G.S. Mandal's
MAHARASHTRA INSTITUTE OF TECHNOLOGY
CHHATRAPATI SAMBHAJINAGAR
(An Autonomous Institute)
Accredited with "Grade A" by NAAC
(Formerly Known as College of Applied Science)
Approved by All India Council for Technical Education (AICTE), New Delhi
Permanently Affiliated to Dr. Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar
DTE Code -2113

Ref: MIT/BTECH/ACAD/H&M/2024/02 Date: 18-01-2024

Notice

Registration for Honor and Minor Scheme (Academic Year 2023-24 Part II)

All the students of Second Year B. Tech. (Autonomous) are hereby informed that, Institute provide the Honor and Minor Scheme for the meritorious students based on the CGPA score. The students can opt for enrollment in the scheme voluntarily. **It is not mandatory**. Few important points to be noted by students willing to enroll in this scheme are as follows:

- **Eligibility:** Applicant must have a minimum **CGPA of 6.75 up to the second semester** of B. Tech. and forDSY Students CGPA of 6.75 or equivalent in Diploma.
- **Student can either choose for Honor or Minor Program and not for both.**
- The brief about this scheme as per the academic rules and regulations is attached in the **Annexure-I**. The list of Honor & Minor courses offered for the Academic Year 2023-24 Part II and the **Program- wise applicability** is given for your reference in **Annexure-II**.
- Students can download syllabus through link **http://tinyurl.com/SYHMAllSyllabi2324** of these courses and advised to meticulously check the syllabus before registration.
- The honor/minor programme will be implemented if minimum 15 students enroll for the same. Students must do online registration for honor/minor on provided link or by scanning the QR Code as given below. The link for registration will be available from **19/01/2024 (Between 10.00 am 5.00 pm) only**. Thereafter, the link will be closed.

http://tinyurl.com/SYHM2324PII

Dean Academics

Maharashtra Institute of Technology, Aurangabad * An Autonomous Institute * MIT

Director
Director
Maharashtra Institute of Technology, Aurangabad

Copy to:

- Dean (Examinations and Evaluations) for information and n.a.
- Registrar/ Deans, for information and n.a.
- HODs for information and Circulation to students through class coordinators

NH-211, MIT Campus, Satara Village Road, Chhatrapati Sambhajinagar 431 010 (M.S.); India. Phone (Director): (0240) 2375111,(Office) 2375365,2375355; Fax:(0240)2376618 ,Email:director.mitt@mit.asia; Website:https://www.mit.asia

Annexure-I: About Honors/Minors Scheme as per Academic rules and Regulations (AR 21)

Regulation 2019, Point 31 - Honors and Minors Certification Schemes

a) Brighter students transiting to the 4th Semester shall be permitted for Honors and Minors certification scheme as an additional avenue for passionate learners. Students are entitled to enrol either for Honors or Minors or not for both simultaneously.

b) A student shall opt for a certificate in Honors for Vertical/Specialization in his/her OWN Programme for Research orientation. He/she shall opt for Minors certificate in any OTHER Programme for Improving Employability.

c) The Scheme shall start from 4th Semester of the UG Programme and the student shall have a minimum CGPA of 6.75 up to 2nd Semester without having any failed courses.

d) The schemes shall also be open for Lateral Entry Students, with equivalent minimum CGPA of 6.75 in Diploma/ B.Sc.

e) Every department shall offer 4 additional theory courses, two laboratories and one mini project with total of 20 credits for the respective Honors and Minors scheme.

f) The Dean (Academics and Quality Assurance) shall invite preferences for Honors/Minors scheme from the second year eligible students on the day of Semester Credit Registration of the 4th semester. Students shall give preferential options for Honors scheme or Minors schemes.

g) The Dean (Academics and Quality Assurance) shall notify a provisional allotment, followed by a final allotment list. Later, a student who received allotment shall register for a course belonging to the respective Honors/Minors scheme, one course per semester and shall acquire minimum additional 20 credits, if successfully completed.

h) A student may voluntarily drop the scheme at any time. However, no certificate/Semester Grade Report shall be awarded for such a partial completion.

i) Students shall have to earn a minimum "C" grade for each course in the scheme. The remedial assessment schemes such as Make-up examination shall NOT be applicable for Minors or Honors schemes. If a student fails/drops/withdraws from the Honors/Minor scheme at any stage, the additional credits earned through Honors/Minor courses shall not be converted into program credits (core/electives/lab/project etc.) and they will remain extra. If at any stage during the duration of the program, if the student is found indulged in any in disciplinary activity (against the Code of Conduct at MIT), he/she shall be terminated from the Honors/Minor scheme and no Honors/Minor certificate shall be awarded to him/her.

j) The scores of these additional courses shall not be accounted towards CGPA calculations at the end of each semester. An additional Semester Grade Report shall indicate the additional courses learnt along with the grades. Successful completion of Honors/Minor scheme will not indicate any Class or Division. For the award of Medal to meritorious students, in case of a tie, student who has earned the Honors/Minor will be preferred.

k) An attendance requirement for the course is same as per the regular courses.

Dean (Academics)

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Annexure-II

List of Honor / Minor Courses and the programme-wise-Applicability Matrix

- **List of Honor/ Minor Courses:**
  1. Robotics and Automation
  2. Cloud Computing
  3. Internet of Things
  4. Data Science
  5. Surface Coating Technology
  6. Electrical Vehicles
  7. Green Technology and Sustainable Engineering
  8. Artificial Intelligence and ML

- **Programme-wise-Applicability Matrix:**

Host Department	Robotics and Automation	Cloud Computing	Internet of Things	Data Science	Surface Coating Technology	Electrical Vehicles	Green Tech and Sus. Engg	AI & ML
Agricultural Engg	**Honor**	Minor	**Honor**	Minor	Minor	Minor	Minor	Minor
Civil Engg	Minor	Minor	Minor	Minor	Minor	Minor	**Honor**	Minor
CSE	Minor	**Honor**	Minor	Minor	Minor	Minor	Minor	**Honor**
Electrical Engg	Minor	Minor	**Honor**	Minor	Minor	**Honor**	Minor	Minor
Electronics and Computer Engg	Minor	Minor	**Honor**	**Honor**	Minor	Minor	Minor	Minor
Mechanical Engg	**Honor**	Minor	Minor	Minor	Minor	**Honor**	Minor	Minor
Plastic and Polymer Engg	**Honor**	Minor	Minor	Minor	**Honor**	Minor	Minor	Minor
Artificial Int. and Data Science	Minor	**Honor**	Minor	**Not Applicable**	Minor	Minor	Minor	**Not Applicable**
Computer Science and Design	Minor	**Honor**	Minor	Minor	Minor	Minor	Minor	**Honor**

Dean (Acad)

Maharashtra Institute of Technology
(An Autonomous Institute)

Proposed Honours* in "Artificial Intelligence and Machine Learning"
Major Disciplines in
Bachelor in Computer Science and Engineering
Bachelor in Computer Science and Design

(With effect from A.Y. 2022-23)

Honours* in Artificial Intelligence and Machine Learning

Year & Semester	Course Code	Course	Teaching Scheme Hours / Week			Examination Scheme and Marks								Credit Scheme		
			Theory	Tutorial	Practical	Mid-Sem Exam-1	Mid-Sem Exam-1	Continuous Internal Evaluation	Teachers Assessment	End-Semester Exam	Term work	Practical	Total Marks	Theory / Tutorial	Practical	Total Credit
SY IV	EST901	Introduction to Artificial Intelligence and Machine Learning	04	--	--	15	15	10	10	50	--	--	100	04	--	04
	EST971	Laboratory	--	--	02	--				--	25	--	25	--	01	01
		Total	04	-	02	100					25	--	125	04	01	05
																Total Credits=05
TY V	EST 902	Introduction to Data Analytics	04	--	--	15	15		20	50	--	--	100	04	--	04
		Total	04	-	-	100					--	--	100	04	--	04
																Total Credits=04
TY VI	EST903	Artificial Neural Networks and DeepLearning	04	--	--	15	15	10	10	50	--	--	100	04	--	04
	EST972	Laboratory	--	--	02	--	--		--	--	25	--	25	--	01	01
		Total	04	--	02	100					25	--	125	04	01	05
																Total Credits=05
Final B.Tech. VII	EST904	Methods and Applications in Artificial Intelligence	04	--	--	15	15	10	10	50	--	--	100	04	--	04
		Total	04	--	--	100					--	--	100	04	--	04
																Total Credits=04
Final B.Tech. VIII	EST973	Mini Project	--	--	04	--	--	--	--	--	25	25	50	--	02	02
		Total	--	--	04	--	--	--	--	--	25	25	50	--	02	02
																Total Credits=02
Total Credit for Semester IV+V+VI+VII +VIII= 20																

Maharashtra Institute of Technology

(An Autonomous Institute)

Department of Computer Science and Engineering

Syllabus of S. Y. B. Tech. (Honours* in Artificial Intelligence & Machine Learning) Semester-IV

Course Code: EST901 Course: Introduction to Artificial Intelligence and Machine Learning Teaching Scheme: Theory: 04 Hrs/week Tutorial: 00 Hr/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation:10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs

Prerequisite	Linear Algebra, Calculus
Objectives	• To review and strengthen important concepts required for AI & ML. • Introduce the concept of Machine Learning algorithms.
Unit-I	**Introduction to AI:** Define Artificial Intelligence, Define AI techniques, Problem solving using State Space Search, applying Heuristics, Hill climbing ,Search using BFS, DFS (**08 Hrs)**
Unit-II	**Knowledge representation and Logic Programming:** Representing Knowledge as Rules, Representing simple facts in logic, Computable functions and predicates, Procedural vs Declarative knowledge, Forward vs Backward reasoning, Logic Programming-Predicate Logic **(08 Hrs)**
Unit-III	**Mathematical foundations**: Matrix Theory and Statistics for Machine Learning. Idea of Machine learning from data, Classification of problem –Regression and Classification, Supervised and Unsupervised learning.**(08 Hrs)**
Unit-IV	**Linear Regression:** Model representation for single variable, Single variable Cost Function, Gradient Decent for Linear Regression, Gradient Decent in practice. **(08 Hrs)**
Unit-V	**Logistic Regression:** Classification, Hypothesis Representation, Decision Boundary, Cost function, Advanced Optimization, Multi-classification (One vs All), Problem of Overfitting.**(08 Hrs)**
Unit-VI	**Supervised & Unsupervised learning:** Discussion on Clustering and Classification algorithms, Naïve Bayes Theorem, Decision Tree, SVM **(08 Hrs)**

References	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition/Year**
	1.	Artificial Intelligence	Rich and Knight	MGH	2nd Edition

	2.	“Practical Workbook Artificial Intelligence and Soft Computing for beginners	Anindita Das Bhattacharjee	Shroff Publisher-X team Publisher	2018
	3.	“Python Machine Learning by Example”	Yuxi (Hayden) Liu	Packet Publishing Limited	2017
	4	Machine Learning	Tom Mitchel	McGraw Hill	2017
	5	Pattern Recognition and Machine Learning,	Christopher M. Bishop,	Springer	2011
	6	The Elements of Statistical Learning	T. Hastie, R. Tibshirani, J. Friedman	Springer	2e 2011

Maharashtra Institute of Technology

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Department of Computer Science and Engineering

Syllabus of S. Y. B. Tech. (Honours* in Artificial Intelligence & Machine Learning) Semester-IV

Course Code: EST971 Course: Laboratory Introduction to Artificial Intelligence and MachineLearning Teaching Scheme: Practical: 02 Hrs/week	Credits: 0-0-1 Term Work: 25 Marks

Prerequisite	Any programming language Python/R/Matlab
Objectives	• Implement AI & ML concepts.
List of Practical	1. Implementation of logical rules in Python. 2. Using appropriate data apply the concept of Linear regression 3. Using appropriate data apply the concept of Gradient decent 4. Using appropriate data apply the concept of Logistic regression 5. To add the missing value in any data set. 6. Perform and plot under fitting and over fitting in a data set. 7. Implementation of clustering algorithms. 8.Implementation of classification algorithms.

The assessment of term work shall be done based on the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Practical/Oral examination conducted on the syllabus and term work mentioned above

Maharashtra Institute of Technology

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Department of Computer Science and Engineering

Syllabus of T. Y. B. Tech. (Honours* in Artificial Intelligence & Machine Learning) Semester-V

Course Code: EST902 Course: Introduction to Data Analytics Teaching Scheme: Theory: 04 Hrs/week Tutorial: 00 Hr/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation:10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs

Prerequisite	Basics of statistics
Objectives	• Provide the knowledge in Data Analytics • Evaluate data visualizations based on their design and use for communicating stories from data
Unit-I	Introduction to Databases: Databases and relational approach, SQL query language, types of data, Basic analytics, Hadoop, MapReduce **(08Hrs)**
Unit-II	Introduction to Data Science, Different Sectors using Data science, Purpose and Components of Python in Data Science. **(07 Hrs)**
Unit-III	Data Analytics Process, Knowledge Check, Exploratory Data Analysis (EDA), EDA- Quantitative technique, EDA- Graphical Technique, Data Analytics Conclusion and Predictions. **(09 Hrs)**
Unit-IV	Feature Generation and Feature Selection (Extracting Meaning from Data)- Motivating application: user (customer) retention- Feature Generation (brainstorming, role of domain expertise, and place for imagination)- Feature Selection algorithms **(09 Hrs)**
Unit-V	Data Visualization- Basic principles, ideas and tools for data visualization, Examples of inspiring (industry) projects- Exercise: create your own visualization of a complex dataset. **(08 Hrs)**

Unit-VI	Applications of Data Science, Data Science and Ethical Issues- Discussions on privacy, security, ethics- A look back at Data Science- Next-generation data scientists. **(07 Hrs)**				
References	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1.	Data Science from Scratch	Joel Grus	Shroff Publisher Publisher /O'Reilly Publisher	2Ed
	2.	Data Science for the Layman	Annalyn Ng, Kenneth Soo, Numsense	Shroff Publisher Publisher	2Ed
	3.	Doing Data Science, Straight Talk from The Frontline	Cathy O'Neil and Rachel Schutt	O'Reilly Publisher Media	1Ed
	4.	Mining of Massive Datasets. v2.1,	Jure Leskovek, Anand Rajaraman and Jeffrey Ullman	Stanford University	1Ed
	5.	Python Data Science Handbook,	Jake VanderPlas	Shroff Publisher Publisher /O'Reilly Publisher Media	2Ed
	6.	Data Analysis with Open Source Tools	Philipp Janert	Shroff Publisher Publisher /O'Reilly Publisher Media	2Ed

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Department of Computer Science and Engineering

Syllabus of T. Y. B. Tech. (Honours* in Artificial Intelligence & Machine Learning) Semester-VI

Course Code: EST903 Course: Artificial Neural Networks and Deep Learning Teaching Scheme: Theory: 04 Hrs/week Tutorial: 00 Hr/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation:10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs

Prerequisite	Basics of Artificial Intelligence, Mathematics
Objectives	• To get a detail insight of Artificial Neural Networks. • To study Deep Learning methods
Unit-I	Characteristics of Neural Networks, Structure and working of a biological neural network, artificial neural network: terminology, models of neurons: Mc Culloch Pitts model, Perceptron model, Adaline model, topology, Basic learning laws. Functional Units for Artificial Neural Network for Pattern Recognition Task **(8 Hrs)**
Unit-II	Perceptron – Learning and Memory, Learning Algorithms, Error Correction and Gradient Decent Rules, Perceptron Learning Algorithms, Supervised Learning Backpropagation, Multilayered Network Architectures, Back propagation Learning Algorithm, example Applications of feed forward neural networks. **(08 Hrs)**
Unit-III	Introduction, Associative Learning, Hopfield network, Error Performance in Hopfield networks, simulated annealing, Boltzmann machine and Boltzmann learning, State transition diagram and false minima problem, stochastic update, simulated annealing **(08 Hrs)**
Unit-IV	Convolutional Neural Networks (CNN), ImageNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Classification using CNN **(10 Hrs)**
Unit-V	Recurrent Neural Networks (RNN) and Long Short-Term Memory (LSTM). Applications of Recurrent Neural Networks in real world. **(8 Hrs)**
Unit-VI	Creating and deploying networks using TensorFlow- open source machine learning

	platform and Keras-python deep learning API **(6 Hrs)**				
References	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition/year**
	1.	Artificial Neural Network	B. Yegnanarayana	PHI Publication	2012
	2.	Deep Learning, A Practitioner's Approach	Adam Gibson, Josh Patterson	Shroff Publisher O'Reilly Publisher Media	2017
	3.	Neural Networks for Pattern Recognition	Christopher M. Bishop	Oxford University Press	1Ed
	4.	Neural Smithing-Supervised Learning in Feedforward Artificial Neural Networks	Russell Reed, Robert J MarksII,	MIT Press	2014
	5.	Machine Learning with Python for Everyone	Mark Fenner	Pearson	2020

Maharashtra Institute of Technology

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Department of Computer Science and Engineering

Syllabus of T. Y. B. Tech. (Honours* in Artificial Intelligence & Machine Learning) (Semester-VI)

Course Code: EST972 Course: Laboratory Artificial Neural Networks and Deep Learning Teaching Scheme: Practical: 02 Hrs/week	Credits: 0-0-1 Term Work: 25

Prerequisite	Any programming language Python/R/Matlab
Objectives	• To implement ANN and Deep Learning concepts.
List of Practical	1. Implementation of MP model 2. Implementation of feed forward neural network 3. Implementation of back propagation neural network 4. Implement all activation function of neural network for any pattern recognition application 5. Implement any one of ImageNet or GoogLeNet 6. Implement a system to recognize hand written character using CNN 7. Classify images appropriately using CNN 8. Implement LSTM Neural Network for Time Series Prediction

The assessment of term work shall be done based on the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Practical/Oral examination conducted on the syllabus and term work mentioned above

Maharashtra Institute of Technology

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Department of Computer Science and Engineering

Syllabus of Final year B. Tech. (Honours* in Artificial Intelligence & Machine Learning) (Semester-VII)

Course Code: EST904 Course: Methods and Applications in Artificial Intelligence Teaching Scheme: Theory: 4 Hrs/week Tutorial: 00 Hr/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation:10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs

Prerequisite	• Basics of Artificial Intelligence and Machine Learning
Objectives	• To give deep knowledge of AI and how AI can be applied in various fields
Unit-I	Bayesian Filtering, Deep Reinforcement Learning, Self-Play Networks, Generative Adversarial Networks **(8 Hrs)**
Unit-II	Learning from Concept-Drifting Data Streams,Audio Signal Processing, Architecturesfor second generation knowledge based systems, Distributed AI and its applications**(8 Hrs)**
Unit-III	An introduction to neurocomputing and its possible role in AI, The role of uncertainty measures and principles in AI.**(8 Hrs)**
Unit-IV	Linguistic aspects of natural language processing, AIand Quantum Computing, Applications of Artificial Intelligence (AI) in business, Robotic Processes Automation for supply chain management **(8 Hrs)**
Unit-V	Emotion Recognition using human face and body language, AI based system to predict the diseases early, Smart Investment analysis, AI in Sales and Customer Support, AI in Agriculture**(10Hrs)**
Unit-VI	AI-Optimized Hardware, Digital Twin i.e. AI Modelling, Information Technology & Security using AI**(6 Hrs)**

References	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition/Year**
	1.	Artificial Intelligence: A Modern Approach	Stuart Russell and Peter Norvig	Pearson Publisher	3Ed

	2.	Artificial Intelligence: Making a System Intelligent	Dr. Nilakshi Jain	John Wiley & Sons	2Ed
	3.	AI and Analytics, Accelerating Business Decisions	Sameer Dhanrajani	John Wiley & Sons.	2Ed
	4.	Life 3.0: Being Human in the Age of Artificial Intelligence	Max Tegmark	Knopf	2Ed
	5.	Artificial Intelligence in Practice: How 50 Successful Companies Used AI and Machine Learning to Solve Problems	Bernard Marr,Matt Ward,	Wiley.	2019
	6.	Artificial Intelligence: A Guide to Intelligent Systems	Michael Negnevitsky	Pearson	3Ed

Maharashtra Institute of Technology

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Department of Computer Science and Engineering

Syllabus of Final Year. B. Tech. (Honours* in Artificial Intelligence & Machine Learning)

Semester-VIII

Course Code: EST973 Course: Mini Project Teaching Scheme: Practical: 04 Hrs/week	Credits: 0-0-2 Term Work: 25 Marks Practical :25 Marks
Prerequisite	Machine Learning and AI Algorithms, Programming Language.

