7.3.1

Highlight the performance of the institution in an area distinct to its priority and thrust.

Additional Information:

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20
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IN CREATING ENGINEERS
aitam
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DATA SCIENCE — MAJOR
ROBOTICS — MINOR
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DATA SCIENCE — MINOR

Urban Planning and Essentials of Smart Cities

Course Code: 20SCT201

L	T	P	C
4	0	0	4

COURSE OBJECTIVES

Students will have

- To interpret and illustrate trends of urbanisation.
- To explain various urban development plans.
- To illustrate design and development of urban development projects.
- To comprehend essential aspects of smart and sustainable cities.
- To infer policy planning and development of smart cities.
- To recognize the role of Governance in addressing the urban challenges and key issues

COURSE OUTCOME

1. Interpret and illustrate trends of urbanisation.
2. Explain various urban development plans.
3. Illustrate design and development of urban development projects.
4. Comprehend essential aspects of smart and sustainable cities.
5. Infer policy planning and development of smart cities.
6. Recognize the role of Governance in addressing the urban challenges and key issues

UNIT I

Basics of Urbanisation:

Definition of Human settlement, Urban area, Town, City, Urbanisation, Suburbanisation, Urban sprawl, Peri - urban areas, Central Business District (CBD), Classification of urban areas, Trends of Urbanisation at International, National, Regional and State level.

UNIT II

Urban Plan Formulation:

Scope and Content of Regional Plan, Master Plan, Detailed Development Plan, Development Control Rules, Transfer of Development Rights, Special Economic Zones- Development of small town and smart cities- case studies

UNIT III

Planning And Design Of Urban Development Projects:

Site Analysis, Layout Design, Planning Standards, Project Formulation – Evaluation, Plan Implementation, Constraints and Implementation, Financing of Urban Development Projects

UNIT IV

Overview of Smart Cities:

Defining smart cities, Dimension, components and categories of smart cities. Global Standards and performance benchmarks, Practice codes.

UNIT V

Planning of Smart Cities:

General prerequisites of smart cities, Policy frame work for smart cities. India 100 smart cities policy and mission, planning and development.

UNIT VI

Smart Governance:

Definitions, functions, objectives and benefits of smart Governance. Infrastructure for smart governance. Initiatives and implementation stages of smart governance.

Text Books:

1. Allen G.Noble, (Eds), 'Regional Development and Planning for the 21st Century: New Priorities and New Philosophies', Aldershot, USA, 1988.
2. Andy Pike, Andres Rodriguez-Pose, John Tomaney, 'Handbook of Local and Regional Development', Taylor & Francis, 2010
3. Andreas Faludi and Sheryl Goldberg, 'Fifty years of Dutch National Physical Planning, Alexandrine Press, Oxford, 1991.
4. Daniel G. Parolek, AIA, Karen Parolek, Paul C. Crawford, FAICP, Form Based Codes: A Guide for Planners, Urban Designers, Municipalities, and Developers, John Wiley & Sons, 2008
5.Smart Cities: Big Data and the Quest for a New Utopia, Anthony M. Townsend, ISBN: 978-0-393-08287-6

References:

1. A.B. Gillion and Simon Eisner, "The Urban Pattern", CBS Publishers and Distributors, Delhi. 2. Ward S (2002), "Planning the 20th Century City" John Wiler & Sons.
3. R. Ramachandran, "Urbanisation and Urban Systems in India", Oxford Publications.
4. FAIR, G.M., GAYER, J.C. AND OKUN, D.A., "Elements of water supply and Waste water Disposal", John Wiley & Sons, New York.
5. TCPO AND MINISTRY OF WORKS AND HOUSING, "Norms and Standards for Urban Water Supply and Sewerage Services", New Delhi.
6. National Institute of Urban Affairs, "status of water supply, sanitation and solid waste management in urban area" 2005,
7. Transforming City Governments for Successful Smart Cities, Editor: Manuel Pedro Rodriguez-Bolivar ISBN: 978-3-319-03166-8

SMART ENERGY & TRANSPORTATION SYSTEMS

(Honors/Minor Course)

Course Code: 20SCT302

L	T	P	C
4	0	0	4

Course Objectives:

The objective of the course is

1. To explain smart energy and net zero energy buildings
2. To explain development of smart cities through solar energy
3. To explain Electric vehicles and EV-ecosystems
4. To explain smart transport system
5. To explain ICT support to smart transport system
6. To explain case studies on smart energy and transport system

Course Outcomes:

Students will get ability to:

1. understand smart energy and energy plus building
2. comprehensive importance of solar energy in development of smart cities
3. synthesize the Electric vehicles and EV-ecosystems
4. understand smart transport system
5. comprehensive ICT support in smart transport system
6. study case studies on smart energy and transport system

Unit I

Smart Energy: - Defining the concept of smart energy, Objectives of smart energy; Elements of smart energy management system. Energy efficient building. Net zero energy and energy plus buildings, building codes and energy efficiency, use of renewable energy (RE) challenges in making city energy smart.

Unit II

Solar energy for smart cities – Development of solar cities – Solar street lights, traffic signal boards. Solar energy conversion-Solar thermal systems – Solar photo voltaics (PV) generating systems – Roof top solar systems.

Unit III

Smart Grid-demand management through smart grids. Electric vehicles (EVs), need for electric vehicles, EV-ecosystem components: Vehicles and battery, charging infrastructure types of chargers, new regulations and consumer awareness

Unit IV

Smart transport system-Need for urban smart transport system, objectives and components of urban transport system. Strategies in smart transport system-Transit orientated development (TOD) - non – motorized transport.

Unit V

ICT supported smart transport Real-time traffic information system (RTIS) Real time traffic monitoring system (RTMS), automated fare collection system. Parking information system, public, private & commercial vehicles and smart transport solutions.

Unit VI: - Case studies at International and national level on smart energy and transport system.

Textbooks:

1. The smart city transformations, Amithsatyam, IGORCALZADA.
2. Smart cities, smart mobility, Lukas Necknmann matador, April 2018.

Reference Books:

1. Smart Cities, P.P. Anil Kumar, Pearson India, First edition, September, 2019.

SMART WATER & WASTE MANAGEMENT SYSTEMS

(Honors/Minor Course)

Subject Code: 20SCT303

L	T	P	C
4	0	0	4

Course Objectives:

- Apply knowledge of basic science and engineering to achieve waste management and its significance in the socio-economic development
- To make the students understand design aspects of Various techniques available for the treatment of different wastes
- Introduction to working biological system and its importance in waste management
- Apply best waste management practices for securing ecologically sustainable development
- To understand the sources of solid and hazardous wastes.
- To understand basics of waste disposal cycle and various disposal methods.

Course Outcomes:

Upon successful completion of this course, students will be able to

1. Demonstrate various Smart water management techniques in solving current water related problems.
2. Analyse and predict waste management parameters /variables to ensure effective delivery of waste management services
3. To evaluate the significance of solid and hazardous waste management in today life
4. To analyse the processes involved in solid and hazardous waste management
5. To comprehend the techniques for various waste management
6. To appreciate the role of common/integrated waste management plants

Unit - I

Smart Water Management

Smart Water Management: The potential for SWM implementation, the role of smart technology in assisting to resolve numerous water challenges- water access and quality; efficient irrigation ; reduced demand ; flood and drought management-storm water management – Detention and Retention ponds; planning and inclusive governance ; data management.

Unit - II

Municipal solid waste, Collection and Transfer

Definition - Sources and types of solid waste- composition and its determinants of Solid waste-factors influencing generation.

Collection: Collection of Solid waste –collection system, equipment's – time and frequency of collection – labour requirement – factors affecting collection.

Transfer and Transport: Need for transfer operation – types – transport means and methods –Manpower requirement.

Unit - III

Processing Techniques and Disposal of Solid Wastes

Processing techniques – purposes mechanical volume reduction – necessary equipment's – chemical volume reduction – incinerators – mechanical size reduction

Refuse disposal – various methods – incinerations site selection and plant layout of an incinerator, sanitary landfill- methods of operation – advantages and disadvantages of sanitary land fill - site selection – reactions accruing in completed landfills

Unit – IV

Hazardous Waste and Nuclear wastes

Need for hazardous waste management – Sources of hazardous wastes – Effects on community – terminology and classification – Storage and collection of hazardous wastes– Protection of public health and the environment. Characteristics – Types – Nuclear waste – Uranium mining and processing – Power reactors – Management of nuclear wastes – Decommissioning of Nuclear power reactors – Health and environmental effects.

