GDPR)", ICO.
3. Peter Gregory, "CDPSE Certified Data Privacy Solution Engineer Exam Guide", McGraw Hill.

20MIM801 Information Security Risk Management and Compliance

Teaching Scheme:
Lectures: 3 hours/week
Tutorial: 1 hours/Week

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

Prerequisites: None

Course Objectives:

Familiarize students with

1. Understand the concepts of governance, risk management and compliance (GRC)
2. Relationship between assets, vulnerabilities, threats, and risks
3. Risk assessment techniques
4. Identify models/frameworks related to Risk Management and Business Continuity

Course Outcomes:

Students will be able to:

1. Analyze how threats and vulnerabilities factor into different aspects of enterprise risk - data management, systems development life cycle, project management, business continuity and disaster recovery,
2. Review the processes of risk identification, evaluation and assessment
3. Examine different control frameworks
4. Describe several key information security compliance and industry standards including NIST, ISO 27001, GDPR, HIPAA, SANS and PCI.

Unit – I Risk Management Life Cycle **4 Hours**

Security risks, risk management life cycle

Unit – II Threat and Vulnerability Management **6 Hours**

Asset, Threat, vulnerability management

Unit – III Risk Assessment and Analysis **6 Hours**

Risk Profiling, Risk sensitivity measurement, risk impact categories

Unit – IV Risk Evaluation and Treatment **6 Hours**

Risk evaluation, Treatment : Accept, Some time Mitigation or Transfer and if not then Avoid, mitigation techniques, cost of mitigation

Unit – V Risk Monitoring and Control **8 Hours**

Security control principles, Control monitoring, control classification, frameworks – NIST, COBIT, PCI-DSS

Unit – VI Compliance Frameworks and Industry Standards **6 Hours**

Audit, Assessment and review - The Role of the Compliance Officer - The duties and responsibilities of the compliance officer and the function of compliance - The requirements of a Compliance Officer -drafting compliance reports - Designing an Internal Compliance System - Regulatory principles – Issues - Developing high-level compliance policies - Defining responsibility for compliance - The compliance function - Specific internal compliance control issues - Audit Reports - Best Practices for IT compliance and Regulatory Requirements.

Text Books

1. Evan Wheeler, "Security Risk Management Building an Information Security Risk Management Program from the Ground Up", Elsevier.
2. Douglas Landoll, "The Security Risk Assessment Handbook", CRC Press.

Reference Books

1. Bobby Rogers, Dawn Dunkerley, "CRISC Certified in Risk and Information Systems Control Exam Guide", McGraw Hill.
2. Timothy Layton, "Information Security: Design, Implementation, Measurement, and Compliance", Auerbach Publications.

Autonomous Program Structure of
B. Tech. Minor Degree in
ENGINEERING MANAGEMENT
Academic Year: 2023 Onwards

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Total Marks	Credit
		Lecture	Tutorial	Practical	In Sem	End Sem	Practical	Oral		
20MEM501	Marketing Management	3	0	0	50	50			100	3
20MEM502	Financial Management for Engineers	3	1	0	50	50			100	4
20MEM601	Industrial Operations Management	3	1	0	50	50			100	4
20MEM602	Organizational Behavior	3	0	0	50	50			100	3
20OEHS801	Lean Six Sigma & Quality Management	3	1	0	50	50			100	4
	Total	**15**	**3**	**0**	**250**	**250**			**500**	**18**
	Grand Total	**18**								

20MEM501 Marketing Management

Pre-requisite

Course Objectives:
Course prepares students to

Upon completion of the course student will able;
1. To develop a foundation of financial management concepts
2. To understand how corporations make important investment and financing decisions,
3. To calculate the time value of money to make investment decisions
4. Compare and chose the appropriate source of finance for the given need

Course Outcomes:

Students will be able to

1. Identify type of organisation and analyze partial and total productivity
2. Apply method study and work measurements technique to solve industrial problem,
3. Analyze production environment under consideration w.r.to its resource planning and control.
4. Apply operations management techniques viz. forecasting techniques, inventory control techniques, scheduling techniques etc.
5. Apply basic resource scheduling and human resource management techniques.
6.

Unit/Module: 1 Marketing Process:
Definition, Marketing process, dynamics, needs, wants and demands, value and satisfaction, marketing concepts, environment, mix. Philosophies, selling versus marketing, organizations, industrial versus consumer marketing, consumer goods, industrial goods, product hierarchy. Buying Behaviour and Market Segmentation: Major factors influencing buying behaviour, buying decision process, business buying behaviour. Segmenting consumer and business markets, market targeting.

Unit/Module: 2 Product Pricing and Marketing Research:
Objectives, pricing, decisions and pricing methods, pricing management. Introduction, uses, process of marketing research.

Unit/Module: 3 Marketing Planning and Strategy Formulation:
Components of marketing plan-strategy formulations and the marketing process, implementations, portfolio analysis, BCG, GEC grids. Advertising Sales Promotion and Distribution: Characteristics, impact, goals, types, and sales promotions – point of purchase – unique selling proposition. Characteristics, wholesaling, retailing, channel design, logistics, and modern trends in retailing.

Text Books:

1. Philip Kolter and Keller, Marketing Management, 14th Edition, Prentice Hall of India, 2012.

2. Chandrasekar, K.S., Marketing Management Text and Cases, 1st Edition, Tata McGraw Hill – Vijaynicole 2010.

Reference Books:

1. Adrain palmer, Introduction to Marketing Theory and practice, Oxford university press IE 2004
2. Czinkota and Kotabe, Marketing Management, Thomson learning, Indian edition 20072004.
3. Donald S. Tull and Hawkins, Marketing Research, Prentice Hall of India-1997.
4. Graeme Drummond and John Ensor, "Introduction to marketing concepts", Elsevier, Indian Reprint, 2007.
5. Philip Kotler and Gary Armstrong Principles of Marketing Prentice Hall of India, 2000.
6. Ramasamy and Nama kumari, Marketing Environment: Planning, implementation and control the Indian context, 1990.
7. Steven J.Skinner, Marketing, All India Publishers and Distributes Ltd. 1998.