Guidelines

To carry out a mini project in Artificial Intelligence and Machine learning.

Each student will have a faculty mentor to guide them.

There will be three reviews with the following details:

Review #	**Requirement**	**Mark Weightage**	
		Internal	**External**
0	Idea Presentation/ Selection	-	-
1	Literature Review / Proposal for Project	10%	-
2	Proposed System Design/ Model	20%	-
3	Implementation and Demonstration	20%	-
End Semester Exam	Final Viva-Voce and Project Demonstration	-	50%

The assessment of term work shall be done on the basis of the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

Note:

1. No additional fees will be charged for students opting for Honours/ Minor Degree
2. All the courses in the Honours/ Minor will be conducted in offline mode.
3. Re-examination is not applicable in Honours and Minor Scheme. Student failing in any of the Minor or Honours courses,at any stage will be discontinued from the Scheme.
4. Examination Scheme and Passing rules will be as per the academic rules and regulations of B. Tech.

Note:

1. No additional fees will be charged for students opting for Honors/ Minor Degree
2. All the courses in the Honors/ Minor will be conducted in offline mode.
3. Re-examination is not applicable in Honors and Minor Scheme. Student failing in any of the Minor or Honors courses,at any stage will be discontinued from the Scheme.
4. Examination Scheme and Passing rules will be as per the academic rules and regulations of B. Tech.

Maharashtra Institute of Technology

(An Autonomous Institute)

Proposed Honours* in Green Technology and Sustainability Engineering

Major disciplines in

Bachelor in Civil Engineering

(With effect from A.Y. 2022-23)

Honors in Green Technology and Sustainability Engineering

Year & Semester	Course Code	Course	Teaching Scheme Hours / Week			Examination Scheme and Marks								Credit Scheme		
			Theory	Tutorial	Practical	Mid-Sem Exam-1	Mid-Sem Exam-1	Mid-Sem Exam-1	Continuous Internal Evaluation	Teachers Assessment	Term work	Practical	Total Marks	Theory / Tutorial	Practical	Total Credit
SY IV	CED901	Green Technology	04	--	--	15	15	10	10	50	--	--	100	04	--	04
	CED971	Green Technology Laboratory	--	--	02	--	--	--	--	--	25	--	25	--	01	01
		Total	04	-	02	100					25	--	125	04	01	05
																Total Credits=05
TY V	CED902	Sustainable Materials and Green Building	04	--	--	15	15	10	10	50	--	--	100	04	--	04
		Total	04	-	-	100					--	--	100	04	--	04
																Total Credits=04
TY VI	CED903	Green Building Rating System	04	--	--	15	15	10	10	50	--	--	100	04	--	04
	CED972	Green Building Rating System Laboratory	--	--	02	--	--	--	--	--	25	--	25	--	01	01
		Total	04	--	02	100					25	--	125	04	01	05
																Total Credits=05
Final B. Tech. VII	CED904	Sustainable Engineering Concepts and Lifecycle Analysis	04	--	--	15	15	10	10	50	--	--	100	04	--	04
		Total	04	--	--	100					--	--	100	04	--	04
																Total Credits=04
Final B. Tech. VIII	CED973	Mini Project	--	--	04	--	--	--	--	--	25	25	50	--	02	02
		Total	--	--	04	--	--	--	--	--	25	25	50	--	02	02
																Total Credits=02
Total Credit for Semester IV+V+VI+VII +VIII= 20																

Maharashtra Institute of Technology, Aurangabad

(An Autonomous Institute)

Department of Civil Engineering

Syllabus of SY B. Tech. (Honours* in Green Technology and Sustainability Engineering)

Semester-IV

Course Code: CED901 Course: Green Technology Teaching Scheme: Theory: 04 Hrs/week Tutorial: 00 Hr/week Practical: 02 Hrs/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation:10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs

Prerequisite	Basics of Environmental science, introduction to ecology, basic concepts of energy generation and conservation.
Objectives	1. To introduce concept of green technology. 2. To impart the knowledge of carbon emission. 3. To introduce concept of life cycle assessment 4. To learn the importance of green fuels and its impact on environment.
Unit-I	**Introduction to green technology:** Definition of Green Technology and its Importance, History and evolution of green technology, advantages and disadvantages of green technologies, factors affecting green technologies, Role of Industry, Government and Institutions, introduction to industrial Ecology and role of industrial ecology in green technology. **(08 Hrs)**
Unit-II	**Cleaner Production (CP):** Definition, Importance, Principles of Cleaner Production and its Benefits, Role of Industry, Government and Institutions in cleaner production, clean development mechanism, reuse, recovery, recycle, raw material substitution-Wealth from waste. **(08 Hrs)**
Unit-III	**CP awareness and life cycle assessment:** Pollution Prevention and Cleaner Production Awareness Plan, Waste audit, Environmental Statement, carbon credit, carbon trading. Introduction to Life Cycle Assessment (LCA) and Elements of LCA. **(08 Hrs)**
Unit-IV	**Energy sources:** Availability and need of conventional energy resources, major environmental problems related to the conventional energy resources, future possibilities of energy need and availability. Non-conventional energy sources: Solar Energy, devices and technology used in solar

	energy conversion, their principles, working and application. **(08 Hrs)**
Unit-V	**Green fuels:** Definition of Green Fuels, their benefits and challenges, comparison of green fuels with conventional fossil fuels with reference to environmental, economic and social impacts, public policies and market driven initiatives Biomass energy: Concept of biomass energy utilization, types of biomass. **(08 Hrs)**
Unit-VI	**Wind, tidal and geothermal energy:** Wind Energy, energy conversion technologies, their principles, and suitability in Indian context; introduction to tidal and geothermal energy and their suitability in various regions. **(08 Hrs)**

	Sr. No.	**Title**	**Author**	**Publication**	**Edition**
References	**1.**	Pollution Prevention: Fundamentals and Practice	Paul L Bishop	McGraw Hill International	Year 2000
	2.	Pollution Prevention and Abatement Handbook – Towards Cleaner Production	World Bank Group	World Bank and UNEP, Washington D.C.	Year 1998
	3.	Cleaner Production Audit (1995)	Prasad Modak, C.Visvanathan and Mandar Parasnis	Environmental System Reviews, No.38, Asian Institute of Technology, Bangkok	Year 1995
	4.	Handbook of Organic Waste Conversion	Bewik M.W.M.	Bewik M.W.M.	1st Edition

Maharashtra Institute of Technology, Aurangabad

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Department of Civil Engineering

Syllabus of SY B. Tech. (Honours* in Green Technology and Sustainability Engineering)

Semester-IV

Course Code: CED971 Course: Green Technology Laboratory Teaching Scheme: Practical: 2 Hrs/week	Credits: 0-0-1 Term Work: 25 Marks

Objectives	To introduce the detailed concept of green technology and various sources of energy as alternative to conventional ones.
List of Practical	The following assignments need to be submitted: 1. Definition of Green Technology, its Importance and advantages and disadvantages 2. Role of industrial ecology in green technology. 3. Principles of Cleaner Production and its Benefits. 4. Clean development mechanism, Wealth from waste. 5. Carbon credit and carbon trading. 6. Introduction to Life Cycle Assessment and its Elements. 7. Comparison of conventional and Non-conventional energy sources. 8. Devices and technology used in solar energy conversion. 9. Green Fuels, their benefit and challenges. 10. Concept of biomass energy utilization, types of biomass 11. Suitability of wind, tidal and geothermal energy in Indian context.

The assessment of term work shall be done on the basis of the following.

- Continuous assessment.
- Performance of students.

Maharashtra Institute of Technology, Aurangabad

(An Autonomous Institute)

Department of Civil Engineering

Syllabus of TY B. Tech. (Honours* in Green Technology and Sustainability Engineering)

Semester-V

Course Code: CED902 Course: Sustainable Materials and Green Building Teaching Scheme: Theory: 04 Hrs/week Tutorial: 00 Hr/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation:10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs

Prerequisite	Basics concepts of green technology and sustainability, introduction to civil engineering building materials.
Objectives	The objective of this course is to expose the students to the concepts of sustainability in the context of building and conventional engineered building materials. The course also intends to make student aware of various green building councils.
Unit-I	**Introduction to sustainability and green building:** Introduction to sustainable materials and the concept of green building. Embodied energy and Operational energy in Building and Life cycle energy. Ecological footprint, Bio- capacity and calculation of planet equivalent. **(08 Hrs)**
Unit-II	**Sustainable materials:** Role of Material: Carbon from Cement, alternative cements and cementitious material, Alternative fuel for cements for reduction in carbon emission. Sustainability issues for concrete. Role of quality, minimization of natural resource utilization, High volume fly ash concrete, geo-polymer concrete etc. concrete with alternative material for sustainability. **(08 Hrs)**
Unit-III	**Energy and resources consumption:** Reduction in water consumption in concrete, Recycled aggregate, Energy for grinding and crushing of cement, aggregate etc. and reduction. Operational energy in building role of materials and thermal conductivity. Clay Bricks, Types of kilns, Comparative energy performance emission performance and financial performance, Indoor air quality. **(08 Hrs)**
Unit-IV	**Operational energy consumption:** Paints, Adhesive and sealants for use in building, Volatile organic content (VOC) emission issues and indoor air quality for Sustainability and Health hazard. Operational energy reduction and net zero building,

	Optimization for design of building for energy efficiency and example of optimization through use of Evolutionary genetic algorithm. **(08 Hrs)**				
Unit-V	**Energy and resources balance:** Radiation budget, Surface water balance, Effects of trees and microclimatic modification through greening. Use of Building Integrated Photo Voltaic (BIPV) and other renewable energy in buildings, basic concepts and efficiency. **(08 Hrs)**				
Unit-VI	**Energy codes**: ECBC requirement, Concepts of Overall Thermal Transfer Value (OTTV), Green Performance rating, requirements of Leadership in Energy and Environmental Design (LEED), Green Rating for Integrated Habitat Assessment (GRIHA) and Indian Green Building Council (IGBC). **(08 Hrs)**				
References	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1.	Sustainability Engineering: Concepts, Design and Case Studies	Allen, D. T. and Shonnard, D. R.	Prentice Hall	I st
	2.	Engineering applications in sustainable design and development	Bradley. A.S; Adebayo, A.O., Maria,	Cengage learning	I st
	3.	Environment Impact Assessment Guidelines	Notification of Government of India	2006	2006
	4.	Basic Concepts in Environmental Management	Mackenthun, K.M.	Lewis Publication London	1998
	5.	GRIHA Rating System	New Delhi Bureau of Energy Efficiency	Publications-Rating System TERI Publications	ECBC Code 2007

Maharashtra Institute of Technology, Aurangabad

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Department of Civil Engineering

Syllabus of TY B. Tech. (Honours* in Green Technology and Sustainability Engineering)

Semester-VI

Course Code: CED903 Course: Green Building Rating System Teaching Scheme: Theory: 04 Hrs/week Tutorial: 00 Hr/week Practical: 02 Hrs/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation:10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs

Prerequisite	Concept of green technology and energy conservation. Introduction to sustainability.
Objectives	1. To create interest among students in green buildings and motivate them to pursue knowledge in this field. 2. To give basic introduction about various green building rating systems. 3. To give practical view of rating of green buildings through case studies.
Unit-I	**Introduction of green building:** Concept of green building, History of green building, Need of green building in present scenario, Importance of green building Merits and demerits, Classification of green building, Assessment methods Global assessment and certification, Local assessment, GRIHA (Green Rating for Integrated Habitat Assessment) **(08 Hrs.)**
Unit-II	**Rating System:** LEED and IGBC rating systems, their comparison and similarities, various points calculation, ratings e.g. Silver, Gold and Platinum based on points given under various criterion. **(08 Hrs.)**
Unit-III	**Building Planning:** Planning a building for less energy consumption, principles of planning, optimized use of natural resources with the help of sun diagram. Plan construction activities for reduced energy consumption. Materials: Recycled, processed, locally available, sustainable material, new age green materials. **(08 Hrs.)**
Unit-IV	**Elements of Green Buildings:** Light, Ventilation, Water recycle & optimization, HVAC system, Electric efficiency, Finishing items, Furniture & fixtures, Low VOC

<table>
<tr><td></td><td colspan="5">paint, Landscaping and its maintenance.
(08 Hrs.)</td></tr>
<tr><td>Unit-V</td><td colspan="5">Energy conservation: Bureau of energy efficiency, its functions, policies, guidelines, Energy Conservation Building Code, Carbon footprint, carbon credits and their calculation, carbon trading, carbon emission. Zero discharge concept.
(08 Hrs.)</td></tr>
<tr><td>Unit-VI</td><td colspan="5">Case Studies: Industrial Building, Hotel, Residential Building, Commercial complex, Educational Institute, Government building, study and report.
(08 Hrs.)</td></tr>
<tr><td rowspan="4">References</td><td>Sr. No.</td><td>Title</td><td>Author</td><td>Publication</td><td>Edition</td></tr>
<tr><td>1.</td><td>Green Buildings: Professional guide to Concepts, Codes & Innovations,</td><td>Anthony Floyd</td><td>Cenage Learning</td><td>Handbook</td></tr>
<tr><td>2.</td><td>Green Building Materials: A guide to product selection & specification</td><td>Ross Spiegel & Dru meadows</td><td>John Wiley & Sons</td><td>1st Edition</td></tr>
<tr><td>3.</td><td>Guide to Energy Conservation, energy planning for buildings</td><td>Seymour Jurmul</td><td>Mc Grow-Hill</td><td>1st Edition</td></tr>
<tr><td></td><td>4.</td><td>Energy efficient buildings in India</td><td>Mili Muzumdar</td><td>Ministry of Nonconventional Energy sources</td><td>Handbook</td></tr>
</table>

Maharashtra Institute of Technology, Aurangabad

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Department of Civil Engineering

Syllabus of TY B. Tech. (Honours* in Green Technology and Sustainability Engineering)

Semester VI

Course Code: CED972 Course: Laboratory of Green Building Rating System Teaching Scheme: Practical: 2 Hrs/week	Credits: 0-0-1 Term Work: 25 Marks

Objectives	To introduce the detailed concept of green building rating system and energy efficiency.
List of Practical	The following assignments need to be submitted: 1. Importance of green building and its evolution. 2. Detailed criterion of LEED rating system. 3. Comparison and similarity between LEED and IGBC. 4. Principles of planning a building. 5. New age green materials. 6. Water recycling and HVAC system. 7. Landscaping and its maintenance. 8. Carbon credits and reduction in carbon emission. 9. Case study of a commercial green building. 10. Case study of a green hotel building.

The assessment of term work shall be done based on the following.

- Continuous assessment.
- Performance of students.