Unit – V

Management of hazardous wastes

Identifying a hazardous waste – methods – Quantities of hazardous waste generated – Hazardous waste minimization – Disposal practices in Indian Industries – Future challenges.

Unit –VI

Biomedical and chemical wastes

Biomedical wastes – Types – Management and handling – control of biomedical wastes Chemical wastes – Sources – Domestic and Industrial - Inorganic pollutants – Environmental effects – Need for control – Treatment and disposal techniques – Physical, chemical and biological processes – Health and environmental effects.

Textbooks:

1) George Techobanoglous et al,"Integrated Solid Waste Management" McGraw - Hill, 1993.
2) J. Glynn Henry and Gary. W. Heinke, "Environmental Science and Engineering", Pretice Hall of India, 2004.

References:

1) R.E.Landrefh and P.A.Rebers," Municipal Solid Wastes-Problems & Solutions" ,Lewis, 1997.
2) Biomedical waste (Management and Handling) Rules, 1998.
3) Ministry of Urban Developmen t Manual on Municipal 1 Solid waste Management, CPHEEO Ministry of Urban Development, Govt. Of. India, New Delhi, 2000

Computational Statistics and Data Analysis
(Common to all Branches)

L	T	P	C
4	0	0	4

Honours / Minor Course: *Artificial Intelligence and Machine Learning*
Subject Code: 20AIT201

Course Objective
To introduce several statistical techniques found to be serving as tools even today in the development of machine learning and artificial intelligence based computer algorithms.

- To imbibe strong foundation of statistics in students for implementation in computation.
- To understand modern computational methods used in statistics.
- To get detailed approach of simulation, estimation and visualization of statistical data.
- To understand the role of computation as a tool of discovery in data analysis.
- To be able to appropriately apply computational methodologies to real world statistical problems.
- To learn the data processing techniques required to get applied on machine learning algorithms.

Course Outcome
On completion of the course, learner will be able to–

1. Identify the suitable method of statistics on the given data to solve the problem of any heuristic approach of prediction.
2. Apply appropriate statistical concepts and skills to solve problems in both familiar and unfamiliar situations including those in real-life contexts.
3. Design and analyze real world engineering problems by applying various statistical modeling techniques.
4. Formulate suitable statistical method required as pre-processing technique for finding the solution of machine learning algorithm.
5. Model and solve computing problem using correlation, and resampling using appropriate statistics algorithms.
6. To introduce students to the basic concepts and techniques of Machine Learning for solving practical problems.

Unit – I
Introduction to Statistics : What is statistics, Statistical Data-Categorical, Numerical (Continuous), Univariate and Bivariate Analysis, Mean, Median, Mode, Standard Deviation, Harmonic Mean, Data Visualization-Line, Scatter, Box plots, Histogram, Descriptive statistics: qualitative and quantitative Variable, discrete variable, population, sample, random sample.

Unit – II
Probability and Distribution: Probability, Random Variable, Joint and Conditional Probability, Baye's Theorem, Monte Carlo Method, Probability Distributions, Characterizing a Distribution, Discrete Distributions, Normal Distributions, Continuous Distributions Derived from the Normal Distribution, Poisson Distribution, Other Continuous distributions: Lognormal, Weighbull, Exponential, Uniform.

Unit – III
Hypothesis and Statistical Tests: Null hypothesis, Alternative hypothesis, Typical Analysis procedures, Hypothesis Concept, Errors, p-Value, z-value, Crucial value, Test on Numerical Data-Distribution of a Sample Mean, Comparison of Two Groups, Comparison of Multiple Groups, degree of freedom, T-test, Z-test, ANOVA analysis.

Unit – IV

Data Pre-processing and Performance Analysis

Data Pre-processing steps: data cleaning-missing data, noisy data, binning method, regression, clustering, data transformation - attribute selection, data reduction-feature selection, dimensionality reduction. Normalization- Decimal Scaling, Min-Max scaling, Z-score

Performance metrics: Confusion matrix, sensitivity, specificity, F1 score, Recall, Precision, ROC-AUC Curve, Cross validation technique – K-fold

Model evaluation: Residual error, Bias, Variance, Mean square error, RMSE, Loss.

Unit – V

Statistical Methods: Dimensionality Reduction Techniques- Principal Component Analysis, Discriminant Analysis, Feature Selection- Chi2 square method, Variance Threshold, Recursive Feature Elimination, Outliers detection methods, Resampling-Random, under-sampling and over re-sampling.

Unit – VI

Machine Learning: Introduction to Machine Learning: Supervised and unsupervised ML, Regression (Linear regression, Logistic regression) Classification (Naïve-Bayes classifier), Clustering (K-means, K-mediod).

Text Books:

1. Thomas Haslwanter, "An Introduction to Statistics with Python with Applications in the Life Sciences", Springer International Publishing Switzerland 2016, ISBN 978-3-319-28315-9, ISBN 978-3-319-28316-6 (eBook)
2. Allen B. Downey, "Think Stats", Second Edition, O'Reilly Media, ISBN: 978-1-491-90733-7
3. Foundations of Machine Learning, Mehryar Mohri, Afshin Rostamizadeh, and Ameet Talwalkar, MIT Press, Second Edition, 2018.

Reference books:

1. José Unpingco, "Python for Probability, Statistics, and Machine Learning", Springer International Publishing Switzerland, ISBN 978-3-319-30715-2, DOI 10.1007/978-3-319-30717-6, ISBN 978-3-319-30717-6 (eBook)
2. Claus Weihs, Olaf Mersmann, Uwe Ligges, "Foundations of Statistical Algorithms", CRC Press, ISBN-978-1-4398-7887-3 (eBook - PDF)

e-Books:

- http://file.allitebooks.com/20151204/Foundations%20of%20Statistical%20Algorithms.pdf
- http://onlinestatbook.com/Online_Statistics_Education.pdf
- https://upload.wikimedia.org/wikipedia/commons/8/82/Statistics.pdf
- http://cnx.org/content/col10522/1.38/pdf
- http://www.greenteapress.com/thinkstats/thinkstats.pdf

MOOC/ Video Lectures available at:

- https://www.udemy.com/course/introduction-to-bayesian-statistics/ (Free Course)
- https://www.youtube.com/watch?v=xxpc-HPKN28
- https://www.udacity.com/course/intro-to-statistics--st101# (Free Course)
- https://nptel.ac.in/courses/111/105/111105090/
- https://nptel.ac.in/courses/111/105/111105077/

Machine Learning using Python

(Honors/Minor Course: Artificial Intelligence & Machine Learning**)**

Subject Code: 20AIT302

L	T	P	C
4	0	0	4

Course Objectives

- Students understand issues and challenges of Machine Learning.
- Should be able to select data, model, model complexity etc.
- Understand the strengths and weaknesses of many popular machine learning approaches.

Course Outcomes

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

1. Understand the basic concepts of various types of machine learning and classification algorithms and their applicability in solving machine learning problems.
2. Assess the suitability of clustering algorithms in solving a particular problem.
3. Apply various dimensionality reduction techniques for the extraction of features from high dimensionality data
4. Develop scaling up machine learning techniques and associated computing techniques and technologies for various applications
5. Choose a suitable regression technique that is appropriate for a particular dataset by analyzing the trade-off of computational complexity versus convergence speed
6. Recognize the feasibility of applying neural network methodology for solving real time application problems

Unit – I

Brief Introduction to Machine Learning: Supervised Learning, Unsupervised Learning, Ensemble Learning, Reinforcement Learning, Supervised Learning: Decision Tree Induction, Naïve Bayes Classification, Rule based Classification, K-Nearest Neighbor, Performance evaluation metrics of Classifiers.

Unit – II

Unsupervised Learning: Clustering, Partitioned Clustering (K-Means), Hierarchical Clustering, BIRCH, CURE, Density based Clustering (DBSCAN). Performance evaluation metrics of Clustering

Unit – III

Feature Analysis: Dimensionality Reduction, Feature Selection, Feature Projection, Filter Method, Wrapper Method, Embedded Method, Feature Projection, Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA).

Unit – IV

Support Vector Machine (SVM): Introduction to SVM, Linear learning machines and Kernel space, Kernels for learning non-linear functions, SVM for classification and regression problems.

Unit – V

Regression: Linear and Logistic regression, Regularization - L1 & L2 regularization, drop out method, Lasso Regression, Ridge regression, Hypothesis testing of Regression Model, R-square and goodness of fit, Influential Observations. Multiple Linear Regression: Polynomial Regression, Regularization methods, Lasso, Ridge and Elastic nets.