20MEM502 Financial Management

Pre-requisite

Unit/Module: 1

Financial Management: Introduction, Meanings and Definitions, Goals of financial Management, Finance Functions, Interface between Finance and Other Business Functions, Financial Planning: Introduction, Objectives, Benefits, Guidelines, Steps in Financial Planning, Factors.

Unit/Module: 2

Affecting Financial Planning, Estimation of Financial Requirements of a Firm Time Value of Money: Introduction, Rationale, Future Value, Present Value, Bonds and Shares: Introduction, intrinsic value, book value, Valuation of Bonds, Valuation of Shares Cost of Capital: Introduction, Meaning of Cost of Capital, Cost of Different Sources of Finance, and Weighted Average Cost of Capital.

Unit/Module: 3

Sources of Finance - Introduction; Short-term Finance; Long-term Funds Capital Structure: Introduction, Features of an Ideal Capital Structure, Factors Affecting Capital Structure, Theories of Capital Structure

Suggested Texts:

Foundations of Financial Management 11th Edition, Stanley Block & Geoffrey Hirt, Published by

McGraw Hill ISBN: 0072842296

Financial Management-Principles & Practice, S N Maheshwari, S. Chand and Sons

20MEM601 Industrial Operations Management [IOM – Minor]

Pre-requisite

Course Objectives:
Course prepares students to

1. Understand type and functions of organization 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 (e.g. inventory 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. Apply method study and work measurements technique to solve industrial problem,
3. Analyze production environment under consideration w.r.to its resource planning and control.
4. Apply operations management techniques viz. forecasting techniques, inventory control techniques, scheduling techniques etc.
5. Apply basic resource scheduling and human resource management techniques.

Unit/Module: 1

Introduction to Industrial Operations Management and Productivity Analysis 7 hours

- **Industrial management:** Functions and principles of management; Organisation: Concept, characteristics, structures and types of organisation- (formal line, military, functional, line and staff organisation);
- Definition and scope of Industrial Operations Management, General model for managing operations
- **Productivity analysis:** Definition, measurement of productivity: productivity models and index (numerical); factors affecting the productivity; productivity improvement techniques;

Unit/Module: 2 Production Operations Management 7 hours

- **Production Planning and Control:** Types of production systems, Functions of Production Planning and Production Control, Aggregate production planning; Master Schedule; ERP
- **Forecasting Methods**: Qualitative and Quantitative Methods, Causal and time series models, moving average, exponential smoothing, trend and seasonality; (Numerical).
- **Supply Chain Management:** Concept, Strategies, Supply Chain Network, Push and Pull Systems, Logistics, Distribution; Order Control strategies: MTO, MTA, MTS.

Unit/Module: 3 Industrial Method Study and Work Measurements 8 hours

- **Method Study:** Definition, objective and procedural steps; activity recording tools, Human factors considerations; Value Engineering
- **Work measurement:** Definition, objectives and techniques: Time study & Work sampling, (numerical); Synthetic motion studies: PMTS and MTM, MOST

Unit/Module: 4 Facility Management 7 hours

- **Facility Layout:** Factors affecting facility location; Types of Plant Layout; Computer Aided Layout Design Techniques; Assembly Line Balancing (Numerical);
- **Material Handling, Inventory Control and Management:** Principles, Types of Material Handling Devices; Stores Management, Inventory costs, Types of Deterministic inventory models, Concept of EOQ, (Numerical); ABC and VED Analysis.

Unit/Module: 5Project Scheduling, Human Resource Management and Industrial Safety 7 hours

- **Scheduling Techniques:** CPM and PERT(Numerical);
- **Human Resource Management:** Functions: Manpower Planning, Recruitment, Selection, Training; Concept of KRA (Key Result Areas); Performance Appraisal (Self, Superior, Peer, 360^0);
- **Industrial Safety:** Introduction, examples.

Total Lecture hours: 36 hours

Text Books:

1. Introduction to Work Study by ILO, ISBN 978-81-204-1718-2, Oxford & IBH
2. Zandin K.B. - Most Work Measurement Systems, ISBN 0824709535, CRC Press, 2002.
3. Industrial engineering and management by O. P. Khanna, Dhanpatrai publication
4. Industrial Engineering , Martend Telsang, S. Chand Publication
5. Industrial Organisation & Engineering Economics by Banga and Sharma, Khanna publication.
6. Prem Kumar Gupta and D S Hira, Operations Research, S Chand in publication 2007.
7. J. K. Sharma, Operations Research: Theory And Application, Laxmi pub. India.

Reference Books:

1. H.B. Maynard, KJell, Maynard's Industrial Engineering Hand Book, McGraw Hill, Education, 2001
2. Taha, H. A. 2007, Operations Research, 8^{th} Edn, Pearson.

20MEM602 Organizational Behavior

Unit-1

OB: Learning objectives, Definition & Meaning, Why to study OB, An OB model, New challenges for OB Manager LEARNING: Nature of learning, How learning occurs, Learning & OB

Unit-2

PERSONALITY: Meaning & Definition, Determinants of Personality, Personality Traits, Personality & OB PERCEPTION: Meaning & Definition, Perceptual process, Importance of Perception in OB MOTIVATION: Nature & Importance, Herzberg's Two Factor theory, Maslow's Need Hierarchy theory, Alderfer's ERG theory.