Maharashtra Institute of Technology, Aurangabad

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Department of Civil Engineering

Syllabus of Final Year B. Tech. (Honours* in Green Technology and Sustainability Engineering)

Semester-VII

Course Code: CED904 Course: Sustainable Engineering Concepts and Lifecycle Analysis Teaching Scheme: Theory: 04 Hrs/week Tutorial: 00 Hr/week Practical: 00 Hrs/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation:10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs

Prerequisite	Introduction to the Basics concepts of sustainability, introduction to cleaner production and green technology.
Objectives	This course will introduce students to the fundamental concepts related to interaction of industrial and environmental/ecological systems. The application of life cycle assessment methodology using appropriate case studies.
Unit-I	**Introduction to LCA:** An Introduction to Sustainability Concepts and Life Cycle Analysis, comparison of life cycle of traditional and green construction materials, concept of Material flow and waste management, What it all means for an engineer, Water energy and food nexus. **(08 Hrs)**
Unit-II	**Risk assessment and EIA:** Risk and Life Cycle Framework for Sustainability, concept of Risk, Environmental Risk Assessment, Examples of risk assessment, Chemicals and Health Efects, Characteristics of Environmental Problems. Environmental Data Collection and concept of environmental impact assessment. **(08 Hrs)**
Unit-III	**Methodology of LCA:** Life Cycle Analysis, Detailed Methodology and ISO Framework of Life Cycle Assessment, Detailed Example on LCA Comparisons, LCA Benefits and Drawbacks, Historical Development and LCA Steps from ISO Framework: Life Cycle Inventory and Impact Assessments, Unit Processes and System Boundary Data Quality, Procedure for Life Cycle Impact Assessment. **(08 Hrs)**
Unit-IV	**LCA Studies:** Factors for Good LCA Study, ISO Terminologies, Life Cycle Assessment Steps Recap, Chemical Release and Fate and Transport, Green

	Sustainable Materials, study of life cycle assessment taking one example. **(08 Hrs)**				
Unit-V	**Design for Sustainability:** Environmental Design for Sustainability, Economic, Environmental Indicators, Social Performance Indicators, Sustainable Engineering Design Principles and Environmental Cost Analysis. **(08 Hrs)**				
Unit-VI	**Case studies:** Case Studies of life cycle analysis and use of sustainable materials in construction, studies like Odor Removal for Organics Treatment Plant, Comparison of Hand Drying Methods, Biofuels for Transportation, Kerosene Lamp vs. Solar Lamp, Bioplastic. **(08 Hrs)**				
References	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1.	Sustainability Engineering: Concepts, Design and Case Studies	Allen, D. T. and Shonnard, D. R.	Prentice Hall	I st
	2.	Engineering applications in sustainable design and development	Bradley. A.S; Adebayo, A.O., Maria,	Cengage learning	I st
	3.	Systems Analysis for Sustainable Engineering: Theory and Applications	Ni bin Chang	McGraw-Hill Professional	Edition I
	4.	Renewable Energy Resources	Twidell, J. W. and Weir, A. D.	English Language Book Society (ELBS)	

Maharashtra Institute of Technology, Aurangabad

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Department of Civil Engineering

Syllabus of Final Year B. Tech. (Honours* in Green Technology and Sustainability Engineering)

Semester-VIII

Course Code: CED973 Course: Mini Project Teaching Scheme: Practical: 04 Hrs/week	Credits: 0-0-2 Term Work: 25 Marks Practical: 25 Marks

Prerequisite	Introduction to the Basics concepts of sustainability, introduction to cleaner production and green technology, green materials, life cycle analysis.

To carry out a mini project and simple prototype in the area of interest based on the knowledge gained in Green technology and sustainable engineering from undergraduate.

Every individual student will be assigned a faculty to guide them. There will be three major reviews which will be carried out as listed below:

Review #	**Requirement**	**Marks Weightage**	
		Internal	**External**
0	Area/ Title selection	-	-
1	Literature review, Proposal for the project.	10%	-
2	Detailed experimentation and analysis of the project work.	20%	-
3	Final interpretation of results and presentation of prototype or simulation.	20%	-
End Semester Exam	Final Viva-Voce and project demonstration.	-	50%

The assessment of term work shall be done on the basis of the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

Note:

1. No additional fees will be charged for students opting for Honours/ Minor Degree
2. All the courses in the Honours/ Minor will be conducted in offline mode.
3. Re-examination is not applicable in Honours and Minor Scheme. Student failing in any of the Minor or Honours courses,at any stage will be discontinued from the Scheme.
4. Examination Scheme and Passing rules will be as per the academic rules and regulations of B. Tech.

Maharashtra Institute of Technology

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Proposed Honours* in “Cloud Computing”

Major Disciplines in

Bachelor in Computer Science and Engineering

Bachelor in Artificial Intelligence and Data Science

Bachelor in Computer Science and Design

Honours*in Cloud Computing

Year & Semester	Course Code	Course	Teaching Scheme Hours/Week			Examination Scheme and Marks								Credit Scheme		
			Theory	Tutorial	Practical	Mid-Sem Exam-1	Mid-Sem Exam-1	Continuous Internal Evaluation	Teachers Assessment	End-Semester Exam	Term work	Practical	Total Marks	Theory /Tutorial	Practical	Total Credit
SY IV	CSE901	Cloud computing Foundation	04	--	--	15	15	10	10	50	--	--	100	04	--	04
	CSE971	Laboratory	--	--	02	--		-		--	25	--	25	--	01	01
		Total	04	-	02	100					25	--	125	04	01	05
																Total Credits=05
TY V	CSE902	Basic Services in Cloud	04	--	--	15	15	10	10	50	--	--	100	04	--	04
		Total	04	-	-	100					--	--	100	04	--	04
																Total Credits=04
TY VI	CSE903	Database and Storage in Cloud Computing	04	--	--	15	15	10	10	50	--	--	100	04	--	04
	CSE972	Laboratory	--	--	02	--	--	-	--	--	25	--	25	--	01	01
		Total	04	--	02	100					25	--	125	04	01	05
																Total Credits=05
Final B.Tech. VII	CSE904	Economics and Billing in Cloud	04	--	--	15	15	10	10	50	--	--	100	04	--	04
		Total	04	--	--	100					--	--	100	04	--	04
																Total Credits=04
Final B.Tech. VIII	CSE973	MiniProject	--	--	04	--	--	-	--	--	25	25	50	--	02	02
		Total	--	--	04	--	--	-	--	--	25	25	50	--	02	02
																Total Credits=20
Total Credit for Semester IV+V+VI+VII +VIII=20																

Maharashtra Institute of Technology

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Department of Computer Science and Engineering

Syllabus of S. Y. B. Tech. (Honours* in Cloud Computing) Semester-IV

Course Code: CSE901 Course: Cloud computing Foundation Teaching Scheme: Theory: 04 Hrs/week Tutorial: 00 Hr/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation:10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs

Prerequisite	Cloud Computing Basics
Objectives	• To review and strengthen important concepts of Cloud Computing • Introduce the concept cloud computing
Unit-I	Introduction to the cloud computing, Advantages of cloud computing, Cloud Adoption Framework, Cloud Computing models, Cloud service categories. IAAS, PAAS, SAAS. Pricing Models, Billing and Cost concepts, Pricing Calculator. (**08Hrs)**
Unit-II	Introduction to the Cloud Infrastructure, On premises Infrastructure, Global Connectivity of cloud computing, Cloud Dashboard Management, Cloud Region, Cloud Availability Zone, Edge Location, Data Centers, Cloud Server. **(08 Hrs)**
Unit-III	Introduction EC2, Define EC2, Compute service overview, EC2 Cost Optimization, Container, Lambda service and its category, difference between managed service and unmanaged service in EC2, Elastic Benstalk service and its application. **(08 Hrs)**
Unit-IV	Introduction to the Cloud Security, Concept of Identity Access Management Service, Shared Responsibility Model, Customers responsibility and Cloud Service Provide Responsibility, Cloud Account Security, Cloud Root Security, Cloud Customer Security. Ensure Security Compliance through Dashboard. **(08Hrs)**
Unit-V	Cloud Network, Introduction to virtualization, Concept of Virtual Machines, Define Instances in cloud, Cloud Network basics, Cloud Network services, Virtual Private

	Cloud, Virtual Private Network. Cloud front service, Cloud Watch service. **(08Hrs)**				
Unit-VI	Cloud Content Delivery methods, VPC security, Route 53 service of cloud computing, Lab Diagram (10 systems), VPC and VPN configuration. Cloud Identity Access group, VPN and VPC cloud compliances. **(08 Hrs)**				
References		**Title**	**Author**	**Publication**	**Edition/Year**
	1	Mastering Cloud Computing	Rajkumar Buyya	Mcgraw Hill	2015
	2	Cloud Computing Implementation Management and security	John W Ritting House	CRC Press	2014
	3	Cloud Computing A Practical approach	Anthony T Velte	Mcgraw Hill	2015
	4	Cloud Computing Web based application that change the way you work and collaborate online	Nichael Miller	Pearson	2015

Maharashtra Institute of Technology

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Department of Computer Science and Engineering

Syllabus of S. Y. B. Tech. (Honours* in Cloud Computing) Semester-IV

Course Code: CSE971 Course: Laboratory Cloud Computing Foundation Teaching Scheme: Practical: 02 Hrs/week	Credits: 0-0-1 Term Work: 25

Prerequisite	Basics of Internet and Computer Network
Objectives	• Basic Implementation of Cloud
List of Practical	1. To Study Cloud Computing Basic Services (IAAS, PAAS, SAAS). 2. To Study create Warehouse application in saleforce.com 3. Creating an Application in SalesForce.com using Apex programming Language 4. Implementation of SOAP Web services in C#/JAVA Applications 5. Implementation of Para-Virtualization using VMware's Workstation/ Oracle's Virtual Box and Guest O.S. 6. Installation and Configuration of Hadoop and Glacier service of AWS 7. Create an application (Ex: Word Count) using Hadoop Map/Reduce. 8. To Study and implement Amazon Web Services: EC-II and Container

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Department of Computer Science and Engineering

Syllabus of T. Y. B. Tech. (Honours* in Cloud Computing) Semester-V

Course Code: CSE902 Course: Basic Services in Cloud Teaching Scheme: Theory: 04 Hrs/week Tutorial: 00 Hr/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation:10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs

Prerequisite	Cloud Computing Basics of services.
Objectives	• To review and strengthen important concepts of Cloud Computing • Introduce the concept cloud computing
Unit-I	Introduction to Cloud services, Concept of Infrastructure as a Service, Platform as a service, Software as service, protocols in cloud computing (HTTP, FTP, IP, TCP), On-Demand Service, Pay as you go service, measured service. (**08Hrs)**
Unit-II	. Introduction to Compute service of cloud computing, Elastic Cloud Computing service, EC-2 Cost Optimization, ECS service, EKS service, Lambda Service, ECR service, Concept of Container, Concept of Docker, Cloud Trail and Config service of Cloud computing. **(08 Hrs)**
Unit-III	Introduction to cloud Database Service, Concept of Relational Database Service (RDS), Cloud computing databases: Mongodb, RedhShift, Aurora. Cloud database Dynomodb. **(08 Hrs)**
Unit-IV	Introduction to Cloud Storage service, Simple Storage service (S3), Basic function of S-3 Storage, Elastics Block Storage (EBS), Elastic File Storage (EFS), Difference between EBS and EFS storage, Cloud Glacier service for database creation, Cloud Object Storage, Cloud Block Storage. **(08Hrs)**
Unit-V	Introduction to the VPC service, Subnet, Network load balancing, Network Gateway, IP-V4 and IP-V6, Reserved IP Address, Elastic Network Interfaces, NAT (Network Address Translation), VPC Sharing, On-Premises Server, Security Group services and Key pair services. **(08Hrs)**
Unit-VI	Introduction to Site to Site Networking in Cloud Computing, Concept of VPN (Direct Connect), VPC End Point, Concept of Transit Gateway, VPC Security

	Group, Network ACL **(08 Hrs)**				
References		**Title**	**Author**	**Publication**	**Edition/Year**
	1	Mastering Cloud Computing	Rajkumar Buyya	Mcgraw Hill	2015
	2	Cloud Computing Implementation Management and security	John W Ritting House	CRC Press	2014
	3	Cloud Computing A Practical approach	Anthony T Velte	Mcgraw Hill	2015
	4	Cloud Computing Web based application that change the way you work and collaborate online	Nichael Miller	Pearson	2015

Maharashtra Institute of Technology

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Department of Computer Science and Engineering

Syllabus of T. Y. B. Tech. (Honours* in Cloud Computing) Semester-VI

Course Code: CSE903 Course: Database Storage in Cloud Computing Teaching Scheme: Theory: 04 Hrs/week Tutorial: 00 Hr/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation:10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs

Prerequisite	Cloud Computing Basics and storage
Objectives	• To review and strengthen important concepts of Cloud Computing • Introduce the concept cloud computing and Storage services of Cloud
Unit-I	Introduction to cloud Storage, Storage billing and Dashboard, Block Storage, Object Storage, individual storage volume, boot volume for EC-2 instances, Data storage, file system, database host, enterprise application for storage of cloud services. (**08Hrs)**
Unit-II	Elastic Block storage volume types, EBS features, Simple storage service (S-3), S-3 Bucket, S-3 Storage Classes, Amazon S3 Intelligent Tiering, Amazon S3 Standard, Infrequent Access (Amazon S3 Standard, Amazon S3 One Zone, Infrequent Access (Amazon S3 One Zone, Amazon S3 Glacier, Amazon S3 Glacier Deep Archive. **(08 Hrs)**
Unit-III	Introduction to Elastic File System, EFS features, EFS Architecture, EFS implementation, EFS resources, Glacier Storage service and its working principle, Glacier service use cases, life cycle policies, cloud storage services, S3 and S3 Glacier services. **(08 Hrs)**
Unit-IV	Introduction to storage server, server encryption, client decryption, KMS (Key Management Service), CMKS (Customer Master Keys), Storage control access service, Data archive with cloud services, 119s durability of storage. **(08Hrs)**
Unit-V	Comparison of difference types of storage in cloud computing, EBS, EFS, S-3, Glacier, Functions of EFS, Durability of EBS, Consistency of S-3, Customer and service provider service of cloud storage. **(08 Hrs)**

Unit-VI	Introduction to storage snapshot service, storage elasticity, difference between SSD and HHD, Storage volume and its type, mounting, Temporary storage, Pricing model for storage, Storage consol, **(08 Hrs)**				
References		**Title**	**Author**	**Publication**	**Edition/ Year**
	1	Cloud Computing Bible	Barrie Sosinsky	Wiley	201
	2	Enterprise Cloud Computing Technology Architecture	Gautam Shroff	Cambridge University	2014
	3	Web Technologies TCP /IP Web Java Programming & Cloud Computing	Achut Godbole	Mcgraw Hill	2014
	4	Cloud computing with the Window Azure Platform	Roger Jennings	Wiley	2015

Maharashtra Institute of Technology

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Department of Computer Science and Engineering

Syllabus of T. Y. B. Tech. (Honours* in Cloud Computing) Semester-VI

Course Code: CSE972 Course: Laboratory Database Storage in Cloud Computing Teaching Scheme: Practical: 02 Hrs/week	Credits: 0-0-1 Term Work: 25 Marks

Prerequisite	Basics of Web Programming
Objectives	• To implement Database concepts in Cloud
List of Practical	1. Installation and configuration of own Cloud 2. Implementation of Virtualization in Cloud Computing to Learn Virtualization Basics, Benefits of Virtualization in Cloud using Open Source Operating System 3. Study and implementation of infrastructure as Service using Open Stack. 4. Write a program for Web feed using PHP and HTML. 5. Write a Program to Create, Manage and groups User accounts in own Cloud by Installing Administrative Features. 6. To Study Amazon Lambda Service. 7. To Study Amazon RDS service for the database. 8. To Study Amazon Object storage

The assessment of term work shall be done based on the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Practical/Oral examination conducted on the syllabus and term work mentioned above

Maharashtra Institute of Technology

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Department of Computer Science and Engineering

Syllabus of Final year B. Tech. (Honours* in Cloud Computing) Semester-VII

Course Code: CSE904 Course: Economics and Billing in Cloud Teaching Scheme: Theory: 4 Hrs/week Tutorial: 00 Hr/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation:10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs

Prerequisite	• Cloud Computing Basics and dashboard / billing
Objectives	• To review and strengthen important concepts of Cloud Computing • Introduce the concept cloud computing and cost and budgeting.
Unit-I	Fundamental of cloud pricing, Cloud Pricing philosophy, Pricing Characteristics, Pricing Calculator, Service utilization methodology, Billing and Account Visibility of Cloud services, Billing Dashboard (**08 Hrs)**
Unit-II	Introduction to Cloud Cost explorer, Services and Budgeting, Cost of services used, Service usage report, Data Transfer rate, Cloud Upfront Expenses, Tiered Pricing model, Custom pricing model, Cloud free tier concept. **(08 Hrs)**
Unit-III	Cloud services with no charge, VPC, Beanstalk, Auto Scaling, Cloud Formation, Identify Access management, Consolidated billing model, Inbound data transfer, Outbound data transfer, Introduction to TCO (Total Cost of Ownership), Business cases and workload. **(08 Hrs)**
Unit-IV	Introduction to Service cost, Storage cost, Network cost, IT Labor Cost, On Premises billing model, Pricing Calculator, Reading and estimate, ROI and billing dashboard, Storage saving, instance saving **(08Hrs)**
Unit-V	Introduction to policy based account management; Group based account management, Automate Account Management, Service Control Polices, Cloud Management Counsel, Command Line Interface, SDK (Software Development Kit). **(08Hrs)**
Unit-VI	Introduction to cost management and billing, Spend Summary, Cloud Budget, Cloud Usage report, Forecast and track costs, SNS (Simple Notification Service), Technical support, Cloud support plan. **(08 Hrs)**

References		Title	Author	Publication	Edition/Year
	1	Cloud Computing Bible	Barrie Sosinsky	Wiley	201
	2	Enterprise Cloud Computing Technology Architecture	Gautam Shroff	Cambridge University	2014
	3	Web Technologies TCP /IP Web Java Programming & Cloud Computing	Achut Godbole	Mcgraw Hill	2014
	4	Cloud computing with the Window Azure Platform	Roger Jennings	Wiley	2015

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Department of Computer Science and Engineering

Syllabus of Final Year. B. Tech. (Honours* in Cloud Computing) Semester-VIII

Course Code: CSE973 Course: Lab : Mini Project Teaching Scheme: Practical: 04 Hrs/week	Credits: 0-0-2 Term Work: 25 Marks Practical: 25 Marks
Prerequisite	Web Programming and Computer Network

Guidelines

To carry out a mini project in Cloud Computing.

Each student will have a faculty mentor to guide them.

There will be three reviews with below mentioned details:

Review #	**Requirement**	**Mark Weightage**	
		Internal	**External**
0	Idea Presentation/ Selection	-	-
1	Literature Review / Proposal for Project	10%	-
2	Proposed System Design/ Model	20%	-
3	Implementation and Demonstration	20%	-
End Semester Exam	Final Viva-Voce and Project Demonstration	-	50%

The assessment of term work shall be done on the basis of the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

Note:

1. No additional fees will be charged for students opting for Honours/ Minor Degree
2. All the courses in the Honours/ Minor will be conducted in offline mode.
3. Re-examination is not applicable in Honours and Minor Scheme. Student failing in any of the Minor or Honours courses,at any stage will be discontinued from the Scheme.
4. Examination Scheme and Passing rules will be as per the academic rules and regulations of B. Tech.