Unit – VI

Models of ANNs: Feed-forward & feedback, Multi-layer Feed forward Networks, Delta learning rule for Multi-Perceptron layer, Generalized delta learning rule, Error back-propagation training networks, Recurrent NN.

Text Book

1. Shalev-Shwartz, S., Ben-David,S., (2014), Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press
2. R. O. Duda, P. E. Hart, D. G. Stork (2000), Pattern Classification, Wiley-Blackwell, 2nd Edition.

Reference Book

1. Mitchell Tom (1997). Machine Learning, Tata McGraw-Hill
2. C. M. BISHOP (2006), Pattern Recognition and Machine Learning, Springer-Verlag New York, 1st Edition.

Reference links

1. https://in.mathworks.com/content/dam/mathworks/ebook/gated/machine-learning-workflow-ebook.pdf
2. https://www.coursera.org/learn/machine-learning-with-python
3. https://nptel.ac.in/courses/106106139
4. https://www.geeksforgeeks.org/machine-learning/

Advance Machine Learning

(Honors/Minor Course: Artificial Intelligence & Machine Learning**)**

Subject Code: 20AIT303

L	T	P	C
4	0	0	4

Course Objectives

- Be familiar with a breadth of foundational machine learning concepts;
- Be able to implement standard machine learning methods without the use of pre-packaged machine learning software;
- Be able to make informed decisions about which machine learning methods are appropriate for different tasks;
- Have awareness of the mathematical and computer science concepts underlying machine learning;

Course Outcomes

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

1. Familiar with the statistical foundation of ensemble approaches and able to interpret the variance and bias trade-off in machine learning algorithms.
2. Able to analyse various boosting approaches and have the ability to adapt the existing boosting approaches to different purposes.
3. Familiar with the working of Restricted Boltzmann machine and their application in solving particular machine learning problem
4. Able to interpret the state-of-the-art methods in Bayesian state estimation, parameter estimation andapplications.
5. Able to demonstrate knowledge of the forecasting models and the relative strengths and weaknesses of each and their most appropriate uses.
6. Able to assess how these modular components can be combined to build state-of-the-art NLP systems.

Unit – I

Introduction to Ensemble Methods: Bagging, weak learner, bias-variance tradeoff, Bootstrapping, Random forests, Voting machine, Application to real world problems.

Unit – II

Boosting ensemble learning: Adaptive boosting, XGboost, Light boost, Catboost, Stacking.

Unit – III

Structured Models: Restricted Boltzmann machine, An overview of Restricted Boltzmann Machines and Contrastive Divergence, size of a mini-batch, Monitoring the progress of learning and overfitting, Markov Random fields, Hidden Markov model.

Unit – IV

Introduction to Regularization: Bias and Variance, Regularization Techniques, Early Stopping, L1 Regularization, L2 Regularization, Sparse Coding, Dropout layer.Dealing uncertainty in ML, Bayesian modelling and Gaussian processes, randomised methods, Bayesian neural networks.

Unit – V

Forecasting models: Trend analysis, Cyclical and Seasonal analysis, Smoothing, Moving averages, Box-Jenkins, Holt-winters, Auto-correlation; ARIMA, Examples: Applications of Time Series in financial markets.

Unit – VI

Natural Language Processing:NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation, Information retrieval, Text Simplification, Text Summarization, Supervised and unsupervised methods for NLP.

Text Book

1. Aurélien Géron (2019) Hands-On Machine Learning with Scikit-Learn and TensorFlow (Concepts, Tools, and Techniques to Build Intelligent Systems), 2nd Edition, ISBN-13: 978-1492032649, O'Reilly Media.
2. Giuseppe Bonaccorso(2020) Mastering Machine Learning Algorithms: Expert techniques for implementing popular machine learning algorithms, fine-tuning your models, and understanding how they work, 2nd Edition, Packt Publishing Limited; 2nd edition.

Reference Book

1. Mitchell Tom (1997). Machine Learning, Tata McGraw-Hill
2. C. M. BISHOP (2006), Pattern Recognition and Machine Learning, Springer-Verlag New York, 1st Edition.
3. Steven Bird, Ewan Klein, Edward Loper (2009) Natural Language Processing with Python: Analysing Text with the Natural, Language Toolkit, O'RELLY publications.

ADITYA INSTITUTE OF TECHNOLGY AND MANAGEMENT (AUTONOMOUS)

Approved by AICTE,
Recognized Under 2(f) & 12(b) of UGC,
Permanently Affiliated to JNTU Kakinada.
K.Kotturu, Tekkali, Srikakulam – 532201. Andhra Pradesh.

B. Tech ECE (Honors Degree in IoT)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Identified Subjects for B.Tech ECE (Honors Degree in IoT)

S. No.	Semester	Code	Theory & Lab	L	T	P	C
1	II-II	20IOT201	Introduction to IoT	3	1	0	4
2	III-I	20IOT302	Sensor Technologies in IoT	3	0	2	4
3	III-II	20IOT303	IoT Web development and Applications	3	0	2	4
4	IV-I	20IOT404	IoT Security and Trust	3	1	0	4

MOOC Courses:

1. https://www.coursera.org/specializations/iot?action=enroll
2. https://onlinecourses.nptel.ac.in/noc21_ee85/course
3. https://www.coursera.org/specializations/uiuc-iot
4. https://www.coursera.org/learn/iot

S.No	Code	MOOC Course	L	T	P	C
1	20IOM201	MOOCS-I	2	0	0	2
2	20IOM302	MOOCS-II	2	0	0	2

Introduction to IoT

(Honors /Major Degree Course)

Subject Code: 20HCTXXX	L	T	P	C
	3	1	0	4.0

Course Objectives:

- To learn fundamentals of IoT such as Components, Networking and Communication technologies.
- To discuss various network configurations and topologies.
- To differentiate sensors and actuators used in IoT.
- To study different communication protocols for IoT communication.
- To study the salient features and application scope of each connectivity protocol.
- To apply IoT data into real world applications.

Course Outcomes:

The student will be able to:

CO 1. Explain the evolution of different internet technologies and need for IoT.
CO 2. Identify different networking components in IoT with respect to OSI layer.
CO 3. Analyze the need of sensors and actuators used in IoT.
CO 4. Determine the requirements associated with each of these communication protocols in real-world solutions.
CO 5. Explain the terminologies and technologies associated with IoT connectivity.
CO 6. Understand the requirements, challenges, and advantages of implementing IoT in real world applications.

Unit –I

Introduction to IoT: Introduction, Evolution of IoT, IoT and M2M, IoT -CPS, IoT- WoT, Various enablers of IoT and Complex interdependence technologies, Networking components of IoT.

Unit – II

Networking Components in IoT: Introduction, Network types, Network reachability, OSI model, Internet Protocol suite, Data link layer addressing, Network layer addressing, TCP/IP transport layer.

Unit- III

IoT sensors and actuators: Introduction, Sensors and its characteristics, types of sensing, sensing considerations, Actuators, characteristics of actuators, types of actuators.

Unit – IV

IoT software and Protocols: Introduction, data protocols, MQTT, MQTT-SN, CoAP, XMPP, HTTP, WebSocket, Identification protocols, EPC, uCode.

Unit – V

Connectivity Technologies in IoT: Introduction, IEEE 802.15.4, Zigbee, Communication topologies in Zigbee, WirelessHART network architecture, RFID, Lora, WI-Fi, Bluetooth.

Unit – VI

IoT Applications: IoT in agriculture, Smart irrigation Management system, IoT in health care systems, Advantages and risks of health care IoT.

Text Books:

1. Misra, S., Mukherjee, A., & Roy, A. (2021). *Introduction to IoT*. Cambridge: Cambridge University Press. doi:10.1017/9781108913560.
2. Adrian McEwen, Hakim Cassimally "Designing the Internet of Things", John Wiley & Sons, 2014.

Reference Books:

1. Vijay Madisetti , Arshdeep Bahga, Adrian McEwen (Author), Hakim Cassimally "Internet of Things A Hands-on-Approach" University Press, 2014.
2. Joe Biron and Jonathan Follett "Foundational Elements of an IoT Solution: The Edge, The Cloud, and Application Development", First Edition. Cisco Press, 2017.

https://onlinecourses.nptel.ac.in/noc21_ee85/course

https://onlinecourses.nptel.ac.in/noc21_cs17/preview

https://nptel.ac.in/courses/106/105/106105166/

Sensor Technologies in IoT

(Honors /Major Degree Course)

Subject Code: 20IOT302	L	T	P	C
	3	0	2	4.0

Course Objectives:

- To learn fundamentals of sensors such as principles, characterization and analysis.
- To discuss different position, displacement and level sensors .
- To learn the characteristics of velocity and acceleration sensors.
- To study different pressure sensors.
- To learn the salient features of flow and acoustic sensors
- To study various thermal and humidity sensors.