Unit-3

COMMUNICATION: Importance, Types, Barriers to communication, Communication as a tool for improving Interpersonal Effectiveness GROUPS IN ORGANISATION: Nature, Types, Why do people join groups, Group Cohesiveness & Group Decision Making- managerial Implications, Effective Team Building

LEADERSHIP: Leadership & management, Theories of leadership- Trait theory, Behavioural Theory, Contingency Theory, Leadership & Followership, How to be an Effective Leader

CONFLICT: Nature of Conflict & Conflict Resolution

TRANSACTIONAL ANALYSIS: An Introduction to Transactional Analysis

Unit-4

ORGANISATIONAL CULTURE: Meaning & Definition, Culture & Organizational Effectiveness

HUMAN RESOURCE MANAGEMENT: Introduction to HRM, Selection, Orientation, Training & Development, Performance Appraisal, Incentives

ORGANISATIONAL CHANGE: Importance of Change, Planned Change & OB Techniques

INTERNATIONAL OB: An Introduction to Individual & Interpersonal Behaviour in Global Perspectives

Reference Book:

1. Luthans, Fred: Organizational Behaviour 10/e, McGraw-Hill, 2009

2. McShane: Organizational Behaviour, 3e, TMH, 2008

3. Nelson: Organizational Behaviour, 3/e, Thomson, 2008.

4. Newstrom W. John and Davis Keith, Organisational Behaviour– Human Behaviour at Work, 12/e, TMH, New Delhi, 2009.

5. Pierce and Gardner: Management and Organisational Behaviour: An Integrated perspective, Thomson, 2009.

6. Robbins, P. Stephen, Timothy A. Judge: Organisational Behaviour, 12/e, PHI/Pearson, New Delhi, 2009.

7. Pareek Udai: Behavioural Process at Work: Oxford and IBH, New Delhi, 2009.

8. Schermerhorn: Organizational Behaviour 9/e, Wiley, 2008.

9. Hitt: Organizational Behaviour, Wiley, 2008

10. Aswathappa: Organisational Behaviour, 7/e, Himalaya, 2009

11. Mullins: Management and Organisational Behaviour, Pearson, 2008.

12. McShane, Glinow: Organisational Behaviour–Essentials, TMH, 2009.

13. Ivancevich: Organisational Behaviour and Management, 7/e, TMH, 2008.

20MEM801 Lean Six Sigma and Quality Management

Pre-requisite Manufacturing Process, Industrial Inspection, Quality Control

Course Objectives:

Course prepares students to

1. Effectively explain concept of **Lean Six Sigma**.
2. Understand different types of analysis using industrial engineering techniques viz. Method Study and Work Measurements
3. Develop mathematical skills to analyse Project Scheduling arising from a wide range of applications.
4. **Understand** the process of use of Quality Control Technique in engineering industries.
5. **Understand** Quality Management System.

Course Outcomes:

Students will be able to

1. **Apply** required tools and techniques to define CTQs and lean six sigma project charter
2. **Apply** required tools and techniques to measure the process characteristics related to defined project.
3. **Analyze** the process characteristics related to defined project using appropriate tools and techniques.
4. **Suggest** implementation strategies for improvements and control procedures related to defined project.
5. **Analyse** clauses wise (operational level) requirements for selected QMS

Unit/Module: 1 Lean Six Sigma Fundamentals *[Green Belt]* **8 hours**
Lean Six Sigma (Introduction): Introduction to Lean Six Sigma: DMAIC,
Lean Fundamentals and Key Concepts: Process Flow and Value Stream Mapping, Process Waste: Muda, Mura and Muri, The 7 Wastes, VOC, CTQs and COPQ, Quality Techniques

Unit/Module: 2 Define and Measure Phases **8 hours**
Define Phase: Six Sigma Principles, Problem Definition, Project Selection, Business Case, Quality Function Deployment (QFD), Process Mapping: SIPOC, Project Charter and Monitoring, Measure Phase: Process Discovery, Process characteristics and analysis, Data Collection and Summarization, Six Sigma Statistics, Measurement System Analysis: Gage R&R study, Process Capability Estimation.

Unit/Module: 3 Analyze Pha **8 hours**
Parameter identification, Hypothesis Testing, Selection of Analysis Methods, Multi-vari Analysis, Failure Mode Effect Analysis (FMEA)
Inferential Statistics: Selection, Correlation and Regression Analysis,

Unit/Module: 4 Improve and Control Phases **6 hours**
Improve Phase: Lean Tools for improvement, Implementation strategies for improvements,
Control Phase: Control Plans, Statistical Process Control (SPC), Control Charts, Control strategies.
Six Sigma Case study.

Unit/Module: 5Quality Management **6 hours**

Quality Management System– Need and design of QMS,
QMS requirements – ISO 9001, TS-16949, ISO-14000, PPAP, Quality Audit.

Total Lecture hours: 36 hours

Text Books:

1. Evans, J R and W M Lindsay (2005). An Introduction to Six Sigma and Process Improvement, CENGAGE.
2. Pyzdek, Thomas (2005). **The Six Sigma Handbook Revised and Expanded**, Quality America Incorporated.
3. Montgomery, D C. **Statistical Quality Control**: A modern introduction, Wiley.
4. Kulkarni V. A. and Bewoor A. K., (2009). **Quality Control,** John Wiley Publication.
5. Howard S. Gitlow and David M. Levine**, Six Sigma for Green Belts and Champions**, Pearson Education, Inc.