Maharashtra Institute of Technology

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Proposed Honours* in ElectricVehicles

Major Disciplines in Bachelor of Electrical Engineering

Bachelor of Mechanical Engineering

(With effect from A.Y. 2022-23)

Honours* in Electric Vehicles

Year & Semester	Course Code	Course	Teaching Scheme Hours / Week			Examination Scheme and Marks								Credit Scheme		
			Theory	Tutorial	Practical	Mid-Sem Exam-1	Mid-Sem Exam-1	Continuous Internal Evaluation	Teachers Assessment	End-Semester Exam	Term work	Practical	Total Marks	Theory / Tutorial	Practical	Total Credit
SY IV	EED901	Fundamentals of Electric Vehicles	04	--	--	15	15	10	10	50	--	--	100	04	--	04
	EED971	Lab: Fundamentals of Electric Vehicles	--	--	02	--				--	25	--	25	--	01	01
		Total	04	-	02	100					25	--	125	04	01	05
																Total Credits=05
TY V	EED902	Electric Vehicles Architecture	04	--	--	15	15	10	10	50	--	--	100	04	--	04
		Total	04	-	-	100					--	--	100	04	--	04
																Total Credits=04
TY VI	EED903	Electric drives and controllers for Electric Vehicles	04	--	--	15	15	10	10	50	--	--	100	04	--	04
	EED972	Lab: Electric drivesand controllersfor Electric Vehicles	--	--	02	--	--	--		--	25	--	25	--	01	01
		Total	04		02	100					25	--	125	04	01	05
																Total Credits=05
Final B. Tech. VII	EED904	Energy Storage Systems for Electric - Vehicles	04	--	--	15	15	10	10	50	--	--	100	04	--	04
		Total	04	--	---	100					--	--	100	04	--	04
																Total Credits=04
Final B. Tech. VIII	EED973	Mini Project	--	--	04	--	--	--		--	25	25	50	--	02	02
		Total	--	--	04	--	--	--		--	25	25	50	--	02	02
																Total Credits=02
Total Credit for Semester IV+V+VI+VII +VIII= 20																

Maharashtra Institute of Technology, Aurangabad

(An Autonomous Institute)

Department of Electrical Engineering

Syllabus of SY B. Tech. (Honours* in Electrical Vehicles) Semester-IV

Course Code: EED901 Course: Fundamentals of Electric Vehicles Teaching Scheme: Theory: 4 Hrs/week Tutorial: 00 Hr/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation:10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs

Prerequisite	Student Should have Knowledge of basic electrical principle and electrical technology.
Objectives	1.Understanding of basic principles, operation, performance of Electric vehicles
Unit-I	**Electric Vehicles** History, Components of Electric Vehicle, General Layout of EV, EV classification Comparison with Internal combustion Engine: Technology, Advantages & Disadvantages of EV, Overview of Tesla car. (6 Hrs)
Unit-II	**Hybrid Electric Vehicles** History, Components of Hybrid Electric Vehicle , General Layout of Hybrid EV, Comparison with Electric Vehicles, Advantages & Disadvantages of Hybrid EV, Overview of Toyota prius. (5 Hrs)
Unit-III	**Vehicle Fundamentals** Vehicle resistance, Types: Rolling Resistance, grading resistance, Aerodynamic drag vehicle performance, Calculating The Acceleration Force, maximum speed, Finding The Total Tractive Effort, Torque Required On The Drive Wheel, Transmission: Differential, clutch &gear box, Braking performance. (6 Hrs)
Unit-IV	**Motors** Principle and working of DC motor, Characteristics and Types of DC Motors-Overview (Speed torque characteristics) of Permanent Magnet motor , BLDC Motor, Induction motor. Comparison of all motors. (7 Hrs)
Unit-V	**Converts** Introduction of DC-DC, AC-AC ,AC-DC,DC-AC, four-quadrant operation, Driver circuits. (6 Hrs)

<table>
<tr><td>Unit-VI</td><td colspan="5">Energy Management Strategies
Introduction to energy management strategies used in electric vehicles, classification of different energy management strategies, comparison of different energy management strategies.
INDIAN and GLOBAL Scenario
Technology Scenario , Market Scenario , Policies and Regulations , Payback and commercial model , Payback and commercial model , Polices in India
(6Hrs)</td></tr>
<tr><td rowspan="6">References</td><td>Sr. No.</td><td>Title</td><td>Author</td><td>Publication</td><td>Edition</td></tr>
<tr><td>1.</td><td>Electric Vehicle Technology Explained</td><td>John Lowry and James Larminie</td><td>Wiley</td><td>2nd Edition</td></tr>
<tr><td>2.</td><td>Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design</td><td>Mehrdad Ehsaniand Yimin Gao</td><td>Power Electronics and Applications Series</td><td>Second Edition</td></tr>
<tr><td>3.</td><td>Electric and Hybrid Vehicles: Design Fundamentals</td><td>Iqbal Husain</td><td></td><td></td></tr>
<tr><td>4.</td><td>Build Your Own Electric Vehicle</td><td>Seth Leitman and Bob Brant</td><td></td><td></td></tr>
<tr><td>5.</td><td>Introduction to Hybrid Vehicle System Modeling and Control</td><td>Wei Liu</td><td></td><td></td></tr>
</table>

Maharashtra Institute of Technology, Aurangabad

(An Autonomous Institute)

Department of Electrical Engineering

Syllabus of SY B. Tech. (Honours* in Electrical Vehicles) Semester-IV

Course Code: EED971 Course: Laboratory Fundamentals of Electric Vehicles **Teaching Scheme:** Practical: 2 Hrs/week	Credits: 0-0-1 Term Work: 25 Marks Practical: Nil

Objectives	**:**	Understanding and Performing various measuring instruments through practical demonstrations.
List of Practical	**:**	**Perform any 8 Experiments.** List of Practical: 1. Experiment for conversion of DC to DC voltage using converter. 2. Simulation for AC to AC conversion 3. Simulation for AC to DC conversion 4. Simulation for DC to AC conversion 5. Study of 3 phase Induction motor. 6. Speed control of DC motor using IGBT. 7. To perform speed reversal of DC shunt motor 8. Study of various elements of transmission systems (clutch, differentials, gearbox etc.) 9. Calculate and compare the brake power, torque and mechanical efficiency of IC Engine and Electrical Motor of same configuration 10. Study of various types of braking systems 11. Case study of Tesla car. 12. Case study of Toyota Prius.

The assessment of term work shall be done on the basis of the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above

<table>
<tr><td colspan="3">Maharashtra Institute of Technology, Aurangabad
(An Autonomous Institute)
Department of Electrical Engineering
Syllabus of TY B. Tech. (Honours* in Electrical Vehicles) Semester-V</td></tr>
<tr><td colspan="2">Course Code: EED902
Course: Electric Vehicles Architecture
Teaching Scheme:
Theory: 4 Hrs/week
Tutorial: 00 Hr/week</td><td>Credits: 4-0-0
Mid Semester Examination-I: 15 Marks
Mid Semester Examination-II: 15 Marks
Continuous Internal Evaluation:10 Marks
Teacher Assessment: 10 Marks
End Semester Examination: 50 Marks
End Semester Examination (Duration): 2 Hrs</td></tr>
<tr><td>Prerequisite</td><td colspan="2">Basic configuration of Batteries, Types of Batteries, Basic concepts of Engineering Drawings, Basic Electrical motor drives, Fundamentals of Mechanical and Electrical Engineering</td></tr>
<tr><td>Objectives</td><td colspan="2">To design understand the chassis of electric vehicle to reduce a cost and weight.
To allocate a proper location of different components used in electric vehicle to make excellent appearance in view of all technical factors.</td></tr>
<tr><td>Unit-I</td><td colspan="2">Basic Architecture of Hybrid Drive Trains and Analysis of Series Drive Train
Hybrid Electric Vehicles (HEV): The gasoline ICE and battery, Diesel ICE and battery, Battery and FC, Battery and capacitor, Battery and flywheel, Battery and battery hybrids. Energy use in conventional vehicles, Energy saving potential of hybrid drive trains: Regenerative braking, More efficient operation of the ICE, including reduction of idle, Smaller ICE, Potential for higher weight, Electrical losses. Various HEV configurations and their operation modes: Series configuration, Parallel configuration, Series-parallelconfiguration, Complex configuration.
Electric Vehicles charging station
Types of charging station, Selection and Sizing of charging station, Components of charging station, Single line diagram of charging station, Charging Station Placement for Electric Vehicles. (6 Hrs.)</td></tr>
<tr><td>Unit-II</td><td colspan="2">Power Flow in HEVs Part-I
Power Flow Control: Optimal ICE operating point, Optimal ICE operating line, Safe battery voltage. Power Flow Control in Series Hybrid: Mode 1, normal driving or acceleration, Mode 2, light load, Mode 3, braking or deceleration, Mode 4, vehicle at stop. Power Flow Control in Parallel Hybrid: Mode 1, start up, Mode 2, normal driving, Mode 3, braking or deceleration, Mode 4, light load. (6 Hrs.)</td></tr>
</table>

Unit-III	**Power Flow in HEVs Part-II** Power Flow Control in Series-Parallel Hybrid: Mode 1: At startup, Mode 2: During full throttle acceleration, Mode 3: During normal driving, Mode 4: During normal braking or deceleration, Mode 5: To charge the battery during driving, Mode 6: When the vehicle is at standstill, The operating modes of EM dominated system, Power Flow Control Complex Hybrid Control: Mode 1: During startup, Mode 2: During full throttle acceleration (6 Hrs.)
Unit-IV	**Torque Coupling and Analysis of Parallel Drive Train** Introduction to Parallel Hybrid Electric Drive Train, Torque Coupling, Speed Coupling, Post-Transmission Parallel Hybrid Drive Train with Torque Coupling, Pre-Transmission Parallel Hybrid Drive Train with Torque Coupling, Parallel Hybrid Drive Train with Speed Coupling: Hybrid traction, Engine alone traction, Motor alone traction, Regenerative braking, Battery charging from the ICE. Complex Hybrid Drivetrain. (6 Hrs.)
Unit-V	**Basic Architecture of Electric Drive Trains-I** Electric Vehicle (EV) Configuration: Electric propulsion-The electronic controller, Power converter, Electric Motor (EM), Mechanical transmission, Driving wheels. Energy source-The energy source (battery, fuel cell, ultra capacitor), Energy management unit, Energy refueling unit. Auxiliary system- Power steering unit, Temperature control unit, Auxiliary power supply. EV alternatives based on drivetrains: EV configuration with clutch, gearbox and differential-I, EV configuration without clutch and gearbox, EV configuration with clutch, gearbox and differential-II. (6 Hrs.)
Unit-VI	**Basic Architecture of Electric Drive Trains-II** EV configuration with two EM, EV configuration with in wheel motor and mechanical gear, EV configuration with in wheel motor and no mechanical gear. EV alternatives based on power source configuration: EV configuration with battery source, EV configuration with two battery sources, EV configuration with battery and fuel cell source, EV configuration with multiple energy sources, EV configuration with battery and capacitors sources, EV configuration with battery and flywheel sources, Single and Multi-motor drives, In wheel drives (6 Hrs.)

	Sr. No.	Title	Author	Publication	Edition
References	1.	Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design	M. Ehsani	CRC Press,2005	
	2.	Electric and Hybrid Electric Vehicles	I. Husain	CRC Press, 2003	2nd ed. edition
	3	Vehicle Propulsion Systems: Introduction to Modeling and Optimization,	L. Guzzella and A. Sciarretta	Springer,2007	fifth edition
	4.	Automotive Transmissions: Fundamentals, Selection, Design and Application	G. Lechner and H. Naunheimer	Springer,1999	Third edition
	5.	Modern Electric Vehicle Technology	C. C. Chan and K. T. Chau	Oxford Science Publication, 2001	VolumeII

Maharashtra Institute of Technology, Aurangabad

(An Autonomous Institute)

Department of Electrical Engineering

Syllabus of TY B. Tech. (Honours* in Electrical Vehicles) Semester-VI

Course Code: EED903 Course: Electric drives and controller for Electric Vehicles Teaching Scheme: Theory: 4 Hrs/week Tutorial: 00 Hr/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation:10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs

Prerequisite	D.C machines, power electronics, utilization of electrical energy
Objectives	1)To understand about basics of motors and controller. 2)To understand about drives and control.
Unit-I	**Electric motors** Types of Motors, Selection and sizing of Motor, RPM and Torque calculation of motor Motor Controllers Component sizing, Physical locations, Mechanical connection of motor Electrical connection of motor (6Hrs.)
Unit-II	**Control Unit and Control Strategies** Controller Overview, Switch Controller, Solid-State Controller, Electronic Controllers, AC Controller, DC Motor Controller- The Lesson of the Jones Switch, An Off-the-Shelf Curtis PWM DC Motor Controller, AC Controllers, Today's Best Controller Solution, Zilla Controller (One of the Best DC Controller for Conversions) ZAPI., Control Strategies, Max. SOC-of-PPS Control Strategy, Thermostat Control Strategy (Engine-On–Off) (6 Hrs.)
Unit-III	**Electric Vehicle Drives** Configurations of Electric Vehicles, Performance of Electric Vehicles, Traction Motor Characteristics, Tractive Effort and Transmission Requirement, Vehicle Performance, Tractive Effort in Normal Driving, Energy Consumption. (6 Hrs.)
Unit-IV	**Concept of Hybrid Electric Drive Trains** Concept of Hybrid Electric Drive Trains, Architectures of Hybrid Electric Drive Trains Series Hybrid Electric Drive Trains, Parallel Hybrid Electric Drive Trains, Torque-Coupling, Parallel Hybrid Electric DriveTrains, Speed-Coupling Parallel Hybrid Electric DriveTrains, Torque-Coupling and Speed-Coupling Parallel Hybrid

	Electric Drive Train. (6 Hrs.)				
Unit-V	**Electric Propulsion Systems** DC Motor Drive, Principle of Operation and Performance, Combined Armature Voltage and Field Control, Chopper Control of DC Motors, Multi quadrant Control of Chopper-Fed, DC Motor Drives, Two-Quadrant Control of Forward Motoring and Regenerative Braking, Single Chopper with a Reverse Switch, Class C Two-Quadrant Chopper, Four-Quadrant Operation, Induction Motor Drives, Basic Operation Principles of Induction Motor, Steady-State Performance, Constant Volt/Hertz Control, Power Electronic Control, Field Orientation Control, Field Orientation Principle, Control, Direction Rotor Flux Orientation Scheme, Indirect Rotor Flux Orientation Scheme, Voltage Source Inverter for FO, Voltage Control in Voltage Source Invert, Current Control in Voltage Source Inverter. (8 Hrs.)				
Unit-VI	**Permanent Magnetic Brush-Less DC Motor Drives and Case studies** Basic Principles of BLDC Motor Drives, BLDC Machine Construction and Classification Properties of PM Material, Alnico, Ferrites, Rare-Earth PMs, case studies. (4 Hrs.)				
References	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1.	Modern Electric, HybridElectric and Fuel Cell Vehicles: Fundamentals, Theory and Design	M. Ehsani	CRC Press,2005	
	2.	Engine control strategyfor a series hybrid electric vehicle incorporating load- leveling and computer controlled. energy management,	C.G. Hochgraf, M.J. Ryan, and H.L. Wiegman	Warrendale, PA, 2002	2nd ed. Edition
	3	Build your own electric vehicle	Seth Leitman Bob Brant	MC graw hill	Second edition

	4.	Automotive Transmissions: Fundamentals, Selection, Design and Application	G. Lechner and H.Naunheimer	Springer,1999	Third edition
	5.	Modern Electric VehicleTechnology	C. C. Chan and K. T. Chau	Oxford Science Publication, 2001	VolumeII

Maharashtra Institute of Technology, Aurangabad

(An Autonomous Institute)

Department of Electrical Engineering

Syllabus of TY B. Tech. (Honours* in Electrical Vehicles) Semester-VI

Course Code: EED972 Course: Laboratory Electric drives and controller for Electric Vehicles Teaching Scheme: Practical: 2 Hrs/week	Credits: 0-0-1 Term Work: 25 Marks Practical: Nil

Objectives	1. Develop the student's simulation skills in Electric drives and controller. 2. Analyze the important parameters for Electric drives and controller.
List of Practical	**Perform any 8 Experiments.** 1. Demonstration of wiring layout of electric vehicle. 2. Current/Voltage Control of an Electric vehicle. 3. Control Circuit of induction motor. 4. Demonstration of Controllers & Actuators in an Electric Vehicle 5. V/f control of three-phase induction motor. 6. Speed control of BLDC motor in two-wheeler. 7. Speed control of Switched Reluctance Motors (SRM) motor in three-wheeler. 8. Simulation of Four quadrant operation of three-phase induction motor. 9. MOSFET based step up and step-down chopper. 10. VI Characteristics of SCR, IGBT & MOSFET. 11. Three phase IGBT based PWM inverter control of induction motor.
Reference	1. MATLAB/SIMULINK examples 2. Power Electronics: Circuits, Devices, and Applications- M.H. Rashid, Pearson Education, PHI 3rd edition, New Delhi 2004. 3. https://www.researchgate.net/publication/334689540_Charging_Station_Placement_for_Electric_Vehicles_a_Case_Study_of_Guwahati_city_India, Sanchari Deb, https://ieeexplore.ieee.org/document/8772029, 2019. 4. A comprehensive review on recent progress in aluminum–air batteries 5. https://ieeexplore.ieee.org/document/7392682

The assessment of term work shall be done on the basis of the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

Maharashtra Institute of Technology, Aurangabad

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Department of Electrical Engineering

Syllabus of B. Tech. Final (Honours* in Electrical Vehicles) Semester-VII

Course Code: EED904 Course: Energy Storage Systems for Electric Vehicles Teaching Scheme: Theory: 4 Hrs/week Tutorial: 00 Hr/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation:10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs

Prerequisite	Student should have knowledge of basic battery characteristics, basic electrical and basic converters.
Objectives	1. Identify suitable energy storage system for Electric Vehicle. 2. Compare different energy storage system. 3. Explain use of energy management system for energy storage systems.
Unit-I	**Electrochemical Battery 1:** Introduction to Electrochemical Battery, Electro Chemical Reactions, Battery capacity, Discharge Rate, SOC, SOD, SOH, DOD, Thermodynamic Voltage, Specific Energy, Specific Power, Energy Efficiency, Battery Technologies (used in Tesla Car), Lead-acid battery. (6 Hrs)
Unit-II	**Electrochemical Battery 2:** Nickel based battery (Nickel Metal Hydride), Lithium battery (Li-ion and Li-Polymer), Introduction to graphene battery, Compare all Electrochemical batteries. (6 Hrs)
Unit-III	**Fuel Cell:** Overview of key fuel cell technologies- Various types of fuel cells, Materials for electrodes, electrolytes and other components, Working mechanisms, Hydrogen generation and storage: limitations, Recent progress in fuel cells, Safety issues and cost expectation and life cycle analysis of fuel cells. (5 Hrs)
Unit-IV	**Ultra-capacitors:** Features of Ultra capacitors, Basic principle operation of Ultra capacitors, Fundamentals of Electrochemical Supercapacitors, Electrode and electrolyte interfaces and their capacitances, Charge-Discharge characteristics, Energy/power density, Design, Fabrication, Ultra capacitor Technologies, Graphene based Ultra capacitor, Introduction to Flywheel, Hybridization of different energy storage devices. (7 Hrs)

Unit-V	**Energy Management System:** In vehicle networks- CAN, Energy Management Strategies: Introduction to energy management strategies with optimization techniques used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies and implementation issues of energy management strategies. (7 Hrs)				
Unit-VI	**Electric Vehicles Charging Station:** Types of charging station, Selection and Sizing of charging station, Components of charging station, Single line diagram of charging station, Charging Station Placement for Electric Vehicles: A Case Study of Guwahati city, India, Case Study of Tesla. (5 Hrs)				
References	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1.	Electric and HybridVehicles: Design Fundamentals	Iqbal Hussein,	CRC Press,2003	Second edition
	2.	Modern Electric, HybridElectric and Fuel Cell Vehicles: Fundamentals, Theory and	Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi,	Design, CRCPress	2004
	3	Electric Vehicle Technology Explained,	James Larminie, John Lowry,	Wiley	2003
	4.	Super capacitors-Materials, Systems, and Applications	F. Beguin and E. Frackowiak	Wiley- VCH Verlag GmbH & Co.	2013
	5.	Fuel Cells and Hydrogen: From Fundamentals to Applied Research	V. Hacker, S. Mitsushima (sdE.)	Elsevier	2018

Maharashtra Institute of Technology, Aurangabad

(An Autonomous Institute)

Department of Electrical Engineering

Syllabus of Final Year B. Tech. (Honours* in Electrical Vehicle) Semester-VIII

Course Code: EED973 Course: Mini Project Teaching Scheme: Practical: 4 Hrs/week	Credits: 0-0-2 Term Work: 25 Marks Practical: 25 Marks

Prerequisite	Fundamentals of electrical drives, motors and controllers used in electrical drives

List of Practical

To carry out a min project and simple prototype in the area of interest based on the knowledge gained in Electrical vehicles from undergraduate and first semester. Every individual student will be assigned a faculty to guide them. There will be three major reviews which will be carried out as listed below.

Review #	**Requirement**	**Mark Weightage**	
		Internal	**External**
0	Area/Title selection	-	-
1	Literature review/Proposal for the Project	10%	-
2	Mathematical modelling /CircuitDesign	20%	-
3	Final simulation/Hardware presentation	20%	-
End Semester Exam	Final Viva-Voce and project demonstration	-	50%

The assessment of term work shall be done on the basis of the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

Note:

1. No additional fees will be charged for students opting for Honours/ Minor Degree
2. All the courses in the Honours/ Minor will be conducted in offline mode.
3. Re-examination is not applicable in Honours and Minor Scheme. Student failing in any of the Minor or Honours courses,at any stage will be discontinued from the Scheme.
4. Examination Scheme and Passing rules will be as per the academic rules and regulations of B. Tech.

Maharashtra Institute of Technology
(An Autonomous Institute)

Proposed Honours* in Data Science

Major disciplines in

Bachelor in Electronics and Computer Engineering
Computer Science and Engineering
Computer Science and Design

(With effect from A.Y. 2022-23)

Honours* in Data Science

Year & Semester	Course Code	Course	Teaching Scheme Hours/Week			Examination Scheme and Marks								Credit Scheme		
			Theory	Tutorial	Practical	Mid-Sem Exam-1	Mid-Sem Exam-1	Continuous Internal Evaluation	Teachers Assessment	End-Semester Exam	Term work	Practical	Total Marks	Theory / Tutorial	Practical	Total Credit
SY IV	ECE901	Data Sciences and Visualization	04	--	--	15	15	10	10	50	--	--	100	04	--	04
	ECE971	Data Sciences and Visualization Laboratory	--	--	02	--				--	25	--	25	--	01	01
		Total	04	-	02	100					25	--	125	04	01	05
														Total		**Credits =05**
TY V	ECE902	Statistical Foundations for Data Science	04	--	--	15	15	10	10	50	--	--	100	04	--	04
		Total	04	-	-	100					--	--	100	04	--	04
																Total Credits =04
TY VI	ECE903	Machine Learning	04	--	--	15	15	10	10	50	--	--	100	04	--	04
	ECE972	Machine Learning Laboratory	--	--	02	--	--	--		-	25	--	25	--	01	01
		Total	04	--	02	100					25	--	125	04	01	05
																Total Credits = 05
Final B.Tech VII	ECE904	Artificial Intelligence for Data Analytics	04	--	--	15	15	10	10	50	--	--	100	04	--	04
		Total	04	--	--	100					--	--	100	04	--	04
																Total Credits = 04
Final B. Tech. VIII	ECE974	Mini Project	--	--	04	--	--	--		-	25	25	50	--	02	02
		Total	--	--	04	--	--	--		-	25	25	50	--	02	02
																Total Credits = 02
Total Credit for Semester IV+V+VI+VII +VIII= 20																

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Maharashtra Institute of Technology, Aurangabad

(An Autonomous Institute)

Department of Electronics and Computer Engineering

Syllabus of SY B. Tech. (Honours* in Data Science) Semester-IV

Course Code: ECE901 Course: Data Sciences and Visualization Teaching Scheme: Theory: 4 Hrs/week Tutorial: 00 Hr/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation:10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs

Prerequisite		Basic knowledge of mathematics and python programming.
Objectives	**:**	The course will introduce students to the fundamental data visualization concepts required for a program in data science.
Unit-I	**:**	**Introduction to Data Analytics** Definition and example. Data Analysis Process: Data Requirement Specifications, Data Collection, Data Processing, Data Analysis, Infer and Interpret Results. Data Analysis Methods: Qualitative Analysis, Quantitative Analysis, Text analysis, Statistical analysis, Diagnostic analysis, Predictive analysis. **(6 Hrs)**
Unit-II		**Working with Data** Data Literacy, Data acquisition, Data examination, Data transformation, Data exploration. **(6 Hrs)**
Unit-III	**:**	**Data Analysis Techniques and Tools** Techniques based on Mathematics and Statistics, Techniques based on Artificial Intelligence and Machine Learning, Techniques based on Visualization and Graphs Introduction to Data Analysis Tools: Excel, Tableau, Power BI, Fine Report, R & Python, SAS. **(6 Hrs)**
Unit-IV	**:**	**Introduction to Data Visualization and Data Representation** Basics of data visualization, Principles of good visualization design, Data visualization design workflow, Introduction to visual encoding, Chart types, Chart families, Categorical,

		Hierarchical, Relational, Temporal and Spatial. **(8 Hrs)**
Unit-V	**:**	**Interactivity** Features of Interactivity, Data adjustments, View adjustments, Features of Annotation, Project Annotation, Chart Annotation, Features of colours, Data legibility, Features of Composition, Project Composition, Chart Composition. **(6 Hrs)**
Unit-VI	**:**	**Graphical analysis with gnuplot** What is gnuplot and its limitation, Data analysis and visualization concepts, Simple plot, saving and exporting with gnuplot Fundamental graphical methods, Relationships, Counting statistics, Ranked data, Multivariate data, Core principle of graphical analysis, A case study in iteration: car data. **(8 Hrs)**
Reference books/ Text books	**:**	1. Andy Kirk, Data Visualization A Handbook for Data Driven Design, Sage Publications, 2016 2. Philipp K. Janert, Gnuplot in Action, Understanding Data with Graphs, Manning Publications, 2010

Maharashtra Institute of Technology, Aurangabad

(An Autonomous Institute)

Department of Electronics and Computer Engineering

Syllabus of SY B. Tech. (Honours* in Data Science) Semester-IV

Course Code: ECE971	Credits: 0-0-1
Course: Laboratory Data Sciences and Visualization	Term Work: 25 Marks
Teaching Scheme:	Practical: Nil
Practical: 2 Hrs/week	

Prerequisite		Basic knowledge of mathematics and Python/R programming/Tableau.
Objectives	**:**	The course will introduce students to the fundamental data visualization concepts required for a program in data science
Laboratory Experiments	**:**	1. Introduction to programming language for data analytics: Python/R 2. Introduction to different libraries in Python/R 3. To Perform All Arithmetic and logical operations with Python/R 4. To perform basic data frame analysis using Python/R 5. Defining data visualization; Visualization workflow 6. Data Representation: chart types: categorical, hierarchical, relational, temporal & spatial 7. 2-D: bar charts, Clustered bar charts, dot plots, connected dot plots, pictograms, proportional shape charts, bubble charts, radar charts, polar 8. Charts, Range chart, Box-and-whisker plots, univariate scatter plots, histograms word cloud, pie chart, waffle chart, stacked bar chart, back-to-back bar chart, treemap and all relevant 2-D charts. 9. 3-D: surfaces, contours, hidden surfaces, pm3d coloring, 3D mapping; 10. Multi-dimensional data visualization; Graph data visualization; Annotation; 11. Case Study: Understanding basics of Recommendation Engines (with case study).
Reference books/ Text books	**:**	1. Andy Kirk, Data Visualization A Handbook for Data Driven Design, Sage Publications, 2016 2. Philipp K. Janert, Gnuplot in Action, Understanding Data with Graphs, Manning Publications, 2010.

The assessment of term work shall be done on the basis of the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

Maharashtra Institute of Technology, Aurangabad

(An Autonomous Institute)

Department of Electronics and Computer Engineering

Syllabus of TY B. Tech. (Honours* in Data Science) Semester-V

Course Code: ECE902 Course: Statistical Foundations for Data Science Teaching Scheme: Theory: 4 Hrs/week Tutorial: 00 Hr/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation:10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs

Prerequisite		Basic knowledge of statistics and probability.
Objectives	**:**	The course will gives students to the fundamental mathematical concepts required for a program in data science.
Unit-I	**:**	**Introduction** Measures of central tendency, mean median mode, measures of dispersion, means and standard deviation. **Probability Review** Sample Spaces, Conditional Probability and Independence, Density Functions, Expected Value, Variance, Joint, Marginal, and Conditional Distributions, Bayes' Rule, Bayesian Inference, Convergence and Sampling, Sampling and Estimation, Probably Approximately Correct (PAC), Concentration of Measure, Importance Sampling. **(8 Hrs.)**
Unit-II	**:**	**Linear Algebra Review** Vectors and Matrices, Addition and Multiplication, Norms, Linear Independence, Rank, Inverse, Orthogonality, Distances and Nearest Neighbors, Metrics, Lp Distances and their Relatives, Distances for Sets and Strings, Modeling Text with Distances, Similarities, Locality Sensitive Hashing. **(6 Hrs.)**
Unit-III	**:**	**Linear Regression** Simple Linear Regression, Linear Regression with Multiple Explanatory Variables, Polynomial Regression, Cross Validation, Regularized Regression, Functions, Gradients, Gradient Descent, Fitting a Model to Data, Least Mean Squares Updates for Regression, Decomposable Functions.

		(6 Hrs.)
Unit-IV	**:**	**Principal Component Analysis** Data Matrices, Singular Value Decomposition, Eigenvalues and Eigenvectors, The Power Method, Principal Component Analysis, Multidimensional Scaling, Clustering, Voronoi Diagrams, Delaunay Triangulation, Connection to Assignment-based Clustering, Hierarchical and k means Clustering. **(8 Hrs.)**
Unit-V	**:**	**Classification** Linear Classifiers, Perceptron Algorithm, Kernels, The Dual: Mistake Counter, Feature Expansion, Support Vector Machines, KNN Classifiers, Neural Networks. **(6 Hrs.)**
Unit-VI	**:**	**Graphs** Markov Chains, Ergodic Markov Chains, Metropolis Algorithm, PageRank, Spectral Clustering on Graphs, Laplacians and their Eigen-Structure, Communities in Graphs, Preferential Attachment, Betweenness, Modularity. **(6 Hrs.)**
Reference books/ Text books	**:**	1. B. L. S. Prakasa Rao, A First Course in Probability and Statistics, World Scientific/Cambridge University Press India, 2009. 2. R. V. Hogg, J. W. McKean and A. Craig, Introduction to Mathematical Statistics, 6th Ed., Pearson Education India, 2006. 3. G. Strang (2016). Introduction to Linear Algebra, Wellesley-Cambridge Press, Fifth edition, USA. 4. Bendat, J. S. and A. G. Piersol (2010). Random Data: Analysis and Measurement Procedures. 4th Edition. John Wiley & Sons, Inc., NY, USA:

Maharashtra Institute of Technology, Aurangabad

(An Autonomous Institute)

Department of Electronics and Computer Engineering

Syllabus of TY B. Tech. (Honours* in Data Science) Semester-VI

Course Code: ECE903 Course: Machine Learning Teaching Scheme: Theory: 4 Hrs/week Tutorial: 00 Hr/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation:10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs

Prerequisite		Basic knowledge of mathematics, statistics and programming language (Python/R).
Objectives	**:**	To introduce students to the basic concepts and techniques of Machine Learning.
Unit-I	**:**	**Introduction** Learning - Types of machine learning - Supervised learning - The brain and the neurons, Linear Discriminants -Perceptron - Linear Separability -Linear Regression - Multilayer perceptron – Examples of using MLP - Back propagation of error. Suggested Activities: Design a Multilayer Perceptron for Rain Forecasting system. **(6 Hrs.)**
Unit-II		**Classification Algorithms** Decision trees - Constructing decision trees - Classification of regression trees - Regression example - Probability and Learning: Turning data into probabilities - Some basic statistics - Gaussian mixture models - Nearest Neighbor methods. Suggested Activities: Explore the Regression Examples in Machine Learning **(8 Hrs.)**
Unit-III	**:**	**Analysis** The k-Means algorithm - Vector Quantization's - Linear Discriminant Analysis - Principal component analysis - Factor Analysis - Independent component analysis - Locally Linear embedding – Iso map -Least squares optimization - Simulated annealing. Suggested Activities: Simulated annealing / Modelling on any data science application. **(8 Hrs.)**
		Optimization Techniques The Genetic algorithm - Genetic operators - Genetic programming - Combining sampling with genetic programming - Markov Decision Process - Markov Chain

Unit-IV	**:**	Monte Carlo methods: sampling – Monte carlo - Proposal distribution. Suggested Activities: Design an Encryption algorithm using Genetic algorithm **(6 Hrs.)**
Unit-V	**:**	**Python for Machine Learning** Baysean Networks - Markov Random moFields - Hidden Markov Models -Tracking methods. **(6 Hrs.)**
Unit-VI	**:**	**Python for MATLAB AND R users** Python: Installation - Python for MATLAB AND R users - Code Basics - Using NumPy and MatPlotlib. Suggested Activities: Design a simple application using NumPy and MatPlotlib. **(6 Hrs.)**
Reference books/ Text books	**:**	1. Kevin P. Murphy, “Machine Learning – A probabilistic Perspective”, MIT Pres, 2016. 2. Randal S, “Python Machine Learning, PACKT Publishing, 2016. 3. Ethem Alpaydin, "Machine Learning: The New AI”, MIT Press, 2016. 4. Shai Shalev-Shwartz, Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms”, Cambridge University Press, 2014. 5. Sebastian Raschka, “Python Machine Learning”, Packt Publishing Ltd, 2015 6. E. Alpaydin, Introduction to Machine Learning, 3rd Edition, Prentice Hall (India) 2015. 7. R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification, 2nd Edn., Wiley India, 2007. 8. C. . Bishop, Pattern Recognition and Machine Learning (Information Science and Statistics), Springer, 2006. 9. S. O. Haykin, Neural Networks and Learning Machines, 3rd Edition, Pearson Education (India), 2016 10. J. Shawe-Taylor and Nello Christianini, Kernel Methods for Pattern Analysis, Cambridge University Press, 2004.

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Department of Electronics and Computer Engineering

Syllabus of TY B. Tech. (Honours* in Data science) Semester-VI

Course Code: ECE972	Credits: 0-0-1
Course: Laboratory Machine Learning	Term Work: 25 Marks
Teaching Scheme:	Practical: Nil
Practical: 2 Hrs/week	

Prerequisite		Basic knowledge of mathematics, statistics and python programming.
Objectives	**:**	• To introduce students to the basic concepts and techniques of Machine Learning.
Laboratory Experiments	**:**	1. Design of experiments in Machine Learning. 2. Introduction to popular Machine Learning Datasets and Toolkits. 3. Face Recognition using PCA. 4. Practical applications of clustering. 5. Experiments on supervised classification using MLP, RBF ANN, SVM and Decision Trees. 6. Application of Classifiers Ensembles. 7. Sequence classification using HMM. 8. Applications of CNN and RNN. 9. Path planning with Reinforcement Learning. 10. Introduction to advanced machine learning tools like, Azure ML studio, Spark.
Reference books/ Text books	**:**	1. Kevin P. Murphy, “Machine Learning – A probabilistic Perspective”, MIT Pres, 2016. 2. Randal S, “Python Machine Learning, PACKT Publishing, 2016. 3. Ethem Alpaydin, "Machine Learning: The New AI”, MIT Press, 2016. 4. Shai Shalev-Shwartz, Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms”, Cambridge University Press, 2014. 5. Sebastian Raschka, “Python Machine Learning”, Packt Publishing Ltd, 2015 6. E. Alpaydin, Introduction to Machine Learning, 3rd Edition, Prentice Hall (India) 2015. 7. R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification, 2nd Edn., Wiley India, 2007. 8. C. . Bishop, Pattern Recognition and Machine Learning (Information Science and Statistics), Springer, 2006.