Course Outcomes:

The student will be able to:

CO 1. Explain the characteristics of the sensors.
CO 2. Choose appropriate sensor for position and displacement measurements.
CO 3. Analyze the need of velocity and acceleration sensors.
CO 4. Evaluate the performance characteristics of pressure sensors.
CO 5. Explain different types of flow and acoustic sensors.
CO 6. Discuss different applications of thermal and humidity sensors.

Unit –I

Sensors and Characteristics: Introduction, Classification of sensors, Transfer function, Accuracy, Calibration, Hysteresis, Resolution and Dynamic characteristics.

Unit –II

Position, Displacement and Level Sensors: Introduction, Potentiometric sensors, Gravitational Sensors, Capacitive Sensors, Optical Sensors, Radar Sensors, LVDT, Hall effect sensor.

Unit –III

Velocity and Acceleration Sensors: Introduction, Accelerometer characteristics, Capacitive Accelerometers, Piezoelectric Accelerometers, Thermal Accelerometers.

Unit –IV

Pressure Sensors: Introduction, Concept of pressure, Mercury pressure sensor, Bellows and Membranes, Piezoresistive sensors, Optoelectronic sensors.

Unit –V

Flow and Acoustic Sensors: Basic flow of dynamics, Thermal transport sensors, Ultrasonic sensors Microphones- resistive, capacitive and fiber optic.

Unit –VI

Thermal, Humidity and Moisture Sensors: Thermo Resistive sensors, Resistance Temperature detectors, Thermistors, Concept of Humidity, Electrical conductivity sensors, Optical Hygrometer.

Text Books:

1. Jacob Fraden, "Hand Book of Modern Sensors: physics, Designs and Applications", 2015, 3rd edition, Springer, New York**.**
2. D. Patranabis – "Sensors and Transducers" –PHI Learning Private Limited.

Reference Books:

1. Sensors and Actuators – D. Patranabis – 2nd Ed., PHI, 2013.
2. Jon. S. Wilson, "Sensor Technology Hand Book", 2011, 1st edition, Elsevier, Netherland

List of Experiments:

(Experiments based on verifying the characteristics of Different IoT Sensors)

1. Basic Arduino UNO, /LED/ Switch/ Buzzer
2. Temperature & Humidity Sensor- DHT11
3. LDR
4. Soil Moisture Sensor
5. PIR Sensor
6. Smoke Sensor -MQ-02
7. Ultrasonic Sensor
8. RFID-EM18
9. Accelerometer & Gyroscope- MPU6050
10. Servo Motor

https://1lib.in/book/542261/0455f7
https://1lib.in/book/465297/0f5b0a
https://nptel.ac.in/courses/108108123

IoT Web development and Applications

(Honors /Major Degree Course)

Subject Code: 20IOT303	L	T	P	C
	3	0	2	4.0

Course Objectives:

- To acquire specific Markup language knowledge to develop static web pages.
- To acquire specific scripting knowledge to develop interactive applications.
- To understand the basics of android application development.
- To apply the programming skills in developing application pertaining to Industrial, medical, agricultural, etc
- To develop applications in Agriculture.
- To develop applications in Health care.

Course Outcomes:

The student will be able to:

CO 1. Design dynamic web forms to acquire and process user & sensor data
CO 2. Interactive forms using Java Script with a focus on internet of things
CO 3. Implement mobile application using android SDK
CO 4. Solve the need for smart systems in a distributed environment
CO 5. Understand the IoT architecture and building blocks for various domains
CO 6. Devise multidisciplinary case to case modelling and execute wide range of application

Unit –I

Markup language:

Introduction to Markup language, HTML document structure, HTML forms, Style (CSS), Multiple CSS style sheets, DHTML, IoT development using charts.

Unit – II

Scripting language:

Introduction to JavaScript, control structures, Functions, DOM, Forms, Object Handlers, Input validation.

Unit- III

Mobile Application Frame Work:

J2ME, application design using J2ME , IoT development using Real time rules, platforms, alerts.

Unit – IV

Applications in agriculture

Smart Farming: Weather monitoring, Precision farming, Smart Greenhouse, Drones for pesticides.

Unit – V
Healthcare applications
Architecture of IoT for Healthcare, Multiple views coalescence, SBC-ADL to construct the system architecture.

Unit – VI
IoMT Applications
Wearable devices for Remote monitoring of Physiological parameter, ECG, EEG, Diabetes and Blood Pressure

Text Books:

1. John Dean, Web Programming with HTML5, CSS and JavaScript, 2018, Jones and Bartlett Publishers Inc., ISBN-10: 9781284091793
2. DiMarzio J. F., Beginning Android Programming with Android Studio, 2016, 4th ed., Wiley, ISBN-10: 9788126565580.

Reference Books:

1. Subhas Chandra Mukhopadhyay, Smart Sensing Technology for Agriculture and Environmental Monitoring, 2012, Springer, ISBN-10: 3642276377
2. Giacomo Veneri, and Antonio Capasso, Hands-on Industrial Internet of Things: Create a powerful industrial IoT infrastructure using Industry 4.0, 2018, Packt Publishing.

EXPERIMENT 1:

Familiarization with the concept of IoT, Ardino/Raspberry pi and perform necessary software installation

EXPERIMENT 2:

Study different operating systems for Raspberry pi /Beagle board .Understanding process of OS installation on Raspberry pi /Beagle board

EXPERIMENT 3:

Study of connectivity and configuration of Raspberry pi /Beagle board circuit with basic peripherals, LEDs, Understanding GPIO and its use in programme

IoT Security and Trust

(Honors /Major Degree Course)

Subject Code: 20IOT404	L	T	P	C
	3	1	0	4.0

Course Objectives:

- To learn fundamentals of cryptography and security algorithms.
- To discuss various IoT security models.
- To learn framework used in IoT.
- To study different security protocols for IoT communication.
- To study the salient features light weight cryptography.
- To study cyber laws and methods.

Course Outcomes:

The student will be able to:

CO 1. Design and implement cryptography algorithms using C programs
CO 2. Solve network security problems in various networks
CO 3. Build security systems using elementary blocks
CO 4. Build Trustable cloud based IoT systems
CO 5. Solve IoT security problems using light weight cryptography
CO 6. Appreciate the need for cyber security laws and methods.

Unit –I

Fundamentals of encryption for cyber security : Cryptography –History of cryptography, symmetric ciphers, block ciphers, DES Public-key cryptography: RSA algorithm

Unit-II

IoT Security Framework: IOT security frame work, Security in hardware, Need and methods of Edge Security, Network Security: Internet, Intranet, LAN, Wireless Networks.

Unit-III

Elementary blocks of IoT Security : Vulnerability of IoT and elementary blocks of IoT Security, Threat modeling – Key elements.

Unit-IV

Models for Identity Management: Identity management Models and Identity management in IoT. Identity management framework.

Unit-V

Trust Management: Trust management lifecycle, Identity and Trust, Web of trust models. Establishment: Cryptosystems – Mutual establishment phases – Comparison on security analysis

Unit-VI

Cyber Crimes, Hackers and Forensics: Cyber Crimes and Laws – Hackers – Dealing with the rise tide of Cyber Crimes – Cyber Forensics and incident Response .

Text Books:

1. John R. Vacca, "Computer and Information Security Handbook", Elsevier, 2013.
2. Parikshit Narendra Mahalle , Poonam N. Railkar, "Identity Management for Internet of Things", River Publishers, 2015.
3. William Stallings, "Cryptography and Network security: Principles and Practice", 5th Edition, 2014, Pearson Education, India.
4. Maryline Laurent, Samia Bouzefrane, "Digital Identity Management", Elsevier, 2015.
5. Joseph Migga Kizza, "Computer NetworkSecurity", Springer, 2005.

Reference Books:

1. Christof Paar and Jan Pelzl, "Understanding Cryptography – A Textbook for Students and Practitioners", Springer, 2014.
2. Behrouz A.Forouzan : Cryptography & Network Security – The McGraw Hill Company, 2007.
3. Charlie Kaufman, Radia Perlman, Mike Speciner, Network Security: "Private Communication in a public World", PTR Prentice Hall, Second Edition, 2002
4. Alasdair Gilchrist, "IoT security Issues", Oreilly publications, 2017.
1. ity Issues", Oreilly publications, 2017.

