HONORS DEGREE

Semester-VA							
S.No	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**Hrs.**	**Credits**
1.	HDEC-611	AI & Machine Learning	3	1	0	04	4
2.	HDEC-612	Optoelectronics Devices & Circuits	3	1	0	04	4
		Total	06	02	00	08	08

	Semester-VI-A						
S.No	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**Hrs.**	**Credits**
1.	HDEC-621	Circuit Design for Electronics system	3	1	0	04	4
		Total	03	01	0	04	04

	Semester-VII						
S.No	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**Hrs.**	**Credits**
1.	HDEC-711	Internet of Things & its applications	3	1	0	04	4
		Total	03	01	0	04	04

	Semester-VIII						
S.No	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**Hrs.**	**Credits**
1.	PHEC-721	Project Hon's	0	0	08	08	4
		Total	0	0	0	08	04

HDEC-611

AI and Machine Learning

	L	T	P	Credits
	3	1	0	4
	Sessional Marks			50
	End Semester Examination Marks			50

Course Objectives

Artificial Intelligence (AI) is concerned with getting computers to perform tasks that currently are only feasible for humans. Within AI, Machine Learning aims to build computers that can learn how to make decisions or carry out tasks without being explicitly told how to do so.

This course provides a broad introduction to Artificial Intelligence. This course will also introduce the field of Machine Learning, focusing on the core concepts of supervised and unsupervised learning.

Upon completing the course, students will acquire the knowledge of applying Machine Learning techniques to solve various real-life problems. To develop skills of using recent machine learning software for solving practical problems. To gain experience of doing independent study and research.

Course Outcomes

1. Understand the strengths and weaknesses of many popular Artificial Intelligence approaches
2. Understand the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
3. Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.
4. Design and implement various machine learning algorithms in a range of real-world applications.

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	2	1	1	1	1	0	2	2	3	2
CO2	3	3	2	1	1	1	2	1	1	0	3	2	3	2
CO3	3	3	3	3	2	2	2	1	1	0	3	2	3	3
CO4	3	3	3	1	3	2	2	1	1	0	3	2	2	3

Unit-I — **8 hrs**

Introduction to AI: Definitions, Historical foundations, Basic Elements of AI, Characteristics of intelligent algorithm, AI application Areas.

Unit-II — **14 hrs**

The Machine Learning Landscape, Supervised/Unsupervised Learning setup. Main Challenges of Machine Learning, LMS, Linear Algebra Review, Linear Algebra, Multivariable Calculus and Modern Applications. Weighted Least Squares. Logistic regression. Newton's Method, Regularization, Decision Boundary, Optimization Techniques, Gradient Descent and its variants, Batch Optimization, Momentum Optimizer, RMSProp, Adam.

Unit-III — **14 hrs**

The Problem of Overfitting, Probability Theory Review, Python/Numpy introduction, Kernels. SVM, Neural

Networks, Multilayer Perceptron, Backpropagation, Applications of Backpropagation, Deep Neural Networks, Effective training in Deep Net- Early stopping, Dropout, Batch Normalization, Instance Normalization	
Unit-IV	**12 hrs**
Convolutional Neural Network: CNN Operations, Building blocks of CNN, Transfer Learning, Discriminative Training, Transfer Learning Applications, Unsupervised Learning with Deep Network, Autoencoders, Generative Adversarial Networks.	

Recommended Books

Title	Author	Publisher
1. Artificial Intelligence	Rich and K. Knight	Tata McGraw Hill
2. Neural networks and learning machines	S. Haykin.	Pearson 2008.
3. Pattern Recognition and Machine Learning	Christopher M. Bishop	Springer 2007.
4. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow	Aurelien Geron	O'Reilly. (2019).

HDEC-612 Optoelectronics Devices & Circuits				
	L	**T**	**P**	**Credits**
	3	**1**	**0**	**4**
	Sessional Marks			**50**
	End Semester Examination Marks			**50**
Course Objectives	The objective of this course is to get familiar with the design concept of optoelectronics devices and circuits by using different design technologies used for design of optoelectronics devices. Implementation approach of optoelectronics devices in modern communication system. To study the design and evaluation of modern optoelectronics integrated systems.			
Course Outcomes	1. Use principles of physics to analyze the fundamental concepts of various optoelectronic components. 2. Describe the characteristics of optoelectronic devices. 3. Familiarize with tools and processes used in fabricating optoelectronic components. 4. Utilize knowledge to implement optoelectronic communication systems.			

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	2	2	3	3	3	0	2	1	0	2	3	0	2	3
CO2	3	3	3	3	3	2	0	1	2	2	3	0	2	3
CO3	3	3	2	2	3	0	1	1	2	2	3	0	2	3
CO4	3	3	3	3	2	1	2	1	2	2	3	0	1	3

Unit-I — **12 hrs**

Introduction: Semiconductors, optical waves, photon generation, optoelectronics, need of optoelectronics, advantages, applications-network, military, civil, industrial, sensors etc.