		9. S. O. Haykin, Neural Networks and Learning Machines, 3rd Edition, Pearson Education (India), 2016 10. J. Shawe-Taylor and Nello Cristianini, Kernel Methods for Pattern Analysis, Cambridge University Press, 2004. 11. I. Goodfellow, Y. Bengio, A. Courville, Deep Learning, MIT Press, 2017 12. R. Sutton, Reinforcement Learning – An Introduction, MIT Press, 1998 13. Relevant Research Papers in the area of Machine Learning

The assessment of term work shall be done on the basis of the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

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Department of Electronics and Computer Engineering

Syllabus of Final Year B. Tech. (Honours* in Data science) Semester-VII

Course Code: ECE904 Course: Machine Learning Teaching Scheme: Theory: 4 Hrs/week Tutorial: 00 Hr/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation:10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs

Prerequisite		Probability and Statistics, data analytics skills, knowledge of Computer science, programming languages and coding.
Objectives	**:**	1. Understanding Human learning aspects. 2. Understanding primitives and methods in learning process by computer. 3. To Provide understanding of the techniques, mathematical concepts, and algorithm used in machines learning.
Unit-I	**:**	**Introduction to Intelligent Systems**, History, Foundations and Mathematical treatments, Problem solving with AI, AI models, Learning aspects in AI, Intelligent Agents, types of Agents. **Intelligent agents**: reactive, deliberative, goal-driven, utility-driven, and learning agents **(6 Hrs.)**
Unit-II		**Problem-solving through Search**: forward and backward, state-space, blind, heuristic, problem-reduction, A, A*, AO*, minimax, constraint propagation, neural, stochastic, and evolutionary search algorithms, sample applications. **(6 Hrs.)**
Unit-III	**:**	**Knowledge Representation and Reasoning**: ontologies, foundations of knowledge representation and reasoning, representing and reasoning about objects, relations, events, actions, time, and space; predicate logic, situation calculus, description logics, reasoning with defaults, reasoning about knowledge, sample applications. **Planning**: planning as search, partial order planning, construction and use of planning graphs.

		(8 Hrs.)
Unit-IV	**:**	**Representing and Reasoning with Uncertain Knowledge**: probability, connection to logic, independence, Bayes rule, bayesian networks, probabilistic inference, sample applications. **(6 Hrs.)**
Unit-V	**:**	**Decision-Making**: basics of utility theory, decision theory, sequential decision problems, elementary game theory, sample applications. **(6 Hrs.)**
Unit-VI	**:**	**Machine Learning and Knowledge Acquisition**: learning from memorization, examples, explanation, and exploration. learning nearest neighbor, naive Bayes, and decision tree classifiers, Q-learning for learning action policies, applications. Sample Applications of AI **(8 Hrs.)**
Reference books/ Text books	**:**	**Text Books:** 1. Artificial Intelligence and Machine Learning By Vinod Chandra S.S. Anand Hareendran S 2. Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach-Second Edition" Pearson Education 3. Tom M. Mitchell. "Machine Learning" McGraw-Hill, 1997. 4. Ethem Alpaydin "Introduction to machine learning" 2nd ed. The MIT Press, 2010

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Syllabus of Final Year B. Tech. (Honours* in Data Science) Semester-VIII

Course Code: ECE973 Course: Mini Project Teaching Scheme: Practical: 4 Hrs/week	Credits: 0-0-2 Term Work: 25 Marks Practical: 25 Marks
Prerequisite	Basic Electronics, Basic Programming Languages.

To carry out a mini project and simple prototype in the area of interest based on the knowledge gained in Data Science from undergraduate and first semester.

Every individual student will be assigned a faculty to guide them. There will be three major reviews which will be carried out as listed below.

Review #	**Requirement**	**Mark Weightage**	
		Internal	**External**
0	Area / Title selection	-	-
1	Literature review / Proposal for the Project	10%	-
2	Mathematical Modelling/Circuit Design	20%	-
3	Final simulation / Hardware presentation	20%	-
End Semester Exam	Final Viva-Voce and project demonstration	-	50%

The assessment of term work shall be done on the basis of the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

Note:

1. No additional fees will be charged for students opting for Honours/ Minor Degree
2. All the courses in the Honours/ Minor will be conducted in offline mode.
3. Re-examination is not applicable in Honours and Minor Scheme. Student failing in any of the Minor or Honours courses,at any stage will be discontinued from the Scheme.
4. Examination Scheme and Passing rules will be as per the academic rules and regulations of B. Tech.

Faculty of Science and Technology

Proposed Honours* in

Internet of Things

Major disciplines in

Bachelor in Electronics and

Computer Engineering

Electrical Engineering

Agricultural Engineering

Honours* in Internet of Things

Year & Semester	Course Code	Course	Teaching Scheme Hours / Week			Examination Scheme and Marks								Credit Scheme		
			Theory	Tutorial	Practical	Mid-Sem Exam-1	Continuous Internal Evaluation	Teachers Assessment	End-Semester Exam	Mid-Sem Exam-1	Term work	Practical	Total Marks	Theory / Tutorial	Practical	Total Credit
SY IV	ECED901	Embedded Internet of Things	04	--	--	15	15	10	10	50	--	--	100	04	--	04
	ECED971	Embedded Internet of Things Laboratory	--	--	02	--	--	--	--	--	25	--	25	--	01	01
		Total	04	-	02	100					25	--	125	04	01	05
														Total		**Credits =05**
TY V	ECED902	Communication Protocols for IoT	04	--	--	15	15	10	10	50	--	--	100	04	--	04
		Total	04	-	-	100					--	--	100	04	--	04
																Total Credits =04
TY VI	ECED903	Sensors Network & Internet of Things	04	--	--	15	15	10	10	50	--	--	100	04	--	04
	ECED972	Sensors Network & Internet of Things Laboratory	--	--	02	--	--	--		--	25	--	25	--	01	01
		Total	04	--	02	100					25	--	125	04	01	05
																Total Credits = 05
Final B. Tech VII	ECED904	Privacy and Security in IoT	04	--	--	15	15	10	10	50	--	--	100	04	--	04
		Total	04	--	--	100					--	--	100	04	--	04
																Total Credits = 04
Final B. Tech. VIII	ECED973	Mini Project	--	--	04	--	--	--		--	25	25	50	--	02	02
		Total	--	--	04	--	--	--		--	25	25	50	--	02	02
																Total Credits = 02
																Total Credit for Semester IV+V+VI+VII +VIII= 20

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Syllabus of SY B. Tech. (Honours* in Internet of Things) Semester-IV

Course Code: ECED901 Course: Embedded Internet of Things Teaching Scheme: Theory: 4 Hrs/week Tutorial: 00 Hr/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation:10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs

Prerequisite		Basic Electronics, Basic Programming Language
Objectives	**:**	This course introduces Concepts for internet of things and how we can embed it into our daily lives for the development of life style. It will also help students to build applications according to their problem statements.
Unit-I	**:**	**Fundamentals and Applications of IoT** Introduction to Internet of Things (IoT)– Functional Characteristics – Recent Trends in the Adoption of IoT – Societal Benefits of IoT, Health Care — Machine to Machine (M2M) - Smart Transportation – Smart Living – Smart Cities- Smart Grid, Industry 4.0 **(8 Hrs)**
Unit-II		**Communication Principles** RFID – ZigBEE – Bluetooth – Internet Communication- IP Addresses - MAC Addresses - TCP and UDP – IEEE 802 Family of Protocols – Cellular-Introduction to EtherCAT. 6 **(6 Hrs)**
Unit-III	**:**	**IoT Architecture** Functional Requirements - Components of IoT: Sensors – Actuators – Embedded Computation Units – Communication Interfaces – Software Development **(6 Hrs)**
Unit-IV	**:**	**Microcontrollers for IoT** Features of ESP8266, Specification of ESP8266, Block diagram of ESP8266, Applications of ESP8266 , Features of ESP32, Specification of ESP32, Block diagram of ESP32, Applications of ESP32, Access point and station point mode **(8 Hrs)**
Unit-V	**:**	**Communication Interface in IoT** IEEE 802.11 Wireless Networks Attacks: Basic Types, WEP Key Recovery Attacks, Keystream Recovery Attacks against WEP – RFID Security – Security Issues in ZigBEE: Eavesdropping Attacks, Encryption Attacks – Bluetooth Security: Threats to Bluetooth Devices and Networks. **(6 Hrs)**

Unit-VI	**:**	**Cloud computation and Big data analytics** Evolution of Cloud Computation, Commercial clouds and their features, open source IoT platforms, cloud dashboards, Big data analytics and Hadoop. Interfacing and data logging with cloud: Thing speak, Blync platform. **(6 Hrs)**
Reference books/ Text books	**:**	1. Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg, Sebastian Lange, Stefan Meissner, "Enabling things to talk – Designing IoT solutions with the IoT Architecture Reference Model", Springer Open, 2016 2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle, "From Machine to Machine to Internet of Things", Elsevier Publications, 2014. 3. LuYan, Yan Zhang, Laurence T. Yang, Huansheng Ning, The Internet of Things: From RFID to the Next-Generation Pervasive Network, Aurbach publications, March, 2008. 4. Vijay Madisetti , Arshdeep Bahga, Adrian McEwen (Author), Hakim Cassimally 5. "Internet of Things A Hands-on-Approach" Arshdeep Bahga & Vijay Madisetti, 2014. 6. Asoke K Talukder and Roopa R Yavagal, "Mobile Computing," Tata McGraw Hill, 2010. 7. Barrie Sosinsky, "Cloud Computing Bible", Wiley-India, 2010 8. RonaldL. Krutz, Russell Dean Vines,Cloud Security: A Comprehensive Guide to Secure Cloud Computing,Wiley-India, 2010 9. Fadi Al-Turjman, Intelligence in IoT- enabled Smart Cities, 2019, 1st edition, CRC Press, ISBN-10: 1138316849 10. Giacomo Veneri, and Antonio Capasso, Hands-on Industrial Internet of Things: Create a powerful industrial IoT infrastructure using Industry 4.0, 2018, Packt Publishing. 11. Subhas Chandra Mukhopadhyay, Smart Sensing Technology for Agriculture and Environmental Monitoring, 2012, Springer, ISBN-10: 3642276377 . 12. Adrian McEwen and Hakim Cassimally, ―Designing the Internet of Things‖, John Wiley and Sons Ltd, UK, 2014. 13. Olivier Hersent, David Boswarthick and Omar Elloumi, ―The Internet of Things: Key Applications and Protocols‖, John Wiley and Sons Ltd., UK 2012. 14. Dieter Uckelmann, Mark Harrison, Florian Michahelles, ―Architecting the Internet of Things‖, Springer, New York, 2011. 15. Johnny Cache, Joshua Wright and Vincent Liu, ―Hacking Exposed Wireless: Wireless Security Secrets and Solutions‖, Tata McGraw Hill, New Delhi, 2010 16. Himanshu Dwivedi, Chris Clark and David Thiel, ―Mobile Application Security‖, Tata McGraw Hill, Nw Delhi, 2010. 17. Vijay Madisetti, Arshdeep Bahga, ―Internet of Things (A Hands-on Approach), Universities Press, 2015.

		18. Tim Mather, Subra Kumaraswamy, ShahedLatif, “Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance” O'Reilly Media; 1 edition 19. [ISBN: 0596802765], 2009

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Syllabus of SY B. Tech. (Honours* in Internet of Things) Semester-IV

Course Code: ECED971 Course: Laboratory Embedded Internet of Things Teaching Scheme: Practical: 2 Hrs/week	Credits: 0-0-1 Term Work: 25 Marks Practical: Nil

Prerequisite		Basic Electronics, Basic Programming Language
Objectives	:	This course introduces Concepts for internet of things and how we can embed it into our daily lives for the development of lifestyle. It will also help students to build applications according to their problem statements.
Laboratory Experiments	:	1. Basics of Internet of Things: Sensors, Actuators, IoT architecture and Gateway. 2. IoT Networking: Connectivity technologies, Protocols and Interoperability in IoT. 3. Blinking LED through Raspberry pi or Arduino OR nodeMCU. 4. IoT sensors interface with Raspberry pi or Arduino OR nodeMCU (Temperature/Light sensors). 5. Integration of Actuators with Raspberry pi or Arduino OR nodeMCU (Servo motor/Relay). 6. Capture Image with Raspberry pi or Arduino OR nodeMCU . 7. Design Traffic control system: using Raspberry pi or Arduino OR nodeMCU. 8. Design Temperature dependent auto cooling system: Using Raspberry pi or Arduino OR nodeMCU. 9. IoT applications in home automation: Implementing IoT home application using Raspberry pi or Arduino OR nodeMCU . 10. Case study: Emergence of IoT Healthcare.
Reference books/ Text books	:	1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities 2. Honbo Zhou, “The Internet of Things in the Cloud:A Middleware Perspective” CRC Press 2012. 3. Manoel Carlos Ramon, “Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino
E-books		1. http://file.allitebooks.com/20170102/Building%20Arduino%20Projects%20for%20the%20Inter net%20of%20Things%202016.pdf
MOOC		1. http://learn.sparkfun.com/tutorials/internet-of-things-experiment-guide

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Syllabus of TY B. Tech. (Honours* in Internet of Things) Semester-V

Course Code: ECED902	Credits: 4-0-0
Course: Communication Protocols for IoT	Mid Semester Examination-I: 15 Marks
Teaching Scheme:	Mid Semester Examination-II: 15 Marks
Theory: 4 Hrs/week	Continuous Internal Evaluation:10 Marks
Tutorial: 00 Hr/week	Teacher Assessment: 10 Marks
	End Semester Examination: 50 Marks
	End Semester Examination (Duration): 2 Hrs

Prerequisite		None
Objectives	**:**	The purpose of this course is to impart knowledge on IoT and various protocols study their implementations.
Unit-I	**:**	**Introduction** IoT architecture outline, standards - IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service (XaaS), M2M and IoT Analytics **(8 Hrs)**
Unit-II		**IoT Reference Architecture** Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints-Introduction, Technical Design constraints **(6 Hrs)**
Unit-III	**:**	**IoT Data Link Layer & Network Layer Protocols** PHY/MAC Layer (3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART, Z Wave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4,IPv6, 6LoWPAN, DHCP, ICMP, RPL, CORPL, CARP **(8 Hrs)**
Unit-IV	**:**	**IoT Transport Layer Protocols** Transport Layer -TCP, MPTCP, UDP, DCCP, SCTP, TLS, DTLS **(6 Hrs)**
Unit-V	**:**	**IoT Session Layer Protocols** Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT **(6 Hrs)**
Unit-VI	**:**	**IoT Service Layer Protocols & Security Protocols** Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC802.15.4 , 6LoWPAN, RPL, Application Layer **(6 Hrs)**
Reference		1. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications ,2016 2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things:

books/ Text books	**:**	Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2015 3. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-64219156-5 e-ISBN 978-3-642-19157-2, Springer, 2016 4. N. Ida, Sensors, Actuators and Their Interfaces, Scitech Publishers, 2014.

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Syllabus of TY B. Tech. (Honours* in Internet of Things) Semester-VI

Course Code: ECED903	Credits: 4-0-0
Course: Sensor networks & IoT	Mid Semester Examination-I: 15 Marks
Teaching Scheme:	Mid Semester Examination-II: 15 Marks
Theory: 4 Hrs/week	Continuous Internal Evaluation:10 Marks
Tutorial: 00 Hr/week	Teacher Assessment: 10 Marks
	End Semester Examination: 50 Marks
	End Semester Examination (Duration): 2 Hrs

Prerequisite		None
Objectives	**:**	To impart the knowledge and technical skills in designing s Sensor networks & IoT
Unit-I	**:**	**Introduction** Introduction to Sensor networks in smart transportation, smart cities, smart living, smart energy, smart health, and smart learning. **(6 Hrs)**
Unit-II		**Sensor Network Systems** Cyber Physical Systems, Systems of Systems, Software Architectures and Connectors, Software Interoperability, Big Data and Big Data Mining, Privacy and Security IoT Reference Architecture Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints-Introduction, Technical Design constraints, hardware, Data representation and visualization, Interaction and remote control. **(8 Hrs)**
Unit-III	**:**	**IoT Physical Devices & Endpoints** Linux on Raspberry, Interface and Programming & IOT Device. Hardware Platforms and Energy Consumption, Operating Systems, Time Synchronization, Positioning and Localization, Medium Access Control, Topology and Coverage Control, Routing: Transport Protocols, Network Security, Middleware, Databases **(6 Hrs)**
Unit-IV	**:**	**Industrial Automation& IoT** Industrial Automation-Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things, Commercial Building Automation **(6 Hrs)**
Unit-V	**:**	**Case Study – IoT Implementations** Case study: Smart Grid &IoT, Commercial building automation using IoT, Recent trends in sensor network and IOT architecture, Automation in Industrial aspect of IOT. **(6 Hrs)**

Unit-VI	**:**	**IoT Projects** Creating the sensor project - Preparing Raspberry Pi/ ARM Cortex - Clayster libraries - Hardware-Interacting with the hardware - Interfacing the hardware- Internal representation of sensor values - Persisting data - External representation of sensor values – Exporting sensor data - Creating the actuator project- Hardware - Interfacing the hardware -Creating a controller - Representing sensor values - Parsing sensor data – Calculating control states - Creating a camera - Hardware -Accessing the serial port on RaspberryPi / ARM Cortex - Interfacing the hardware - Creating persistent default settings – Adding configurable properties - Persisting the settings - Working with the current settings -Initializing the camera **(8 Hrs)**
Reference books/ Text books	**:**	1. Mandler, B., Barja, J., MitreCampista, M.E., Cagáová, D., Chaouchi, H., Zeadally, S., Badra, M., Giordano, S., Fazio, M., Somov, A., Vieriu, R.-L., Internet of Things. IoT Infrastructures, Springer International Publication 2. Internet of Things: A Hands-On Approach Paperback – 2015, by ArsheepBahga (Author), Vijay Madisetti (Author) 3. Dr. Guillaume Girardin , Antoine Bonnabel, Dr. Eric Mounier, 'Technologies Sensors for the Internet of Things Businesses & Market Trends 2014 -2024',Yole Development Copyrights ,2014 4. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 5. Editors Ovidiu Vermesan Peter Friess,'Internet of Things – From Research and Innovation to Market 6. N. Ida, Sensors, Actuators and Their Interfaces, Scitech Publishers, 2014. 7. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things by Pearson Paperback – 16 Aug 2017 ,by Hanes David (Author), Salgueiro Gonzalo (Author), Grossetete Patrick (Author), Barton Rob (Author)