INTRODUCTION TO ELECTRICAL VEHICLE TECHNOLOGY

(Honors/Minor Course)

Subject Code: 20EVT201

L	T	P	C
3	1	0	4

Course Objectives:

1. To describe the different types of electrical and hybrid vehicles
2. To discuss the basic components of Electric vehicle power train.
3. To discuss the basics of different Motor Principles
4. To describe the concepts of Hybrid Electric Drive Trains
5. To describe and analyze different types of batteries and energy storage systems
6. To describe different controllers and converters in Electric Vehicles

Course Outcomes:

At the end of the course the student will able to

1. Understand basics of Electric vehicle & Hybrid Electric Vehicle.
2. Understand about power train drives and control in Electric Vehicles.
3. Understand basics of different Motor Principles
4. Understand concepts in different Electrical Drive trains
5. Analyze different types of batteries and energy storage requirements.
6. Understand different controllers and converters in Electric Vehicles

Unit-I- Introduction to Electric vehicle

Comparison of Conventional Vehicle vs Electric Vehicle, Introduction to Electric Vehicles: Types of EVs, Hybrid Electric Vehicles, Introduction to EV Technology, History of Electric Vehicle, Benefits Of Electric Vehicles, Types of Electric vehicle and Hybrid Vehicles. Norms and Standards.

Unit-II- Power Train in Electric vehicle

Working of an Electric Vehicle, Major Components in an Electric Vehicle Power train, Energy Source of an EV, Transmission configuration, Components – Motor, gears, differential, clutch, brakes regenerative braking, Battery pack, Controller. Hybrid Electric Drive-train

Unit-III- Motor-Principles of Electrical Machines

Motor-Principles of Electrical Machines, EM Fundamentals**,** Classification of Motors, Selection of Motor, Motor Specifications Calculations, Gear ratio Calculations.

Unit-IV- Electrical Drive trains

Concept of Hybrid Electric Drive Trains, Electric Propulsion unit, Configuration and control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, switched reluctance motor

Unit-V- Energy Storage systems

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles:- Battery based energy , storage , Types of Batteries and Classification, different energy storage devices. Battery Selection Criteria, Major Components of a Battery pack, Applications

Unit-VI- Controllers & Converters

Controller & Converters, EV Controllers**,** DC-DC Converter**,** DC-AC Converter

Text Books:

1. Iqbal Husain, "Electric and Hybrid Vehicles Design Fundamentals", CRC Press, 2010
2. James Larminie, John Lowry, "Electric Vehicle Technology Explained", Wiley 2012.
3. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, Ali Emadi, "Modern Electric, Hybrid Electric,and Fuel Cell Vehicles Fundamentals, Theory, and Design", CRC Press, 2004

References:

1. Mehrdad Ehsani, Yimin Gao, Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel CellVehicles: Fundamentals”, CRC Press, 2010.
2. Sandeep Dhameja, “Electric Vehicle Battery Systems”, Newnes, 2000

.http://nptel.ac.in/courses/108103009/

SPECIAL ELECTRICAL MACHINES
(Honors Course)

Subject Code: 20EVT302

L	T	P	C
4	0	0	4

Course objectives:
To develop knowledge on Principles & operation, construction, performance, maintenance, testing and performance of special motors such as BLDC motors, stepper motors and electrical motor drives.

Course Outcomes:
Students will be able to:
CO1: Analyze the structure of Electrical drive system of SRM motor.
CO2: Understand open loop and closed loop control of Stepper motors and also compare the open loop and closed loop systems
CO3: Evaluate torque, speed and position controller of BLDC motor drives.
CO4: Explain the basic properties of magnetic materials as applied to electric machines and applications of LIM.
CO5: Analyze the equivalent circuit of a permanent magnet motors
CO6: Describe the operation of motor drives to meet mechanical load requirements

UNIT I:
Stepper Motors Stepper Motors Construction – Principle of operation – Theory of torque production – Hybrid stepping motor – Variable reluctance stepping motor – Open loop and closed loop control. Applications

UNIT II:
Switched Reluctance Motor Principle of operation, Torque production, Power converter for switched reluctance motor, Control of switched reluctance motor.

UNIT III:
Brushless DC motor Permanent Magnet Brushless DC Motor Construction – Principle of operation – Theory of brushless DC motor as variable speed synchronous motor.

UNIT IV:
Linear induction motors Construction– principle of operation– application of linear induction drive for traction.

UNIT V:
Permanent Magnet Motors Construction – Principle of working – Torque equation and equivalent circuits, electrically commutated DC motor.

UNIT VI:
Electric Motors for traction AC motors– DC motors –Single sided linear induction motor for traction drives – Comparison of AC and DC traction.

TEXT BOOKS:

1. Special electrical Machines, K.VenkataRatnam, University press, 2009, New Delhi.
2. Special electrical machines, E.G.Janardhanan, PHI learning private limited.

REFERENCE BOOKS:

1. Brushless Permanent magnet and reluctance motor drives, Clarenden press, T.J.E. Miller, 1989,Oxford.
2. Special electrical machines, Simmi P Burman, S.K. Kataria& Sons private limited.

BATTERY TECHNOLOGIES

(Honors/Minor Course)

Subject Code: 20EVT303

L	T	P	C
4	0	0	4

Course objectives:

To impart fundamental knowledge on electrochemical energy storage systems considering the operation and design of various battery technologies. To enable the students to understand the requirement of batteries for automotive application combined with environment policy considerations.

Course Outcomes:

On the successful completion of the course, students will be able to

1. Recognize the basic physical concepts of thermodynamics and kinetics involved in electrochemicalreactions

2. Select the appropriate battery system with respect to application

3. Analyze the characterization methods of batteries and interpret concepts describing batteryperformance

4. Describe the recent developments battery systems

5. Understand the requirements of battery systems for automotive applications and understand themodelling of battery systems

6. Discuss the Life Cycle Analysis according to cost and environmental aspects; material and energyconsumption, reuse, recycling

Unit-I: Introduction to Electrochemical energy storage

Introduction to battery technologiesElectromotive force- Reversible cells- Relation between electricalenergy and energy content of a cell-Free energy changes and electromotive force in cell- Current challenges in Energy storage Technologies.

Unit-II: Major Battery Chemistries Development and testing:

Battery performance evaluation- Primary battery - Service time- Voltage data- Service life – ohmic loadcurve- Effect of operating temperature on service life. Secondary batteries- Discharge curvesTerminal voltages- Plateau voltage –Lead acid Batteries – Construction and application.

Unit-III: Recent Technologies-I:

Recent development of electrode materials in lithium ion batteries- Recent development of solidelectrolytes and their application to solid state batteries.

Unit-IV: Recent Technologies-II:

Polymer solid electrolytes for lithium ion conduction– Thin Film solid state Batteries: Fundamentals,Constriction and application – Super Capacitors: Fundamental, Construction and application.

Unit-V: Batteries for Automotives – Future prospects:
Degrees of vehicle electrification - Battery size vs. application -USABC and DOE targets for vehicularenergy storage systems - Analysis

Unit-VI: Modelling of Batteries for Automotives:
Simulation of batteries - Equivalent circuit and life modelling – Environmental concerns in batteryproduction – recycling of batteries.

Text Books:
1. T.Minami, M.Tatsumisago,M.Wakihara,C. Iwakura,S. Kohijiya, Solid state ionics for batteries,Springer Publication, 2009
2. Sandeep Dhameja, Electric Vehicle Battery Systems, Newnes publication, 2001.

Reference Books :
1. Bard, Allen J., and Larry R. Faulkner. Electrochemical Methods: Fundamentals and Applications. 2nded.,Wiley– VCH, Verlag, GmbH, 2000.
2. MasatakaWakihara and Osamu Yamamoto, Lithium ion Batteries Fundamental andPerformance,Wiley–VCH, Verlag GmbH, 1999.
3. Robert A.Huggins, Advanced Batteries – Materials science aspects,Springer, 2009

Statistical Analysis and Programming for Data Science(Common to all Branches)

L	T	P	C
3	0	2	4

Subject Code: 20DSI201

Course Objectives

After the completion of the course, students would:

- Be prepared with a varied range of expertise in different aspects of data science such asdata collection, visualization, processing and modeling of data sets.