Reference Books:

1. Juran J. M., **Quality Handbook,** McGraw Hill Publications.
2. Montgomery, D C (2007). **Design and Analysis of Experiments**, 5th ed., Wiley

- Web references:
  - https://www.sixsigmacouncil.org/six-sigma-training-material/
  - https://www.processexam.com/iassc/iassc-certified-lean-six-sigma-green-belt-icgb-syllabus
  - https://www.usi.edu/media/5618492/dalrymple-mba604-sp19.pdf
  - https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-660j-introduction-to-lean-six-sigma-methods-january-iap-2012/syllabus/

Autonomous Program Structure
B.Tech in **All Discipline**
with **Minor Degree Programme** in
Entrepreneurship
Academic Year: 2022-2023 Onwards

Course Code	Year and Semester	Course Title	Teaching Scheme (hours/week)			Marks	Credits
			Lectures	Tutorial	Practical		
20MEN501	TY Sem I	Business Essentials	3	0	0	100	3
20MEN502	TY Sem I	Human Resource and relationship management	3	0	0	100	3
20MEN501L	TY Sem I	Business Essentials Lab	0	0	2	50	1
20MEN601	TY Sem II	Advanced Entrepreneurship	3	0	0	100	3
20MEN602	TY Sem II	Financial management for venture	3	0	0	100	3
20MEN601L	TY Sem II	Advanced Entrepreneurship Lab	0	0	2	50	1
20MEN801	Final Year Sem II	Launch and Fund ready	3	0	0	100	3
20MEN801L	Final Year Sem II	Launch and fund ready Lab	0	0	2	50	1
		Total	15	0	6	650	18
		Grand Total	21			650	18

20MEN501 BUSINESS ESSENTIALS

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
ISE: 50 Marks
ESE: 50 Marks
Credits: 3

Prerequisite: NIL

Course Objectives:

1. To introduce different types of businesses and the overall ecosystem
2. To apply theories in practice such as game theory for business negotiations, pricing strategies
3. To identify types of customers and customer psychology
4. To understand the practical use of business protection through IPR

Course Outcomes:

After completion of the course, students will be able to

CO1 Explore business types and ecosystem involved
CO2 Apply appropriate pricing strategy considering product/service and market
CO3 Examine the customer psychology and identify the needs of the customer
CO4 Develop strategy for business protection using IPR

Contents:

Unit I: Introduction to business essentials 8

Business entities: private, partnership, public, limited. Business Products/services domains: manufacturing, trading, retailer, SAAS, consultancy, maintenance. Business Analysis: market competition, risk, financial, demand, brand. Business planning: roadmap. Ecosystem: startup opportunities, support systems

Unit II: Business practices 8

Branding: brand strategy and positioning in the market. Pricing strategies: premium, competitive, minimum, demand based, cost based. Negotiations: gaming theory. Business ethics: commitments, compliances.

Unit III: Customer Psychology 8

Customer psychology frameworks, Cognition and affect, Knowledge and beliefs, Types of customers: B2B and B2C, Decision maker/makers, consumer behavior, motivation and perception, attitudes, decision making process, customer satisfaction and delight, CRM.

Unit IV: IPR 8

Importance of IP, Patentable inventions, Copyright, Trade Marks, Patent searching, Geographical Indications, ownership and infringement. Patent application: problem solution statement, claims, preamble, body, summary

Text Books:

1. A handbook for entrepreneurs: https://static.america.gov/uploads/sites/8/2017/05/Startup-Smart_A-Handbook-for-Entrepreneurs_English_20140322_Hi-Res.pdf
2. Game Theory and its business Applications: Anurag Korlakunta Manish Yadav
3. Consumer behavior: https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_CB_Lecture%20_Notes.pdf
4. Venkataraman M., "An introduction to Intellectual property Rights", Venkataraman M.

Reference Books:

1. Business analysis handbook:http://analyst.by/wp-content/uploads/2013/02/Course-Technology-The-Business-Analysts-Handbook.pdf
2. Harvard business essentials negotiations: https://law.bsu.by/pub/14/Harvard_Business_Essentials_Negotiation.pdf
3. Handbook of Consumer Psychology PDF available at https://carlsonschool.umn.edu/sites/carlsonschool.umn.edu/files/2020-03/loken%20barsalou%20joiner%20handbook%20of%20cp.pdf
4. R Puri, "Practical approach to intellectual property Rights"

Online Resources:

Business ecosystems: https://www2.deloitte.com/content/dam/insights/us/articles/platform-strategy-new-level-business-trends/DUP_1048-Business-ecosystems-come-of-age_MASTER_FINAL.pdf
Pricing strategy: https://www.uschamber.com/co/run/finance/pricing-strategies-for-your-business
Game Theory : https://www.youtube.com/watch?v=gDA3mbeJMOE
https://www.researchgate.net/publication/46540815_AN_INTRODUCTION_TO_GAME_THEORY_AND_BUSINESS_STRATEGY
Principles and practices of management
https://www.elearning.panchakotmv.in/files/335B6FFC15896569440.pdf
Consumer behavior
https://books.mec.biz/tmp/books/NXHQRTHBQ2L87NIU6YVN.pdf
Consumer Psychology
https://www.emotiv.com/glossary/consumer-psychology/
Intellectual Property (IP) Policy | USPTO - https://www.uspto.gov/intellectual property-ip-policy
The NPTEL course material on "Patent Drafting for Beginners" - https://onlinecourses.nptel.ac.in/noc18_hs17/preview

Milestone Presentations:

1. Market Survey of specific industry with product/service
2. Business strategies for specific product/service
3. Customer profiling and psychology assessment
4. Proposed IP plan

20MEN502 Human Resource and Relationship Management

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
ISE: 50 Marks
ESE: 50 Marks
Credits: 3

Prerequisite: NIL

Course Objectives:

1. To introduce human resource management
2. To design hiring strategy for the organization
3. To identify importance of human relationship with building organization
4. To explore organization structures and functional requirements

Course Outcomes:

After completion of the course, students will be able to

CO1 Explore sources of hiring human resources
CO2 Design a hiring plan along with job description and KRAs
CO3 Examine the role of interpersonal relationships for sustainable growth of the organization
CO4 Demonstrate importance of organization structure and continuous training

Contents:

Unit I: Introduction to human resource management 8

Human resource management: Key Requirements, Planning, Organization plan, Selection, Orientation, Training requirements, Laws, Types of recruitments, workplace environment, retention and motivation, challenges in current situations

Unit II: Hiring Strategy and planning 8

Identification of human resource needs, timelines, plan for hiring, sources of hiring, recruitment planning and procedures, compensation and facilities, Diversity, writing job descriptions and KRAs, Selection process, training and development, growth plans for employees

Unit III: Human relationship management 8

Role of human relationship in building organization: ethics, loyalty, trust, personal relations. Performance appraisal, conflict management, stress management, Types of leaderships and impact on employees, teamwork, co-ordination and cooperation of individuals involved.