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Syllabus of TY B. Tech. (Honours* in Internet of Things) Semester-VI

Course Code: ECED972 Course: Laboratory Sensor networks & IoT Teaching Scheme: Practical: 2 Hrs/week	Credits: 0-0-1 Term Work: 25 Marks Practical: 25 Marks

Prerequisite		Basic Electronics, Basic Programming Language
Objectives	**:**	To impart the knowledge and technical skills in designing s Sensor networks & IoT
Laboratory Experiments	**:**	1. Node MCU/ESP 32 - Temperature Sensor Interfacing (LM35) - Bluetooth Interfacing (HC05)- Motor driver Interfacing (L298) -LCD Interfacing (HD44780) 2. IMPLEMENTATION OF IoT using BLYNK/CAYENNE - –Installation and Activation - Blinking an LED -Reading Analog Voltage - LCD Interfacing (HD44780) -Project 3. IMPLEMENTATION OF IoT using Google Assistant – Arest server - Creating own server – Project 4. IMPLEMENTATION OF IoT using Raspberry Pi & Python Programming: - LCD Interfacing (HD44780) - Motor driver Interfacing (L298) – Camera interface
Reference books/ Text books	**:**	1. Mandler, B., Barja, J., MitreCampista, M.E., Cagáová, D., Chaouchi, H., Zeadally, S., Badra, M., Giordano, S., Fazio, M., Somov, A., Vieriu, R.-L., Internet of Things. IoT Infrastructures, Springer International Publication 2. Internet of Things: A Hands-On Approach Paperback – 2015, by ArsheepBahga (Author), Vijay Madisetti (Author) 3. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things by Pearson Paperback – 16 Aug 2017 ,by Hanes David (Author), Salgueiro Gonzalo (Author), Grossetete Patrick (Author), Barton Rob (Author)

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Syllabus of Final Year B. Tech. (Honours* in Internet of Things) Semester-VII

Course Code: ECED904	Credits: 4-0-0
Course: Privacy and Security in IoT	Mid Semester Examination-I: 15 Marks
Teaching Scheme:	Mid Semester Examination-II: 15 Marks
Theory: 4 Hrs/week	Teacher Assessment: 10 Marks
Tutorial: 00 Hr/week	Continuous Internal Evaluation:10 Marks
	End Semester Examination: 50 Marks
	End Semester Examination (Duration): 2 Hrs

Prerequisite		None
Objectives	**:**	• Ability to understand the Security requirements in IoT. • Understand the cryptographic fundamentals for IoT • Ability to understand the authentication credentials and access control • Understand the various types Trust models and Cloud Security.
Unit-I	**:**	**Introduction** Security Requirements in IoT Architecture - Security in Enabling Technologies - Security Concerns in IoT Applications. Security Architecture in the Internet of Things **(6 Hrs)**
Unit-II		**Securing the Internet of Things** Security Requirements in IoT - Insufficient Authentication/Authorization - Insecure Access Control - Threats to Access Control, Privacy, and Availability - Attacks Specific to IoT. Vulnerabilities – Secrecy and Secret-Key Capacity - Authentication/Authorization for Smart Devices - Transport Encryption – Attack & Fault Trees **(8 Hrs)**
Unit-III	**:**	**Cryptographic fundamentals for IoT** Cryptographic primitives and its role in IoT – Encryption and Decryption – Hashes Digital Signatures – Random number generation – Cipher suites – key management fundamentals – cryptographic controls built into IoT messaging and communication protocols – IoT Node Authentication **(8 Hrs)**
Unit-IV	**:**	**Identity & Access Management Solutions for IoT** Identity lifecycle – authentication credentials – IoT IAM infrastructure – Authorization with Publish / Subscribe schemes – access control **(6 Hrs)**

Unit-V	**:**	**Privacy Preservation And Trust Models for IoT** Concerns in data dissemination – Lightweight and robust schemes for Privacy protection – Trust and Trust models for IoT – self-organizing Things - Preventing unauthorized access. **(6 Hrs)**
Unit-VI	**:**	**Cloud Security for IoT** Cloud services and IoT – offerings related to IoT from cloud service providers – Cloud IoT security controls – An enterprise IoT cloud security architecture – New directions in cloud enabled IoT computing
Reference books/ Text books	**:**	1. Practical Internet of Things Security (Kindle Edition) by Brian Russell, Drew Van Duren 2. Securing the Internet of Things Elsevier 3. Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations

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Syllabus of Final Year B. Tech. (Honours* in Internet of Things) Semester-VIII

Course Code: ECED973 Course: Mini Project Teaching Scheme: Practical: 4 Hrs/week	Credits: 0-0-2 Term Work: 25 Marks Practical: 25 Marks
Prerequisite	Basic Electronics, Basic Programming Language

To carry out a mini project and simple prototype in the area of interest based on the knowledge gained in Internet of Things from undergraduate and first semester

Every individual student will be assigned a faculty to guide them. There will be three major reviews which will be carried out as listed below.

Review #	**Requirement**	**Mark Weightage**	
		Internal	**External**
0	Area / Title selection	-	-
1	Literature review / Proposal for the Project	10%	-
2	Mathematical modelling/Circuit Design	20%	-
3	Final simulation / Hardware presentation	20%	-
End Semester Exam	Final Viva-Voce and project demonstration	-	50%

The assessment of term work shall be done on the basis of the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

Note:

1. No additional fees will be charged for students opting for Honours/ Minor Degree
2. All the courses in the Honours/ Minor will be conducted in offline mode.
3. Re-examination is not applicable in Honours and Minor Scheme. Student failing in any of the Minor or Honours courses,at any stage will be discontinued from the Scheme.
4. Examination Scheme and Passing rules will be as per the academic rules and regulations of B. Tech.

Maharashtra Institute of Technology

(An Autonomous Institute)

Proposed Honors* in Robotics and Automation

Major Disciplines Bachelor of Mechanical Engineering

Agricultural Engineering

Plastic and Polymer Engineering

(With effect from A.Y. 2022-23)

Honors* in Robotics and Automation

Year & Semester	Course Code	Course	Teaching Scheme Hours / Week			Examination Scheme and Marks								Credit Scheme		
			Theory	Tutorial	Practical	Mid-Sem Exam-1	Mid-Sem Exam-1	Continuous Internal Evaluation	Teachers Assessment	End-Semester Exam	Term work	Practical	Total Marks	Theory / Tutorial	Practical	Total Credit
SY IV	MED-901	Fundamentals of Automation	04	--	--	15	15	10	10	50	--	--	100	04	--	04
	MED-971	Laboratory	--	--	02	--	--	--	--	--	25	--	25	--	01	01
		Total	04	-	02	100					25	--	125	04	01	05
														Total		**Credits=05**
TY V	MED-902	Fundamentals of Robotics	04	--	--	15	15	10	10	50	--	--	100	04	--	04
		Total	04	-	-	100					--	--	100	04	--	04
														Total Credits=04		
TY VI	MED-903	Automation System Design	04	--	--	15	15	10	10	50	--	--	100	04	--	04
	MED-972	Laboratory	--	--	02	--	--		--	--	25	--	25	--	01	01
		Total	04	--	02	100					25	--	125	04	01	05
														TotalCredits=05		
Final B. Tech. VII	MED-904	Robotics & Automation	04	--	--	15	15	10	10	50	--	--	100	04	--	04
		Total	04	--	--	100					--	--	100	04	--	04
														Total	**Credits=04**	
Final B. Tech. VIII		Mini Project	--	--	04	--	--	--	--	--	25	25	50	--	02	02
		Total	--	--	04	--	--	--	--	--	25	25	200	--	02	02
														Total Credits=02		
	Total Credit for Semester IV+V+VI+VII +VIII= 20															

Maharashtra Institute of Technology, Aurangabad

(An Autonomous Institute)

Department of Mechanical Engineering

Syllabus of SY B. Tech. (Honours* in Robotics and Automation) Semester-IV

Course Code: MED901 Course: Fundamentals of Automation Teaching Scheme: Theory: 4 Hrs/week Tutorial: 00 Hr/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation:10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs

Unit 1	Introduction Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations. **(6hrs)**
Unit 2	Type of Automation, Automated Flow lines, Methods of Work-part Transport, Transfer Mechanism, Buffer Storage, Control Functions, and Automation for Machining Operations, Design and Fabrication Considerations. Automated Flow Lines: General Terminology, Partial Automation, Automated Flow. **(6hrs)**
Unit 3	Material handling and its function, Types of Material Handling Equipment, Analysis for Material Handling Systems, Design of the System, Conveyor Systems, Automated Guided Vehicle Systems. Automated Storage/Retrieval Systems. Automated Assembly Systems: Design for Automated Assembly, Types of Automated Assembly Systems, Part Feeding Devices. **(6hrs)**
Unit 4	Introduction to flexible manufacturing systems, Types of FMS, Components of FMS, Group Technology **(6hrs)**
Unit 5	Automated Inspection and Testing Inspection and testing, Statistical Quality Control, Automated Inspection Principles and Methods, Sensor Technologies for Automated Inspection, Coordinate Measuring Machines, Machine Vision, Other optical Inspection Methods. **(6hrs)**
Unit 6	Programmable Logic Controllers (PLCs)- Introduction to PLC, Logic Functions, Input & Output Modules, PLC Processors, PLC Instructions, Introduction to Programming a PLC. **(6hrs)**

Reference / Text Books	1. Programmable Logic Controller, W. Bolton, Newnes. 2. Mechatronics, Robert H. Bishop, Tailor and Francis. 3. Computer Based Industrial Control, Krishna kant, TMH. 4. Automatic Control system, Hasan Sayeed, New India publications.

<table>
<tr><td colspan="3">Maharashtra Institute of Technology, Aurangabad
(An Autonomous Institute)
Department of Mechanical Engineering
Syllabus of SY B. Tech. (Honours* in Robotics and Automation) Semester-IV</td></tr>
<tr><td colspan="2">Course Code: MED971
Course: Laboratory Fundamentals of Automation
Teaching Scheme:
Practical: 2 Hrs/week</td><td>Credits: 0-0-1
Term Work: 25 Marks
Practical: Nil</td></tr>
<tr><td>List of practical</td><td colspan="2">1. Study of automation system components.
2. Study and demonstration of CNC machines.
3. Study of various material handling systems.
4. Study and demonstration of robot system.
5. Study of FMS systems and its components.
6. Study and demonstration of ASRS.
7. Study of automated flow lines.
8. Demonstration and study of PLC and its components.
9. PLC programing for ON/OFF of a motor
10. Case study of a typical automation system.</td></tr>
</table>

Maharashtra Institute of Technology, Aurangabad

(An Autonomous Institute)

Department of Mechanical Engineering

Syllabus of TY B. Tech. (Honours* in Robotics and Automation) Semester-V

Course Code: MED902 Course: Fundamentals of Robotics Teaching Scheme: Theory: 4 Hrs/week Tutorial: 00 Hr/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation:10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs

Unit 1	Introduction Robot configurations, Robot Anatomy Basic Components of Robot Systems: Manipulators, end effectors, sensors, controllers etc. Mechanical System in Robotics: Robot motion analysis and control, Robot kinematic, position analysis. **(6hrs)**
Unit 2	Electrical Drives for Robot Stepper motor, DC motors, AC motors, hydraulic and pneumatic systems, drive selection for robotics joints. **(6hrs)**
Unit 3	Robotic grippers and Sensors Linkage activated mechanical grippers, adhesive grippers, magnetic grippers, collets, scoops, expansion bladders, etc. **(6hrs)**
Unit 4	Sensors in Robotics: Position sensor, velocity sensor, proximity sensors, touch sensors, force sensors. Vision Sensor. **(6hrs)**
Unit 5	Robot Programming methods – Teach Pendant, Joint Co-ordinates, Global co-ordinates, Tool co-ordinates, Workpiece co-ordinates, Lead through, Off-line programing, Applications of Robots Application of robots in Material Handling, process operations and Assembly and inspection. **(6hrs)**
Unit 6	Collaborative Robots, Types of Cobots. Robot Implementation Issues Approach for implementing Robotics, Safety, Training and Maintenance Social Aspects of Robotics. **(6hrs)**

Reference / Text Books	1. Fu.K.S. Gonzalz.R.C., and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”, McGrawHill Book Co., 1987. 2. Yoram Koren, “Robotics for Engineers”, McGrawHill Book Co., 1992. 3. Janakiraman.P.A., “Robotics and Image Processing”, Tata McGrawHill, 1995. 4. Ronald Siegwart, Illah R. Nourbakhsh, "Autonomus Mobile Robot", MIT.

Maharashtra Institute of Technology, Aurangabad

(An Autonomous Institute)

Department of Mechanical Engineering

Syllabus of TY B. Tech. (Honours* in Robotics and Automation) Semester-VI

Course Code: MED903 Course: Automation System Design Teaching Scheme: Theory: 4 Hrs/week Tutorial: 00 Hr/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation:10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs

Unit 1	Sensors and Transducers, Classification and types of sensors, Digital sensors – Proximity Sensors, Reed sensors, temperature switch, pressure switch, Selection of sensors and transducers, Analog sensors and ADC. **(6hrs)**
Unit 2	Pneumatic Actuators – linear, rotary, semi-rotary cylinders, Direction control valves, Flow Control Valves, Typical pneumatic system working, Comparison between Hydraulic and Pneumatic systems. **(6hrs)**
Unit 3	Selection of Motors, Basics of - Induction motors, Stepper motors, Servo motors, Variable frequency drives - Introduction. **(6hrs)**
Unit 4	Selection of Mechanical components Gears, bearing, chain, sprockets, shafts, belts conveyor and its types. **(6hrs)**
Unit 5	Selection of PLC and PLC programming basics – programming for typical latching circuit etc., Types of PLC programming methods. **(6hrs)**
Unit 6	Automation system design, developing automation system for a typical industrial application. Case study of automation system. **(6hrs)**
Reference / Text Books	1. Programmable Logic Controller, W. Bolton, Newnes. 2. Mechatronics, Robert H. Bishop, Tailor and Francis. 3. Process Control Instrumentation Technology, Curtis Johnson, PHI. 4. SCADA, Stuart A Boyer, ISA.

Maharashtra Institute of Technology, Aurangabad

(An Autonomous Institute)

Department of Mechanical Engineering

Syllabus of TY B. Tech. (Honours* in Robotics and Automation) Semester-VI

Course Code: MED972 Course: Laboratory Automation System Design Teaching Scheme: Practical: 2 Hrs/week	Credits: 0-0-1 Term Work: 25 Marks Practical: Nil

List of practical	1. Sensor demonstration and study of sensor applications. 2. Actuators demonstration and study of actuator applications. 3. Study and demonstration of pneumatic systems. 4. Study and demonstration of hydraulic systems. 5. Demonstration and study of robot and its components. 6. Robot programing for given co-ordinates. 6. Study and demonstration of PLC and its components. 8. PLC programming – SR and RS blocks. 9. PLC programming – Latching. 10. Case study of a mechatronics system.

Maharashtra Institute of Technology, Aurangabad

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Department of Mechanical Engineering

Syllabus of Final Year B. Tech. (Honours* in Robotics and Automation) Semester-VII

Course Code: MED904 Course: Automation and Robotics Teaching Scheme: Theory: 4 Hrs/week Tutorial: 00 Hr/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation:10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs

Unit 1	CAD/CAM, Product cycle and CAD CAM in it, CAD- 3D modeling and its types, CAM, and its technologies. **(6hrs)**
Unit 2	Finite Element Analysis, Types of analysis, FEA procedure, Computer Integrated Manufacturing, FMS and its types, FMS Components. **(6hrs)**
Unit 3	SCADA System, SCADA architecture, DCS, Micro Electrical Mechanical Systems, Applications of MEMS. **(6hrs)**
Unit 4	Industry 4.0-History of industrial revolutions, Components of I4.0, IoT and its architecture, applications of IoT - Energy sector, smart homes, and smart cities etc. **(6hrs)**
Unit 5	Digital Manufacturing Industry, role of digital manufacturing in optimizing production cost and time, difference between digitization and digitalization. **(6hrs)**
Unit 6	Cyber physical systems, Cloud computing, Additive manufacturing, Big data analytics etc. **(6hrs)**
Reference / Text Books	1. CAD/CAM, M. P. Groower and E. W. Zimmer, Prentice hall of India. 2. CAD/CAM, Zeid Ibrahim, R. Sivasubramanian, Tata McGraw Hill.

	3. The Internet of Things: Applications and Protocols, Oliver Hersent, David Boswarthick, Omar Elloumi, Wiley publications. 4. Mechatronics, Robert H. Bishop, Tailor and Francis.

Maharashtra Institute of Technology, Aurangabad

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Department of Mechanical Engineering

Syllabus of Final Year B. Tech. (Honours* in Robotics and Automation) Semester-VIII

Course Code: MED973 Course: Mini Project Teaching Scheme: Practical: 4 Hrs/week	Credits: 0-0-2 Term Work: 25 Marks Practical: 25 Marks

Prerequisite Fundamentals of electrical drives, motors and controllers used in electrical drives

List of Practical

To carry out a min project and simple prototype in the area of interest based on the knowledge gained in Electrical vehicles from undergraduate and first semester. Every individual student will be assigned a faculty to guide them. There will be three major reviews which will be carried out as listed below.

Review #	**Requirement**	**Mark Weightage**	
		Internal	**External**
0	Area/Title selection	-	-
1	Literature review/Proposal for the Project	10%	-
2	Mathematical modelling /CircuitDesign	20%	-
3	Final simulation/Hardware presentation	20%	-
End Semester Exam	Final Viva-Voce and project demonstration	-	50%

The assessment of term work shall be done on the basis of the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

Note:

1. No additional fees will be charged for students opting for Honours/ Minor Degree
2. All the courses in the Honours/ Minor will be conducted in offline mode.
3. Re-examination is not applicable in Honours and Minor Scheme. Student failing in any of the Minor or Honours courses,at any stage will be discontinued from the Scheme.
4. Examination Scheme and Passing rules will be as per the academic rules and regulations of B. Tech.