Course Outcomes:

The student will be able to:

1. Identify the need for data science and solve basic problems using Python built-in data typesand their methods.
2. Design an application with user-defined modules and packages using OOP concept.
3. Employ efficient storage and data operations using NumPy arrays.
4. Apply powerful data manipulations using Pandas.
5. Develop data pre-processing and visualization using Pandas.
6. Produce visualization of data with Matplotlib

Unit – I

Descriptive Statistics and Probability Distributions: Statistical Data-Categorical, Numerical (Continuous), Univariate and Bivariate Analysis, Mean, Median, Mode, Standard Deviation, Descriptive statistics: qualitative and quantitative Variable, discrete variable, population, sample, random sample. Probability Distributions: Binomial Distribution, Poisson Distribution, Uniform Distribution, Normal Distribution, Exponential Distribution.

Unit – II

Introduction to Data Science and Python Programming:

Introduction to Data Science - Why Python? - Essential Python libraries - Python Introduction- Features, Identifiers, Reserved words, Indentation, Comments, Built-in Data types and their Methods: Strings, List, Tuples, Dictionary, Set - Type Conversion- Operators. Decision Making- Looping- Loop Control statement- Math and Random number functions. User defined functions - function arguments & its types.

File, Exception Handling and OOP: User defined Modules and Packages in Python- Files: File manipulations, File and Directory related methods- Python Exception Handling.
OOPs Concepts -Class and Objects, Constructors – Data hiding- Data Abstraction- Inheritance.

Practical Component:

1. Implement basic Python programs for reading input from console.
2. Perform Creation, indexing, slicing, concatenation and repetition operations on Pythonbuilt-in data types: Strings, List, Tuples, Dictionary, Set
3. Solve problems using decision and looping statements.

4. Apply Python built-in data types: Strings, List, Tuples, Dictionary, Set and their methods to solve any given problem
5. Handle numerical operations using math and random number functions
6. Create user-defined functions with different types of function arguments.
7. Create packages and import modules from packages.
8. Perform File manipulations- open, close, read, write, append and copy from one file toanother.
9. Handle Exceptions using Python Built-in Exceptions
10. Solve problems using Class declaration and Object creation.
11. Implement OOP concepts like Data hiding and Data Abstraction.
12. Solve any real-time problem using inheritance concept.

Unit – III
Introduction to Numpy

NumPy Basics: Arrays and Vectorized Computation- The NumPy ndarray- Creating ndarrays- Data Types for ndarrays- Arithmetic with NumPy Arrays- Basic Indexing and Slicing - Boolean Indexing-Transposing Arrays and Swapping Axes.

Universal Functions: Fast Element-Wise Array Functions- Mathematical and Statistical Methods-Sorting-Unique and Other Set Logic.

Practical Component:

1. Create NumPy arrays from Python Data Structures, Intrinsic NumPy objects and RandomFunctions.
2. Manipulation of NumPy arrays- Indexing, Slicing, Reshaping, Joining and Splitting.
3. Computation on NumPy arrays using Universal Functions and Mathematical methods.
4. Import a CSV file and perform various Statistical and Comparison operations on rows/columns.
5. Load an image file and do crop and flip operation using NumPy Indexing.

Unit – IV
Data Manipulation with Pandas
Introduction to pandas Data Structures: Series, DataFrame, Essential Functionality: Dropping Entries- Indexing, Selection, and Filtering- Function Application and Mapping- Sorting and Ranking.

Summarizing and Computing Descriptive Statistics- Unique Values, Value Counts, and Membership. Reading and Writing Data in Text Format.

Practical Component:

1. Create Pandas Series and DataFrame from various inputs.
2. Import any CSV file to Pandas DataFrame and perform the following:
   a) Visualize the first and last 10 records
   b) Get the shape, index and column details
   c) Select/Delete the records(rows)/columns based on conditions.
   d) Perform ranking and sorting operations.
   e) Do required statistical operations on the given columns.
   f) Find the count and uniqueness of the given categorical values.
   g) Rename single/multiple columns.

Unit – V

Data Cleaning and Preparation

Data Cleaning and Preparation: Handling Missing Data - Data Transformation: Removing Duplicates, Transforming Data Using a Function or Mapping, Replacing Values, Detecting and Filtering Outliers- String Manipulation: Vectorized String Functions in pandas.

Plotting with pandas: Line Plots, Bar Plots, Histograms and Density Plots, Scatter or Point Plots.

Practical Component:

1. Import any CSV file to Pandas Data Frame and perform the following:
   a) Handle missing data by detecting and dropping/ filling missing values.
   b) Transform data using apply() and map() method.
   c) Detect and filter outliers.
   d) Perform Vectorized String operations on Pandas Series.

Unit – VI

Data Visualization

A brief Matplotlib API primer, Plotting with pandas: Line Plots, Bar Plots, Histograms and DensityPlots, Scatter or Point Plots.

Practical Component:

1. Visualize data for the following:
   a) Line Plots
   b) Bar Plots
   c) Histograms
   d) Density Plots
   e) Scatter Plots.

Text Books

1. Y. Daniel Liang, “Introduction to Programming using Python”, Pearson,2012.
2. Wes McKinney, “Python for Data Analysis: Data Wrangling with Pandas, NumPy, andIPython”, O’Reilly, 2nd Edition,2018.
3. Jake VanderPlas, “Python Data Science Handbook: Essential Tools for Working with Data”, O’Reilly, 2017.

Reference Books

1. Wesley J. Chun, “Core Python Programming”, Prentice Hall,2006.
2. Mark Lutz, “Learning Python”, O’Reilly, 4th Edition, 2009.

MOOC:

1. https://www.edx.org/course/python-basics-for-data-science
2. https://www.edx.org/course/analyzing-data-with-python
3. https://www.coursera.org/learn/python-plotting?specialization=data-science-python

Data Handling and Visualization
(Honors/Minors Degree Course)

L	T	P	C
3	0	2	4

Subject Code: 20DSI302
Prerequisite: Data Science with Python or R

Course Objectives:

After the completion of the course, students would:

- Be prepared with a varied range of expertise in different aspects of data science such as data collection, visualization, processing and modeling of data sets.

Course Outcomes:

The student will be able to:

1. Understand basics of Data Visualization
2. Implement visualization of distributions
3. Develop programs on visualization of time series, proportions & associations
4. Develop programs on visualization of Scatter plots, Mosaic plots
5. Apply visualization on Trends and uncertainty
6. Explain principles of proportions

Unit 1: Introduction to Visualization

Visualizing Data-Mapping Data onto Aesthetics, Aesthetics and Types of Data, Scales Map Data Values onto Aesthetics, Coordinate Systems and Axes- Cartesian Coordinates, Nonlinear Axes, Coordinate Systems with Curved Axes, Color Scales-Color as a Tool to Distinguish, Color to Represent Data Values ,Color as a Tool to Highlight, Directory of Visualizations- Amounts, Distributions, Proportions, x–y relationships, Geospatial Data.

Practical Component:

1) Download the House Pricing dataset from Kaggle and map the values to Aesthetics
2) Use different Color scales on the Rainfall Prediction dataset

Unit 2: Visualizing Distributions

Visualizing Amounts-Bar Plots, Grouped and Stacked Bars, Dot Plots and Heat maps, Visualizing Distributions: Histograms and Density Plots- Visualizing a Single Distribution, Visualizing Multiple Distributions at the Same Time, Visualizing Distributions: Empirical Cumulative Distribution Functions and Q-Q Plots-Empirical Cumulative Distribution Functions, Highly Skewed Distributions, Quantile-Quantile Plots, Visualizing Many Distributions at Once-Visualizing Distributions Along the Vertical Axis, Visualizing Distributions Along the Horizontal Axis

Practical Component:

1) Create different Bar plots for variables in any dataset
2) Show an example of Skewed data and removal of skewedness

Unit 3: Visualizing Associations & Time Series 1

Visualizing Proportions-A Case for Pie Charts, A Case for Side-by-Side Bars, A Case for Stacked Bars and Stacked Densities, Visualizing Proportions Separately as Parts of the Total, Visualizing Nested Proportions- Nested Proportions Gone Wrong, Mosaic Plots and Tree maps, Nested Pies, Parallel Sets.