Unit IV: Organization structure and functional requirements 8

Types of organization structures, Advantages and disadvantages of different structures, Individual and organizational goal alignment for growth, functional roles, responsibilities, authorities, activity flows, delegation, changing dynamics and flexibility in structures

Text Books:

1. Human relationship management
   https://brauss.in/hrm-basic-notes.pdf
2. https://www.opentextbooks.org.hk/system/files/export/32/32088/pdf/Human_Resource_Management_32088.pdf
3. http://anucde.info/Contemporary%20Administrative%20Theory.pdf
4. https://ils.unc.edu/daniel/405/Montana11.pdf

Reference Books:

1. https://www.ipa.ie/_fileUpload/Documents/THE_PRACTICE_OF_HRM.pdf
2. https://www.sscasc.in/wp-content/uploads/downloads/BBM/Human-Resource-Management.pdf
3. https://thebusinessprofessor.com/en_US/management-leadership-organizational-behavior/human-relations-theory-of-management
4. http://pvkketcho.pbworks.com/f/Chapter13_Org_Structure.pdf

Online Resources:

https://www.researchgate.net/publication/305954894_Human_Resource_Management_Theory_and_Practice
https://www.aihr.com/blog/human-resource-basics/
https://www.whatishumanresource.com/human-resource-management
https://www.youtube.com/watch?v=aA1OlFHZWtU
https://nanoglobals.com/glossary/human-relations-management-theory/#:~:text=Human%20Relations%20management%20theory%20is,worker%20as%20a%20unique%20individual.
https://www.slideshare.net/JackOng10/human-relation-theoryl5
http://www.himpub.com/documents/Chapter2553.pdf
https://www.investopedia.com/terms/o/organizational-structure.asp#:~:text=An%20organizational%20structure%20is%20a,between%20levels%20within%20the%20company.

Milestone Presentations:

1. Human resource planning and strategy for venture
2. People plan with job descriptions and KRAs
3. Organization vision, mission, values and human relationship plans
4. Organization structure with function roles, responsibilities, activity flows

20MEN501L BUSINESS ESSENTIALS LAB

Teaching Scheme
Laboratory: 2 Hours / Week

Examination Scheme
ISE: 25 marks
Oral: 25 marks
Credits: 1

Prerequisite: NIL

Course Objectives:

1. To introduce different businesses and the overall ecosystem
2. To apply theories in practice such as game theory for business negotiations, pricing strategies
3. To identify types of customers and customer psychology
4. To understand the practical use of business protection through IPR

Course Outcomes:

After completion of the course, students will be able to

CO1 Explore business types and ecosystem involved
CO2 Apply appropriate pricing strategy considering product/service and market
CO3 Examine the customer psychology and identify the needs of the customer
CO4 Develop strategy for business protection using IPR

Suggested Sample assignments:

The instructor can decide and modify assignments considering the need of the hour

1. Study of overall business ecosystem
2. Study of business ecosystem for specific business
3. Identify business skills for specific business and demonstrate at least one skill
4. Analyze latest business articles/blogs related to a specific domain and summarize them
5. Identify and explore profiles of people working in similar domain via Linked inn and analyze them to identify the skills/ possible connections/ networking.
6. Identify challenges and role of EQ in the specific business
7. Demonstrate with suitable examples how game theory can be applied for the specific business domain
8. Build model of consumer decision making process for specific product or service, including societal, cultural, personal, perceptional issues
9. Case study of decision-making process like IPL auction, Mergers and acquisitions etc.
10. Build IPR strategy for the specific business

Text Books:

1. A handbook for entrepreneurs: https://static.america.gov/uploads/sites/8/2017/05/Startup-Smart_A-Handbook-for-Entrepreneurs_English_20140322_Hi-Res.pdf
2. Game Theory and its business Applications: Anurag Korlakunta Manish Yadav

3. Consumer behavior: https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_CB_Lecture%20_Notes.pdf
4. Venkataraman M., "An introduction to Intellectual property Rights", Venkataraman M.

Reference Books:

1. Business analysis handbook: http://analyst.by/wp-content/uploads/2013/02/Course-Technology-The-Business-Analysts-Handbook.pdf
2. Harvard business essentials negotiations: https://law.bsu.by/pub/14/Harvard_Business_Essentials_Negotiation.pdf
3. Handbook of Consumer Psychology PDF available at: https://carlsonschool.umn.edu/sites/carlsonschool.umn.edu/files/2020-03/loken%20barsalou%20joiner%20handbook%20of%20cp.pdf
4. R Puri, "Practical approach to intellectual property Rights"

Online Resources:

Business ecosystems: https://www2.deloitte.com/content/dam/insights/us/articles/platform-strategy-new-level-business-trends/DUP_1048-Business-ecosystems-come-of-age_MASTER_FINAL.pdf
Pricing strategy: https://www.uschamber.com/co/run/finance/pricing-strategies-for-your-business
Game Theory: https://www.youtube.com/watch?v=gDA3mbeJMOE
https://www.researchgate.net/publication/46540815_AN_INTRODUCTION_TO_GAME_THEORY_AND_BUSINESS_STRATEGY
Principles and practices of management
https://www.elearning.panchakotmv.in/files/335B6FFC15896569440.pdf
Consumer behavior
https://books.mec.biz/tmp/books/NXHQRTHBQ2L87NIU6YVN.pdf
Consumer Psychology
https://www.emotiv.com/glossary/consumer-psychology/
Intellectual Property (IP) Policy | USPTO - https://www.uspto.gov/intellectual property-ip-policy
The NPTEL course material on "Patent Drafting for Beginners" - https://onlinecourses.nptel.ac.in/noc18_hs17/preview