Maharashtra Institute of Technology

(An Autonomous Institute)

Proposed Honours* in Surface Coating Technology

Major Disciplines Bachelor of Plastic and Polymer Engineering

(With effect from A.Y. 2022-23)

Honours in Surface Coating Technology

Year & Semester	Course Code	Course	Teaching Scheme Hours / Week			Examination Scheme and Marks								Credit Scheme		
			Theory	Tutorial	Practical	Mid-Semester-1	Mid-Semester-2	CIE	Teachers Assessment	End-Semester	Term work	Practical	Total Marks	Theory / Tutorial	Practical	Total Credit
SY IV	**PPE901**	Introduction to Paint Technology	04	--	--	15	15	10	10	50	--	--	100	04	--	04
	PPE971	Laboratory	--	--	02	--	--	--	--	--	25	--	25	--	01	01
		Total	04	-	02	100					25	--	125	04	01	05
															Total	**Credits=05**
TY V	**PPE902**	Corrosion Science and Technology	04	--	--	15	15	10	10	50	--	--	100	04	--	04
		Total	04	-	-	100					--	--	100	04	--	04
															Total Credits=04	
TY VI	**PPE903**	Coating Technology	04	--	--	15	15	10	10	50	--	--	100	04	--	04
	PPE972	Laboratory	--	--	02	--	--		--	--	25	--	25	--	01	01
		Total	04	--	02	100					25	--	125	04	01	05
															Total Credits=05	
Final B. Tech. VII	**PPE904**	Advanced Surface Coating Technology	04	--	--	15	15	10	10	50	--	--	100	04	--	04
		Total	04	--	--	100					--	--	100	04	--	04
															Total	**Credits=04**
Final B. Tech. VIII	**PPE973**	Mini Project	--	--	04	--	--		--	--	25	25	50	--	02	02
		Total	--	--	04	--	--		--	--	25	25	200	--	02	02
															Total Credits=02	
Total Credit for Semester IV+V+VI+VII +VIII= 20																

Maharashtra Institute of Technology, Aurangabad

(An Autonomous Institute)

Department of Plastic and Polymer Engineering

Syllabus of SY B. Tech. (Honours* in Surface Coating Technology) Semester IV

Course Code: PPE901 Course: Introduction to Paint Technology Teaching Scheme: Theory: 04 Hrs/week Tutorial: 00 Hr/week Practical: 02 Hrs/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation: 10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs

Prerequisite	Basics of Polymer Chemistry
Objectives	• The students will have basic understandings of the commonly used terminologies, various ingredients and their role in paint formulations. • The students will have in-depth exposure to manufacturing, characterizations, and applications of paint.
Unit-I	**Introduction:** Definition, importance, classification of paint, basic concept and definition of monomer; polymer; oligomer; telomer; macromolecules; functionality; polymerization. Molecular weight of polymer: its distribution and determination, classification of Polymer. Structure and property of polymer. **(10 Hrs)**
Unit-II	**Components of paint:** Base, Binders: Chemistry and Technology of Synthetic resins viz. Alkyds, Polyester, Phenolics, Amino, Acrylic & Vinyl resins: Raw materials for these resins, Chemistry of synthesis of these resins, processing techniques, properties & applications of these resins for surface coatings. Pigments, Filler, drier, thinner, extenders, solvents etc. **(8 Hrs)**
Unit-III	**Paint Manufacturing:** Principles of paint formulation, steps in paint manufacture- mixing, grinding, letdown, thinning, tinting (shade matching), straining, phenomenon of wetting, grinding and dispersion. Paint manufacturing methods and equipments: sand mill, ball mill, high speed disperser (HSD). General hazards. **(6 Hrs)**
Unit-IV	**Surface modification and paint application methods:** Importance of surface preparation, various surface preparation methods such as chemical, electrochemical, mechanical like sand blasting, shot peening, vapor phase

	degreasing, carburizing, nitriding, cyaniding, hot dipping, galvanizing, chromating, anodizing, phosphating etc. Laser assisted surface modification, Paint application and curing methods, paint defects: settling, skinning, orange peals, pin holes, crater, etc. **(8 Hrs)**
Unit-V	**Additive used in paint formulation:** Definition and function of additives, use of wetting and dispersing agents, anti-skin, rheology modifier (flow promoter, sag, leveling agents, shear thickener, shelf stability promoter etc.), mar resistance, anti-foam, anti-settling, corrosion inhibitor, biocide, adhesion promoter and photo-stabilizers. **(8 Hrs)**
Unit-VI	**Characterization:** Viscosity, specific gravity, drying time, hardness (pencil hardness, pendulum harness, scratch hardness etc.), brief idea about rheological, optical and morphological characterization of paint, thermal barrier, corrosion, chemical and weather resistance properties. **(8 Hrs)**

References

Sr. No.	Title	Author	Publication	Edition
1.	Basics of Paint Technology, Vol I	V.C. Malshe		1st ed. 2000
2.	Basics of Paint Technology, Vol II	V.C. Malshe		1st ed. 2008
3.	Introduction to Paint Chemistry & Principle of Paint Technology	Turner G.P	Chapman & Hall.	3rd ed., 1988
4.	Paints and Surface Coatings	R.Lambourne,TA Strivens	Elsevier	2nd edition, 1999
5.	Testing of paints : technical analysis of paints and paint raw materials	Shreekant Patil	Colour Pub	2009
6	Paint flow and pigment dispersion.	T.C. Patton		2nd ed,1979
7	Outlines of Paint Technology	W.M. Morgans		3rd Ed.

Maharashtra Institute of Technology, Aurangabad

(An Autonomous Institute)

Department of Plastic and Polymer Engineering

Syllabus of SY B. Tech. (Honours* in Surface Coating Technology) Semester IV

Course Code: PPED971 Course: Laboratory Introduction to Paint Technology Teaching Scheme: Practical: 2 Hrs/week	Credits: 0-0-1 Term Work: 25 Marks

List of Practical (Any 8 practical to be conducted)

1) Synthesis & characterization of various surface coating resins.
2) Preparation of different architectural & industrial coatings.
3) Preparation of organic & inorganic pigments.
4) Paint application & curing, shade matching.
5) Determination of acid value, iodine value and saponification value of oils.
6) Determination of the physical properties of liquid paints, varnishes & lacquers such as color, weight per liter, fineness of grind, viscosity, non volatile content, spreading capacity.
7) Determination of the physical properties of dry films of paints, varnishes & lacquers
8) Determination of mechanical properties of dry film paints, varnishes & lacquers.
9) Determination of optical properties of dry films of paints, varnishes & lacquers.
10) Determination of chemical resistance properties of dry films of paints, varnishes & lacquers.

Maharashtra Institute of Technology, Aurangabad

(An Autonomous Institute)

Department of Plastic and Polymer Engineering

Syllabus of TY B. Tech. (Honours* in Surface Coating Technology) Semester V

Course Code: PPE902 Course: Corrosion Science and Technology Teaching Scheme: Theory: 04 Hrs/week Tutorial: 00 Hr/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation: 10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs

Prerequisite	Physical chemistry of materials.
Objectives	• To enable the students to understand the methodologies for predicting, measuring, and analyzing corrosion performance of materials. • To enable the students to identify various methods of corrosion prevention.
Unit-I	**Introduction:** Electrochemical and thermodynamic principles, electrode potential of metals, EMF and galvanic series, Faraday's laws, Theory of corrosion, action of corroding environment. (6 Hrs)
Unit-II	**Electrochemical Kinetics of corrosion:** Corrosion rate expressions, exchange current density, polarization, passivity, electrochemical behaviour of active-passive metals, factors governing metals exhibiting passivity, mixed potential theory and its application. (9 Hrs)
Unit-III	**Corrosion in industries:** Corrosion in fossil fuel & power plants, automotive industry, aerospace industry, chemical processing industries, corrosion in petroleum production operations and refining, corrosion of pipelines. Corrosion in space environment. (9 Hrs)
Unit-IV	**Forms of Corrosion:** Atmospheric, galvanic, crevice, pitting, stress corrosion cracking, intergranular corrosion, corrosion fatigue, cavitation, fretting corrosion and high temperature oxidation-description. (8 Hrs)

Unit-V	**Corrosion prevention:** Corrosion prevention by design improvements, material selection, anodic and cathodic protection, metallic, non-metallic and inorganic coatings, mechanical and chemical methods and various corrosion inhibitors, pigments, binders & additives for corrosion prevention, recent developments in corrosion protection materials (8 Hrs)				
Unit-VI	**Corrosion measurement & testing:** Purpose of testing, laboratory, semi-plant and field tests, susceptibility tests of Intergranular corrosion, stress corrosion cracking and pitting, ASTM standards for corrosion testing; polarization methods to measure corrosion rate, surface characterisation techniques. (8 Hrs)				
References	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1.	Principles and Prevention of Corrosion	D. A. Jones	Prentice Hall, USA,	2nd edition, 1996
	2.	Corrosion Engineering	Fontana, M.G.	McGraw-Hill, USA	3rd edition
	3.	Corrosion Control	Samuel A.Bradford	Springer	1st edition,1993
	4.	Fundamentals of corrosion: mechanisms, causes, and preventative methods	Philip A. Schweitzer	CRC Press	1st edition, 2009

Maharashtra Institute of Technology, Aurangabad

(An Autonomous Institute)

Department of Plastic and Polymer Engineering

Syllabus of TY B. Tech. (Honours* in Surface Coating Technology) Semester VI

Course Code: PPE903 Course: Coating Technology Teaching Scheme: Theory: 04 Hrs/week Tutorial: 00 Hr/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation: 10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs

Prerequisite	Basics of paint technology
Objectives	• To make the students aware of the essential components of paints and coatings • To make the students familiar with the basic and recent advancements in coating technologies
Unit-I	**Introduction:** Concepts & terminologies, classification of coatings interfacial tension, free energy changes, wetting, dispersion, cohesive and adhesive forces, chemistry & technology of surfactants. **(6 Hrs)**
Unit-II	**Technology of water based paints & coatings:** Preparation of latex for paints, chemistry and technology of emulsion and latex paints, developments in waterborne coating **(6 Hrs)**
Unit-III	**Various surface coatings:** Preparation and characteristics of Coil coating, UV cured coating, Anti-corrosive coating, Non stick coating, Automotive coating, Road marking coating, Insulating coating, Metallic coating, Leather coating, and Fire-retardant/Fire resistive coating. **(12 Hrs)**
Unit-IV	**Powder coatings, Varnishes and Lacquers:** Powder coating, Dry distempers, Cement paints, Oil based distempers and paints, Other stiff paints, Putties, Technology of manufacturing varnishes, lacquers and their applications. **(8 Hrs)**
Unit-V	**Technology of construction chemicals:** Adhesives & sealants, Waterproofing compounds, and Polymeric additives for

	concrete admixtures. **Specific application of paints and coatings:** Wood finishes, Road marking paint and Novelty finishes **(6 Hrs)**
Unit-VI	**Study of important characteristics of surface coating :** Rheological properties, Optical properties, Adhesion and mechanical properties, Corrosion and chemical resistance properties, Film thickness, Liquid paint analysis according to ASTM, BIS and BS standards, Characterization of varnishes according to ASTM, BIS and BSS Standards. **(10 Hrs)**

References

Sr. No.	Title	Author	Publication	Edition
1.	Chemistry, Materials and Properties of surface coatings	Gungor Gundoz	Destech Pub	
2.	Surface Coating Technology Handbook	NPCS Board	Asia Pacific Business Press	
3.	Modern Technology of Paints, Varnishes & Lacquers	NIIR Board	National Institute Of Industrial Research	January 2005
4.	Paints and Surface Coatings	R. Lambourne, TA Strivens	Elsevier	2nd edition, 1999
5.	Testing of paints : technical analysis of paints and paint raw materials	Shreekant Patil	Colour Pub	2009
6.	Coating Technology Handbook	Edited by Arthur A. Tracton	Taylor & Francis	3rd Edition, 2005
7.	Modern Surface Technology	Edited by F. W. Bach, K. Mohwald, A. Laarmann, T. Wenz	WILEY-VCH	2006

Maharashtra Institute of Technology, Aurangabad

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Department of Plastic and Polymer Engineering

Syllabus of TY B. Tech. (Honours* in Surface Coating Technology) Semester VI

Course Code: PPED972	
Course: Laboratory Coating Technology	Credits: 0-0-1
Teaching Scheme:	Term Work: 25 Marks
Practical: 2 Hrs/week	

List of Practical (Any __8_ practical to be conducted)

1. To determine opacity of paint film.
2. To determine the drying time of a paint film.
3. To determine the temperature stability of paint film.
4. Determining the washability and cleanability of paint film.
5. Evaluate alkyd resin based on long, medium and short oil alkyd and phthalic content.
6. Analyse synthetic enamel based on its gloss and scratch resistance.
7. To test the solvent, acid, alkali and light resistance of pigments.
8. Formulate a paint using different pigment value concentration values.
9. Analyse emulsion paint for its non volatile matter content and % solids content.
10. Analyse a synthetic enamel based on its corrosion resistance by salt spray.

Maharashtra Institute of Technology, Aurangabad

(An Autonomous Institute)

Department of Plastic and Polymer Engineering

Syllabus of Final Year B. Tech. (Honours* in Surface Coating Technology) Semester VII

Course Code: PPE904 Course: Advanced Surface Coating Technology Teaching Scheme: Theory: 4 Hrs/week Tutorial: 00 Hr/week	Credits: 4-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation: 10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs

Prerequisite	• Physical chemistry of materials. • Fundamentals of paint technology • Basics of corrosion science and technology
Objectives	• To develop understanding of various surface modification techniques to improve the surface properties and to evaluate their properties • To provide a comprehensive overview of the latest developments in thin films • To develop competence and skills to select the suitable thin film deposition techniques/surface modification methods for a certain application • To understand the types and uses of advanced coatings, their application, and associated quality control
Unit-I	**Surface modification techniques:** Surface engineering by material removal and material addition; Surface modification of ferrous and nonferrous metals- carburizing, nitriding, cyaniding, hot dipping, galvanizing, chromating, anodizing, phosphating of aluminium; Surface engineering by energy beams, Plasma for surface engineering, Laser assisted surface modification (8 Hrs)
Unit-II	**Film deposition techniques:** Sputter deposition of thin films and coatings by RF, MF, DC, Magnetron, Pulsed laser, Ion beam, Ion implantation, electroplating, electroless plating, electro polishing, electroforming, chemical vapour deposition (CVD) and plasma enhanced CVD, atomic layer deposition, atomic layer chemical vapour deposition, molecular beam epitaxy, lithography, Langmuir Blodgett, Spin coating (8 Hrs)
Unit-III	**Inter diffusion, reactions and transformations in thin films:** Fundamentals of diffusion, Inter-diffusion in thin metal films, Mass transport in thin films; Properties and characterization of thin films- optical, electrical, mechanical and

	magnetic, structural morphology of deposited films and coating (8 Hrs)
Unit-IV	**Surface engineering of nanomaterials:** Hybridization of nanomaterials, microencapsulation, synthesis, processing and characterization of nanostructured coatings and their application (8 Hrs)
Unit-V	**Various smart coatings:** Electrodeposition coating, Hygienic coating, High temperature coating, Aerospace coating, Thermal sensitive coating, Electrical conducting coating, Optical fiber coating, Pharmaceutical tablet coating, Textiles for coating, Self cleaning and self healing coatings. (10 Hrs)
Unit-VI	**Marine coatings:** Fouling of surfaces, Paint optimization, Paint formulation, Surface preparation, Theoretical and practical coverage, Paint application (8 Hrs)

References

Sr. No.	Title	Author	Publication	Edition
1.	Coating Technology Handbook	Edited by Arthur A. Tracton	Taylor & Francis	3rd Edition, 2005
2.	Modern Surface Technology	Edited by F. W. Bach, K. Mohwald, A. Laarmann, T. Wenz	WILEY-VCH	2006
3.	Modern Surface Technology	Edited by Friedrich-Wilhelm Bach, Andreas Laarmann, and Thomas Wenz	WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany	2006
4.	Frontiers of Thin Film Technology,	M. H. Francombe, S. M. Rossnagel, A. Ulman	Academic press, Vol. 28	2001
5.	Thin Film Phenomena, Deposition Technologies for Films and Coatings	K. L. Chopra,	McGraw Hill, R.F. Bunshah Noyes Publications, New Jersey	1982

	6.	Materials Science of Thin Films	M. Ohring	2nd ed., Academic	2002
	7.	Electroplating	F. A. Lowenheim,	McGraw Hill, New York, 1978	
	8.	Introduction to Tribology	B. Bhushan	John &Sons, New York	2002
	9.	Engineering Tribology,	G.W. Stachowiak, A.W. Batchelor,	3rd ed., Elsevier-Butterworth-Heinemann,	2005
	10.	ASM Metals Handbook, Surface Engineering,	-	American Society for Metals, Vol.5, 9th ed.,	1994
	11.	Nanomaterials and Surface Engineering,	Edited by Jamal Takadoum	John Wiley & Sons, Inc., USA	-
	12.	Marine Paint Web link: https://www.mistra.org/wp-content/uploads/2010/10/Marine-Paint-FinalReport_2003-2011-ENG.pdf			
	13.	Marine Coatings, HILONG Web link: http://en.hilonggroup.com/uploads/files/MARINE%20Coatings%20Brochure.pdf		Shanghai Hilong Shine New Material Co.,Ltd	-

Maharashtra Institute of Technology, Aurangabad

(An Autonomous Institute)

Department of Plastic and Polymer Engineering

Syllabus of Final Year B. Tech. (Honours* in Surface Coating Technology) Semester VIII

Course Code: PPE973 Course: Mini Project Teaching Scheme: Practical: 04 Hrs/week	Credit: 0-0-2 Teamwork: 25 Marks Practical: 25 Marks

Objectives

- To carry out a mini project and simple prototype in the area of interest based on knowledge gained in Surface Coating Technology. There will be three major reviews which will be carried out as listed below.

Review	**Requirement**	**Mark Weightage**	
		Internal	External
0	Area / Title selection	-	-
1	Literature Review/Proposal for the mini project	10%	-
2	Prototype Modelling	20%	-
3	Final working presentation of project	20%	-
End semester	Final viva project demonstration	-	50%

The assessment of term work shall be done on the basis of the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

Note:

1. No additional fees will be charged for students opting for Honours/ Minor Degree
2. All the courses in the Honours/ Minor will be conducted in offline mode.
3. Re-examination is not applicable in Honours and Minor Scheme. Student failing in any of the Minor or Honours courses,at any stage will be discontinued from the Scheme.
4. Examination Scheme and Passing rules will be as per the academic rules and regulations of B. Tech.