Practical Component:

1) For a sales dataset do a Time Series visualization
2) Build a Scatter plot and suggest dimension reduction

Unit 4: Visualizing Associations & Time Series 2

Visualizing Associations Among Two or More Quantitative Variables-Scatter plots, Correlograms, Dimension Reduction, Paired Data. Visualizing Time Series and Other Functions of an Independent Variable-Individual Time Series , Multiple Time Series and Dose–Response Curves, Time Series of Two or More Response Variables

Practical Component:

1) For a sales dataset do a Time Series visualization
2) Build a Scatterplot and suggest dimension reduction

Unit 5: Visualizing Uncertainty

Visualizing Trends-Smoothing, Showing Trends with a Defined Functional Form, Detrending and Time-Series Decomposition, Visualizing Geospatial Data-Projections, Layers, Choropleth Mapping, Cartograms, Visualizing Uncertainty-Framing Probabilities as Frequencies, Visualizing the Uncertainty of Point Estimates, Visualizing the Uncertainty of Curve Fits, Hypothetical Outcome Plots

Practical Component:

1) Use Geospatial Data-Projections on datasets in
http://www.gisinindia.com/directory/gis-data-for-india
2) Create a trend line with a confidence band in any suitable dataset

Unit 6: Principle of Proportional Ink

The Principle of Proportional Ink-Visualizations Along Linear Axes, Visualizations Along Logarithmic Axes, Direct Area Visualizations, Handling Overlapping Points-Partial Transparency and Jittering, 2D Histograms, Contour Lines, Common Pitfalls of Color Use-Encoding Too Much or Irrelevant Information, Using Non-monotonic Color Scales to Encode Data Values, Not Designing for Color-Vision Deficiency

Practical Component:

1) Illustrate Partial Transparency and Jittering
2) Illustrate usage of different color codes

Text Books

1) Claus Wilke, “Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures”, 1st edition, O’Reilly Media Inc, 2019.

Reference Books:

1) Tony Fischetti, Brett Lantz, R: Data Analysis and Visualization,O’Reilly ,2016
2) Ossama Embarak, Data Analysis and Visualization Using Python: Analyze Data to Create Visualizations for BI Systems, Apress, 2018

MOOC:

1. https://www.coursera.org/learn/data-visualization

https://www.coursera.org/learn/python-for-data-visualization#syllabus

Predictive Modeling and Analytics

(Honors/Minors Degree Course)

Subject Code: 20DSI303
Prerequisite: Data Mining and Machine Learning

L	T	P	C
3	0	2	4

Course Objectives:

After the completion of the course, students would:

- Be prepared with a varied range of expertise in different aspects of data science such as data collection, visualization, processing and modeling of data sets.

Course Outcomes:

The student will be able to:

1. Understand the basics of predictive analytics and summarize Data, Categorize Models, and techniques
2. Apply Decision tree, Support Vector Machine for Data Classification
3. Apply Methods such as Naïve Bayes Markov Model, to Boost Prediction Accuracy for Data Classification.
4. Apply Methods such as Linear Regression, Neural Networks to Boost Prediction Accuracy for Data Classification.
5. Develop predictive models for various Real-Time Applications.
6. Analyze and Visualize predictive Model's results using Data Visualization tools.

Unit 1: Data Preparation

Introduction – Predictive Analytics in the Wild – Exploring Data types and associated Techniques - Complexities of data - Applying Models: Models and simulation, Categorizing Models, Describing, summarizing data, and decisions – Identify similarities in Data: Data Clustering, converting Raw Data into a Matrix, Identify K-groups in Data.

Practical Component:

Using Machine learning approach with R

1) Healthcare Analytics Case Study: Cancer survivability predictors
2) Social and Marketing Analytics Case Study: Tweets as predictors for the stock market

Step 1- Collecting data

Step 2 – Exploring and preparing the Data

Unit 2: Data Classification - Part I

Background – Exploring Data classification process - Using Data Classification to predict the future: Decision tree, Algorithm for generating Decision Trees, Support Vector Machine.

Practical Component:

Using Machine learning approach with R (Case Studies mentioned in Unit 1)

1) Apply Decision tree classification model on Healthcare Analytics
2) Apply Support Vector Machine model on Social and Marketing Analytics

Unit 3: Data Classification - Part II

Ensemble Methods to Boost Prediction Accuracy: Naïve Bayes Classification Algorithm, The Markov Model, Linear Regression, Neural Networks – Deep learning.

Practical Component:

Using Machine learning approach with R (Case Studies mentioned in Unit 1)

1) Apply Naïve Bayes Classification Algorithm on Healthcare Analytics
2) Apply Linear Regression Algorithm on Social and Marketing Analytics

Unit 4: Data Prediction

Adopt predictive analytics - Processing data: identifying, cleaning, generating, reducing dimensionality of data – Structuring Data – Build predictive model: develop and test the model.

Practical Component:

Using Machine learning approach with R (Case Studies mentioned in Unit 1)

1) Develop and test the model for Healthcare Analytics
2) Develop and test the model for Social and Marketing Analytics

Unit 5: Data Visualization

Introduction to visualization tool – Evaluate the data – visualize Model's Analytical Results: hidden grouping, data classification results, outliers, decision trees.

Practical Component:

Implement Using Tableau or Matplotlib

1) Visualize Data Classification results
2) Visualize the decision trees

Unit 6: Visualization of Analytical Results

Visualization as a Predictive Tool, Evaluating Your Visualization, Visualizing Your Model's Analytical Results, prediction – Novel visualization in Predictive Analytics, Big Data Visualization Tools

Practical Component:

Implement Using Tableau or Matplotlib

1) Visualize the prediction

Text Books

1) Anasse Bari, Mohamed Chaouchi, Tommy Jung, "Predictive Analytics For Dummies", Wiley Publisher, 2nd Edition, 2016.

Reference Books:

1) Bertt Lantz, Machine Learning with R: Expert techniques for predictive modeling to solve all your data analysis problems, Pack Publisher, 2nd Edition, 2015.
2) Aurelien,"Hands-On Machine Learning with Scikit-Learn & TensorFlow", O'Reilly Publisher, 5th Edition, 2017.
3) Max Kuhn, Kjell Johnson, " Applied Predictive Modeling" Springer, 2013.

MOOC:

1) https://www.coursera.org/learn/predictive-modeling-analytics
2) https://www.edx.org/course/predictive-analytics
3) https://www.udemy.com/course/machinelearningandlogisticregression/

ADITYA INSTITUTE OF TECHNOLGY AND MANAGEMENT (AUTONOMOUS)

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K.Kotturu, Tekkali, Srikakulam – 532201. Andhra Pradesh.

B. Tech MECH (Honors Degree in Robotics)

DEPARTMENT OF MECHANICAL ENGINEERING

Identified Subjects for B.TechMECH(Honors Degree in Robotics)

S. No.	Semester	Code	Theory & Lab	L	T	P	C
1	II-II	20ROT201	Introduction to Robotics and Mechatronics	3	1	0	4
2	III-I	20ROI301	Robot Transformations, Kinematics and Dynamics	3	0	2	4
3	III-II	20ROI302	Robot Programming and Applications	3	0	2	4
4	IV-I	20ROT401	Robot Vision, Image & System Design	3	1	0	4

S.No	Semester	Code	Course	L	T	P	C
1			Any two MOOCS	0	0	0	4

Introduction to Robotics and Mechatronics
(Honors /Major Degree Course)

Subject Code:	**L**	**T**	**P**	**C**
	3	**1**	**0**	**4.0**

Course Objectives:

- The course is aimed at providing concepts and skills in the industrial automation domain relatedto mechatronics, robotics, electrical machines and drives.
- In this subject, the fundamental concepts and methodologies are introduced for understandingmechatronics systems and industrial robots; then, they will acquire fundamental knowledge andcompetences of the subject.
- This course will helps in understanding the evolving Mechatronics systems from their underlyingphysical principles and properties.
- This course recognizes the synergistic combination of all related branches of engineering andhave adequate multi-disciplinary knowledge and conceptual skills

Course Outcomes:

The student will be able to:

CO1: Understand the history, evolution and anatomy of robot.
CO2: Comprehend the concept of machine and mechanism, architecture and selection of actuation systemfor various applications.
CO3: Understand and apply knowledge about sensors for a typical application.
CO4: Understand and apply the design process of mechatronics system
CO5: Understand and gain the knowledge on data acquisition and signal conditioning
CO6: Describe and discuss the basic fundamentals of microprocessors and microcontrollers

Unit – I: Introduction to Robotics: Brief History, Automation and Types, Robots, Robotics and,Principles, Development of Robotics, Laws of Robotics, Specifications and Classifications, Degree ofFreedom, Anatomy and Work Volume, Applications.

Unit – II: Robot Actuation Systems: Machine and Mechanism, Architecture of Robotics SystemsMechanical - Cams, Gear trains, Ratchet and Pawl, Belt and chain drives, Bearings. Electrical – Electricalsystems, Solid State Switches, Solenoids, D.C. motors, A.C. motors, Stepper motors, Pneumatic and,Hydraulic Actuation System - Introduction to Hydraulic and Pneumatic Systems, Directional Controlvalves, Flow control valves.