20MEN601 Advanced Entrepreneurship

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
ISE: 50 Marks
ESE: 50 Marks
Credits: 3

Prerequisite: NIL

Course Objectives:

1. To understand the importance of pivoting
2. To refine your business model
3. To orient your customer acquisition, operations, revenue and sales strategy
4. To list and comply with the requirements relating to regulatory compliance

Course Outcomes:

After completion of the course, students will be able to

CO1 Refine business model and Identify additional customer segments
CO2 Develop channels and strategy for budgeting and planning
CO3 Analyze opportunities for growing revenues, strengthening sales and improving margins
CO4 Estimate customer lifetime value and competition for venture growth

Contents:

Unit I: Refining the Business Model and Product/Service 8

Growth stage, Product market fit, Refine business model, Identification of additional customer segments, Evaluate business model for new segments, Relook at the problem statement for possible expansion, Solution refinement

Unit II: Traction 8

Traction beyond early customers, Costs of customer acquisition, Customer lifetime value, Identify waste in operations, Focus on key operations, Bullseye framework, Channel identification, Measuring effectiveness of channels, Budgeting and planning

Unit III: Money 8

Developing additional revenue streams, Sales planning, unique value proposition (UVP), Strengthening sales, Improving margins, Testing price elasticity, Optimization of costs, Financial modeling for venture growth, Competition analysis, Financing for the growth

Unit IV: Building A Team and Support 8

Building a team beyond founders, stock options, HR needs of growing business, Identify technology needs, cost estimation of using technology, Technology as a differentiator and competitive advantage, Professional help for legal matters, Mentors, Advisors, Experts

Text Books:

1. http://businessmodels.eu/images/BUSINESS_MODELS_compendium_EN.pdf

2. https://www.pdfdrive.com/traction-get-a-grip-on-your-business-e199827090.html
3. https://assets.kpmg/content/dam/kpmg/ca/pdf/2021/04/cost-optimization-playbook-en.pdf
4. http://yespartners.com/wp-content/uploads/2017/07/Building_Your_Startup_Team-EJ-1012.pdf

Reference Books:

1. http://www.bmcommunity.sitew.com/fs/Root/8jig8-businessmodelsbusinessstrategy.pdf
2. https://www.pdfdrive.com/traction-how-any-startup-can-achieve-explosive-customer-growth-e157096822.html
3. https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/Marketing%20and%20Sales/Our%20Insights/The%20new%20growth%20game/The-new-growth-game-Web.pdf
4. https://repository.upenn.edu/cgi/viewcontent.cgi?article=1016&context=ace

Online Resources:

https://www.marketing91.com/5-types-of-business-growth/
https://www.indeed.com/career-advice/career-development/types-of-business-growth
https://brianbalfour.com/essays/traction-the-bullseye-framework
https://www.designwithvalue.com/bullseye-framework
https://neilpatel.com/blog/customer-acquisition-cost/
https://www.masterclass.com/articles/unique-value-proposition-guide#what-is-a-unique-value-proposition
https://devrix.com/tutorial/10-key-success-factors-for-startups/
https://desktime.com/blog/optimize-business-costs-in-2020
https://otm.illinois.edu/sites/default/files/Start-Up%20Handbook%20for%20web.pdf
https://www.startupindia.gov.in/content/sih/en/reources/resource-partners/legal/Law-wagon.html
https://www.indialegallive.com/10-legal-advice-for-startups-business-in-india/
Shark Tank USA and India videos

Milestone presentations:

1. Refined business model and MVP for venture
2. Traction for the venture with customer and channel focus
3. Growth plan with cost optimization and building revenue streams
4. Proposed A team and support systems

20MEN602 Financial management for ventures

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
ISE: 50 Marks
ESE: 50 Marks
Credits: 3

Prerequisite: NIL

Course Objectives:

1. To introduce finance management for ventures
2. To design a financial plan with probable costs, revenues to check financial sustainability
3. To analyze budgeting requirements, assets and liabilities, cash flow, risks involved
4. To explore financial schemes and taxation for the ventures

Course Outcomes:

After completion of the course, students will be able to

CO1 Explore the needs of finance and importance of finance management
CO2 Design a financial plan for 1 to 3 years
CO3 Examine the scalability, sustainability and financial risks involved
CO4 Develop a project report for financial institutions

Contents

Unit I: Introduction to finance for ventures 8

Venture financing institutes, Seed capital, Requirement of funding and stages, Equity or debt, parameters for financing startup ventures, Financial analysis: Health of organization, balance sheet, cash flow analysis, profitability projection, market potential and scalability, a pitch deck

Unit II: Financial management 8

Capital budgeting, Payback periods, rate of return, Net Present Value, profitability index, balance sheet, Assets, current Vs. long term liabilities, liquidity, Gig economy: how it works, benefits and issues, scalability and finance management, new approaches for financing

Unit III: Risk management 8

Risk management, Types of risks: operational, management, market, technology, valuation, project, growth, competition, timing. Risk assessment, credits, insurance, SWOT analysis, market survey, future predictions, contingency plans

Unit IV: Project report for financial institutions 8

Identification of sources of finance, Government schemes, taxation, elements of project report: summary and scope of venture, promoter details, Product/service, funding requirements with details of fund utilization, Market potential, financial statements

Text Books:

1. https://www.accaglobal.com/content/dam/ACCA_Global/Technical/smb/pi-financial-management-entrepreneurs.pdf
2. https://www.sba.gov/sites/default/files/files/PARTICIPANT_GUIDE_FINANCIAL_MANAGEMENT.pdf
3. https://www.ige.unicamp.br/neal/wp-content/uploads/sites/51/2015/07/Book-Chapter_Vonortas-Kim_2015.pdf
4. https://www.oecd.org/cfe/smes/New-Approaches-SME-full-report.pdf

Reference Books:

1. https://www.ycombinator.com/library/4A-a-guide-to-seed-fundraising
2. https://www.coursera.org/learn/finance-for-startups
3. https://www.citigroup.com/citi/citizen/community/data/guide4_eng.pdf
4. https://www.pay4.com/wp-content/uploads/2017/03/The-Business-Owners-Guide-to-Scaling-Up-Successfully.pdf

Online Resources:

https://digify.com/blog/startup-funding-guide/
https://www.investopedia.com/articles/personal-finance/102015/series-b-c-funding-what-it-all-means-and-how-it-works.asp
https://www.slideshare.net/AlpsVP/venture-funding-guide-for-startups-india-region
https://www.researchgate.net/publication/328081416_Risk_management_and_financing_among_Start-ups
https://core.ac.uk/download/pdf/84799568.pdf
https://www.investopedia.com/articles/financial-theory/11/corporate-project-valuation-methods.asp
https://cleartax.in/s/capital-budgeting
https://digit.business/financial-literacy/what-is-an-asset-what-is-a-liability#:~:text=In%20its%20simplest%20form%2C%20your,and%20liabilities%20take%20money%20out!
https://www.investopedia.com/terms/g/gig-economy.asp

https://udyamregistrationform.com/project-report-on-bank-loan/

Milestone Presentations:

1. Financial plan with risk analysis
2. Refined financial plan with at least 3 year projections with proposed growth
3. Fund raising plan with possible sources, and financial schemes applicable
4. Project Report for financial institutes

20MEN601L Advanced Entrepreneurship Lab

Teaching Scheme
Laboratory: 2 Hours / Week

Examination Scheme
ISE: 25 Marks
Oral: 25 Marks
Credits: 1

Prerequisite: NIL

Course Objectives:

1. To understand the importance of pivoting
2. To refine your business model
3. To orient your customer acquisition, operations, revenue and sales strategy
4. To list and comply with the requirements relating to regulatory compliance

Course Outcomes:

After completion of the course, students will be able to

CO1 Refine business model and identify additional customer segments
CO2 Develop channels and strategy for budgeting and planning
CO3 Analyze opportunities for growing revenues, strengthening sales and improving margins
CO4 Estimate customer lifetime value and competition for venture growth

Suggested Sample assignments:

The instructor can decide and modify assignments considering the need of the hour

1. Explore the possible need of pivoting
2. Identify new customer segment and evaluate
3. Refine product market fit
4. Estimate cost of customer acquisition and Customer lifetime value
5. Identify waste in operations and key operations
6. Apply bulls eye framework to identify channels and evaluate
7. Refine UVP for sales proposition and positioning
8. Identify additional revenue streams
9. Identify technology needs and possible leverage over competition
10. Identify needs of growing business and explore the scalability of the venture

Text Books:

1. http://businessmodels.eu/images/BUSINESS_MODELS_compendium_EN.pdf
2. https://www.pdfdrive.com/traction-get-a-grip-on-your-business-e199827090.html
3. https://assets.kpmg/content/dam/kpmg/ca/pdf/2021/04/cost-optimization-playbook-en.pdf
4. http://yespartners.com/wp-content/uploads/2017/07/Building_Your_Startup_Team-EJ-1012.pdf

Reference Books:

1. http://www.bmcommunity.sitew.com/fs/Root/8jig8-businessmodelsbusinessstrategy.pdf
2. https://www.pdfdrive.com/traction-how-any-startup-can-achieve-explosive-customer-growth-e157096822.html
3. https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/Marketing%20and%20Sales/Our%20Insights/The%20new%20growth%20game/The-new-growth-game-Web.pdf
4. https://repository.upenn.edu/cgi/viewcontent.cgi?article=1016&context=ace

Online Resources:

https://www.marketing91.com/5-types-of-business-growth/
https://www.indeed.com/career-advice/career-development/types-of-business-growth
https://brianbalfour.com/essays/traction-the-bullseye-framework
https://www.designwithvalue.com/bullseye-framework
https://neilpatel.com/blog/customer-acquisition-cost/
https://www.masterclass.com/articles/unique-value-proposition-guide#what-is-a-unique-value-proposition
https://devrix.com/tutorial/10-key-success-factors-for-startups/
https://desktime.com/blog/optimize-business-costs-in-2020
https://otm.illinois.edu/sites/default/files/Start-Up%20Handbook%20for%20web.pdf
https://www.startupindia.gov.in/content/sih/en/reources/resource-partners/legal/Law-wagon.html
https://www.indialegallive.com/10-legal-advice-for-startups-business-in-india/
Shark Tank USA and India videos

20MEN801 Launch and Fund Ready

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
ISE: 50 Marks
ESE: 50 Marks
Credits: 3

Prerequisite: NIL

Course Objectives:

1. To review the venture plan
2. To apply the appropriate business strategy
3. To identify funding opportunities and prepare pitch for investors
4. To explore and decide the type of company and business compliances needed

Course Outcomes:

After completion of the course, students will be able to

CO1 Formulate and analyze the venture plan
CO2 Apply appropriate business strategy considering product/service and market
CO3 Examine the funding opportunities
CO4 Develop pitch deck for potential stakeholders including investors

Contents:

Unit I: Review of venture plan **8**

Executive summary, Company description, Product/service description, Marketing plan, Operational plan, Management and Organization, Setup expenses and financial plan, Agreements, IP, Market Research studies, Specific requirements and plan.

Unit II: Business strategies **8**

Social, cultural and commercial forces, Strategic decision making, scenario thinking, growth strategy, competitive strategy, customer focus, knowledge and information, technology and tools, marketing and branding, managing finance and risk, leadership

Unit III: Funding opportunities **8**

Types and sources of financing, Recent trends in Indian startup ecosystem, the role of innovation, Types of funding, Government support, VC activity in India, Emerging sectors, Unicorns and potential disruptors, World canvas, challenges for funding.

Unit IV: Company formation and Pitch deck preparation **8**

Types of companies, company registration and procedures, compliances. Potential stakeholders, including potential employees, suppliers/distributors, investors. Branding pitch for promotion and strategy, Company formation: registration, business compliances

Text Books:

1. https://vhsbi.com/wp-content/uploads/2019/02/Startup-Business-Plan-Template.pdf

2. http://www.hostgator.co.in/files/writeable/uploads/hostgator12628/file/businessstrategyaguidetotakingyourbusinessforward.pdf
3. https://www.adb.org/sites/default/files/publication/612516/adbi-wp1145.pdf
4. https://www.jumpstartinc.org/wp-content/uploads/2016/09/Investor-Pitch-Tool-9616.pdf

Reference Books:

1. Business plan for new ventures https://www.diva-portal.org/smash/get/diva2:3939/FULLTEXT01.pdf
2. https://www.canr.msu.edu/field_crops/uploads/archive/Business%20plan%20for%20Startups.pdf
3. https://www.extension.iastate.edu/agdm/wholefarm/pdf/c5-92.pdf
4. https://visme.co/blog/best-pitch-decks/

Online Resources:

https://omarndiaye.files.wordpress.com/2011/07/milestones-for-successful-venture-planning.pdf
https://www.wrike.com/blog/12-steps-to-a-startup-business-plan-infographic/#What-is-a-startup-business-plan
https://www.forbes.com/sites/allbusiness/2018/09/17/dont-waste-time-on-a-startup-business-plan-do-these-5-things-instead/?sh=7a57e32037a6
https://masschallenge.org/article/technology-startup-business-plan
https://businessjargons.com/business-strategy.html#:~:text=A%20business%20strategy%20is%20a,to%20reach%20the%20desired%20ends.
https://www.imd.org/imd-reflections/reflection-page/business-strategy/
https://strategyforexecs.com/business-strategy/
http://www.bmcommunity.sitew.com/fs/Root/8jig8-businessmodelsbusinessstrategy.pdf
https://www.startupindia.gov.in/content/sih/en/funding.html
https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2020-chapter4.pdf
https://www.startupindia.gov.in/content/sih/en/forum/forum-details.5d74e5a4e4b0fad8ed6bf704.html
Shark Tank USA and India videos

Milestone presentations:

1. Pitch deck with a venture plan for potential employees/ suppliers
2. Pitch deck for business strategy for potential stakeholders
3. Pitch deck to VCs for fund raising
4. Company formation and compliance documents

20MEN801L LAUNCH AND FUND READY LAB

Teaching Scheme
Laboratory: 2 Hours / Week

Examination Scheme
ISE: 25 marks
Oral: 25 marks
Credits: 1

Prerequisite: NIL

Course Objectives:

1. To review and revise the venture plan
2. To apply the appropriate business strategies
3. To identify funding opportunities and prepare pitch for investors
4. To explore and decide the type of company and business compliances needed

Course Outcomes:

After completion of the course, students will be able to

CO1 Formulate and analyze the venture plan
CO2 Apply appropriate business strategy considering product/service and market
CO3 Examine the funding opportunities
CO4 Develop pitch deck for potential stakeholders including investors

Suggested Sample assignments:

The instructor can decide and modify assignments considering the need of the hour

1. Write executive summary
2. Write company and product/service description
3. Identify and write specific requirements
4. Develop strategy for growth and competition
5. Develop strategy for customer focus
6. Identify use of technology and tools for the venture
7. Identify funding opportunities for venture
8. Preparing for a company formation procedure with all required documents
9. Identify the compliances and prepare documents for same
10. Develop pitch deck for investors

Text Books:

1. https://vhsbi.com/wp-content/uploads/2019/02/Startup-Business-Plan-Template.pdf
2. http://www.hostgator.co.in/files/writeable/uploads/hostgator12628/file/businessstrategyaguidetotakingyourbusinessforward.pdf
3. https://www.adb.org/sites/default/files/publication/612516/adbi-wp1145.pdf
4. https://www.jumpstartinc.org/wp-content/uploads/2016/09/Investor-Pitch-Tool-9616.pdf

Reference Books:

1. Business plan for new ventures
   https://www.diva-portal.org/smash/get/diva2:3939/FULLTEXT01.pdf
2. https://www.canr.msu.edu/field_crops/uploads/archive/Business%20plan%20for%20Startups.pdf
3. https://www.extension.iastate.edu/agdm/wholefarm/pdf/c5-92.pdf
4. https://visme.co/blog/best-pitch-decks/

Online Resources:

https://omarndiaye.files.wordpress.com/2011/07/milestones-for-successful-venture-planning.pdf
https://www.wrike.com/blog/12-steps-to-a-startup-business-plan-infographic/#What-is-a-startup-business-plan
https://www.forbes.com/sites/allbusiness/2018/09/17/dont-waste-time-on-a-startup-business-plan-do-these-5-things-instead/?sh=7a57e32037a6
https://masschallenge.org/article/technology-startup-business-plan
https://businessjargons.com/business-strategy.html#:~:text=A%20business%20strategy%20is%20a,to%20reach%20the%20desired%20ends.
https://www.imd.org/imd-reflections/reflection-page/business-strategy/
https://strategyforexecs.com/business-strategy/
http://www.bmcommunity.sitew.com/fs/Root/8jig8-businessmodelsbusinessstrategy.pdf
https://www.startupindia.gov.in/content/sih/en/funding.html