Unit – III: Sensors: Robotic Sensors, Position Sensors - Optical, Non-Optical, Velocity Sensors,Accelerometers, Proximity Sensors - Contact, Non-Contact, Range Sensing, Touch and Slip Sensors,Force and Torque Sensors.

Unit – IV: Introduction to Mechatronics: Definition and Components, Applications, Mechatronics SystemDesign, Procedure and Possible Design Solutions, Building Blocks of Mechanical, Electrical, Electro-Mechanical, Thermal and Fluid Systems, Open and Closed Loop Systems, Digital and Analogue ControlSystems.

Unit – V: Signal Conditioning and Data Acquisition: Filtering, Pulse Modulation, A/D and D/AConverters, Multiplexers, Data Acquisition Systems.

Unit – VI: Basic Introduction to Microprocessor, Microcontrollers and PIC Microcontroller, 8051Programming, Peripheral Interfacing, Microprocessor, Microcontroller in Robotics, Control Modes, PIDand Digital Controllers, Velocity Control, Adaptive Control, , Programmable Logic Controllers:Fundamentals of PLCs, Mnemonics and Timers, Relays and Counters, Master and Jump Control, DataControl, Analogue I/O Control

Text Books:

- R.K. Mittal & I.J. Nagrath, "Robotics & Control" TMH-2007.
- Groover. M.P. Industrial Robotics, technology, programming and application Mc-Graw Hill 2012.
- Brian morriss, "Automated manufacturing Systems – Actuators Controls, sensors and Robotics", McGraw Hill International Edition, 2000.
- DevadasShetty, Richard A.Kolkm, "Mechatronics system design, PWS publishing company, 2009.

References:

- K.S Fu, R.C. Gonzalez, C.S.G. Lee, Robotics, McGraw Hill, 1987.
- S. K. Saha, "Introduction to Robotics", Tata McGraw-Hill Publishing Company Ltd. (2008).
- Craig. J. J. "Introduction to Robotics- mechanics and control", Addison- Wesley, 1999.
- Asada, H., and J. J. Slotine. *Robot Analysis and Control.* New York, NY: Wiley, 1986. ISBN: 9780471830290.
- Introduction to Embedded Systems: Shibu K V, McGRAW Hill Publications.
- PIC Microcontrollers and Embedded Systems: M. A. Mazidi, R.D. Mckinlay and D. Casey, Pearson Publications
- W.Bolton, "Mechatronics" , Pearson education, second edition, fifth Indian Reprint, 2003.

AR – 20: B.Tech. – MECH **III Year - I Semester**

Robot Transformations, Kinematics and, Dynamics
(Honors /Major Degree Course)

Subject Code:	L	T	P	C
	3	0	2	4.5

Course Objectives:

- The course is aimed at providing concepts and programming skills of robotics motion and control.
- In this subject, the fundamental concepts and numerical methodologies with programming are introduced for understanding the transformations of industrial robots; then, they will acquire fundamental knowledge and competences of the subject.
- This course will helps in understanding the evolving concepts of kinematics, dynamics and trajectory generation from their underlying physical and numerical principles and properties with programming skills.
- This course recognizes the synergistic combination of all related branches of engineering and have adequate multi-disciplinary knowledge and conceptual skills

Course Outcomes:

The student will be able to:

CO1: Understand the fundamental transformations and rotation matrices of robot.

CO2: Comprehend and apply the concepts of direct kinematics with matrix methods and D-H Notations for various applications.

CO3: Understand and apply the concepts of Inverse Kinematics with matrix methods for various robots.

CO4: Understand and apply the knowledge for the generation of trajectory planning and tasks.

CO5: Understand and gain the knowledge on differential motion and statics.

CO6: Describe and discuss the basic fundamentals of robot dynamics with application of different formulations.

Unit – I: Coordinate Frames and Transformations, Coordinate frames, Description of objects in space, Transformation of vectors, inverting a Homogeneous transform, Fundamental rotation Matrices.

Exercise I*: Build a robot by adding body parts and joints and Assign values and then perform the transformation operation.*

Unit – II: Degrees of freedom and mobility, Rotation representation, Coordinate transformations, DH parameters, Structure & Notations, D-H Notation, Direct Kinematics, Problems.

Exercise II*: Perform the operation by calculating and visualizing the forward kinematics problem*

Unit – III: Introduction to Inverse Kinematics, Structure & Notations, Matrix methods for Inverse transformations, Problems.

Exercise III*:Perform the operation by calculating and visualizing the inverse kinematics problem. Apply DH technique*

Unit – IV: Trajectory Planning and Generation, Definitions and Planning Tasks, Joint & Cartesian Space Techniques, Joint-Space versus Cartesian Space trajectory planning.

***Exercise IV**: Generate a trajectory to connect waypoints for a robot*

Unit – V: Differential Motion & Statics: Linear and Angular Velocities of Rigid Body and its Relationships, Mapping and Propagations along Links, Jacobian and Inverse Jacobian, Singularities and Static Analysis.

***Exercise V**: Compute Jacobian system for any given robot*

Unit – VI: Mechanics and Langrangian Dynamic Models – 2DOF, Langrangian - Euler and Newton – Euler Formulations, Comparisons, Inverse Dynamics.

***Exercise VI**: Generate matlab code for given robot dynamics problem*

Text Books:

- Craig, J. J., Introduction to Robotics: Mechanics and Control, Pearson, 3rd Edition, 2004.
- R.K. Mittal & I.J. Nagrath, "Robotics & Control" TMH-2007.
- Groover. M.P. Industrial Robotics, technology, programming and application Mc-Graw Hill 2012.

References:

- K.S Fu, R.C. Gonzalez, C.S.G. Lee, Robotics, McGraw Hill, 1987.
- Asada, H., and J. J. Slotine. *Robot Analysis and Control.* New York, NY: Wiley, 1986. ISBN: 9780471830290.

Robot Programming and Applications
(Honors /Major Degree Course)

Subject Code:	L	T	P	C
	3	0	2	4.5

Course Objectives:

- The course is aimed at providing concepts and basic programming skills of robotics and methods.
- In this subject, the fundamental concepts of programming are introduced for basic applications with use of sensors and actuators.
- This course will helps in understanding the evolving concepts underlying physical and numerical principles and properties with programming skills for robot applications.
- This course recognizes the synergistic combination of all related branches of engineering with applications in multi-disciplinary wing and have adequate multi-disciplinary knowledge and conceptual skills

Course Outcomes:

The student will be able to:

CO 1. Understand the fundamental programming skills and methods.

CO2: Comprehend and apply the concepts of programming skills and methods.

CO3: Understand and apply the concepts of programming skills with use of sensors and actuators.

CO4: Understand and apply the knowledge for the programming applications with use of sensors and actuators

CO5: Understand and gain the knowledge on generation of mobile robots and their design considerations.

CO6: Describe and discuss the basic fundamentals of programming skills for various applications

Unit – I: Robot Programming Basics, VAL and Rapid Language, VAL –II and MAL, Methods, Virtual Robot, offline & online programming and its Application

Exercise I*: Basic introduction and understanding the language of Cprog*

Unit – II: Level of robot programming, Language based programming, task level programming, Robot programming synthesis, robot programming for various industrial applications..

Exercise II*: Generate the code for pick and place operation using magnetic / hydraulic gripper using Cprog*

Unit – III: Robot Programming using Sensors and Actuators with ROS, SCORBOT structure, joint movements, work envelop, motors, encoders, micro switch, transmission, gripper, SCORBOT programming, Mobile Robot Programming, Industrial Robot Programming

Exercise III*: Write a program for touch sensor and test it using Cprog*

Unit – IV: Robot applications-Material handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting.

***Exercise IV**: Introduction to Programming Robots using Python*

Unit – V:Introduction to Mobile robot, Microbots and, Service Robots - Recent developments in robotics- safety considerations.

***Exercise V**: Write a program for pick and place operation using Python*

Unit – VI: Detailed study and applications of Nanorobots, Cognitive Robots and, Medical Robots.

***Exercise VI**: Generate a code by performing any task of your choice using Python*

Text Books:

- Groover. M.P. Industrial Robotics, technology, programming and application Mc-Graw Hill 2012.
- R.K. Mittal & I.J. Nagrath, "Robotics & Control" TMH-2007.
- Craig, J. J., Introduction to Robotics: Mechanics and Control, Pearson, 3rd Edition, 2004.

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- K.S Fu, R.C. Gonzalez, C.S.G. Lee, Robotics, McGraw Hill, 1987.
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