Unit-II — **12 hrs**

Optoelectronic sources: Introduction, basic concepts, optical emission from semiconductor, semiconductor injection laser & its various structures, injection laser characteristics, threshold condition, wavelength tunable lasers, LED power and efficiency, heterojunction, LED structure designs, characteristics, modulation response of an LED.

Optoelectronic detectors: Introduction, device types, basic principle of optoelectronic detection, absorption, quantum efficiency, responsivity, wavelength cut-off, types of photodiodes with and without internal gain, mid-infrared photodiode, phototransistors, photo conducting detectors, noise considerations

Unit-III	**12 hrs**
Passive network components & sensors: Introduction, couplers/splitters, WDM multiplexers, demultiplexers, filters, isolators, circulators, attenuators, electro-optic modulators, acousto-optic modulators and their application areas, optical sensors: classification-point, distributed, intensity, phase & spectral. smart structures & applications **Optical amplifiers and integrated optics:** Introduction, semiconductor optical amplifiers (SOA), erbium-doped fiber amplifiers (EDFA), fiber Raman amplifiers (FRA), application areas of optical amplifiers, some integrated optical devices, OEICs, optical bi-stability and digital optics, optical computation.	
Unit-IV	**12 hrs**
Optoelectronic integrated circuits: Introduction, hybrid and monolithic integration, application of opto electronic integrated circuits, integrated transmitters and receivers, guided wave devices.	

RECOMMENDED BOOKS

Title	Author	Publisher
1. Semiconductor Optoelectronic Devices	Pallab Bhattacharya	Pearson Education Inc
2. Photonics - Optical Electronics in Modern Communications	A. Yariv and P. Yeh,	Oxford University Press
3.Opto Electronics – As Introduction to materials and devices	Jasprit Singh	McGraw-Hill International
4.Opto Electronics – An Introduction	J. Wilson and J. Haukes	Prentice Hall, 1995

HDEC-621
Circuit Design for Electronics Systems

	L	T	P	Credits
	3	1	0	4
	Sessional Marks			50
	End Semester Examination Marks			50

Course Objectives	The objective of this course is to provide adequate theoretical and practical knowledge about the components required for electronic circuit design. Next focus is to get students familiarize with the concepts of design of power supply, heat sink, and amplifiers
Course Outcomes	1. Explain and identify the devices which can be used in applications like power supply, amplifiers etc 2. Design linear and variable power supply in power efficient manner 3. Read data sheets, design and develop amplifiers using transistors and op-amps. 1. Design different base drive circuits

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	3	1	1	1	3	3	3	3	3
CO2	3	3	3	1	2	2	2	1	1	3	2	3	3	2
CO3	3	1	3	2	1	1	1	1	3	3	1	3	3	3
CO4	3	1	3	3	1	1	1	1	1	1	3	3	2	2

Unit-I — **12 hrs**

INTRODUCTION: Review of transistor basis-transistor as a switch, transistor as amplifier, problems in the transistor amplifier, temperature drift and device to device variation and their solution, use of op-amp for different applications and basic issues in use of op-amps.

Unit-II — **12 hrs**

POWER SUPPLY DESIGN: Designing a linear power supply using transistor and op amp, selection of components, design of heat sink, design of inductor, design of transformer for the linear power supply, selection of core material, insulating materials and wires, comparison of linear power supply with SMPS and design of low drop out regulators.

Unit-III — **12 hrs**

SMPS DESIGN: Study of PWM control ICs, design of base drive circuits, design of temperature indicator using IC sensors, thyristor and transistor-based drive circuit design, use of pulse width modulation circuits and short circuit protection techniques.

Unit-IV — **12 hrs**

ELECTRONIC CIRCUIT DESIGN: Design of an amplifier, design of an on/off temperature controller, design of different types of heater drive circuits, errors due to resistance drift, op amp offset voltage drift, offset current drift, importance of grounding, high frequency ground method, low frequency ground method and error budgeting.

RECOMMENDED BOOKS		
Title	**Author**	**Publisher**
1. The Art of Electronics	Paul Horowitz	Cambridge University Press
2. Design with Operational Amplifiers and Analog Integrated Circuits	Sergio Franco	McGraw Hills

HDEC-711
Internet of Things and its Applications

	L	T	P	
	3	**0**	**0**	**3**
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

This course focuses on hands-on Internet of Things (IoT) concepts such as sensing, actuation, and communication. It covers the development of prototypes—including devices for sensing, actuation, processing, and communication. The IoT is the next wave the world is going to witness. Today we live in an era of connected devices the future is of connected things. Therefore, it is very important to learn the fundamentals of this emerging technology.

Course Outcomes

1. To understand the fundamentals of loT.
2. Choose between available technologies and devices for stated IoT challenge
3. To learn to implement secure infrastructure for IoT
4. To learn real world application scenarios of IoT along with its societal and economic impact using case studies
5. Implement an architectural design for IoT for specified requirement

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	0	3	1	2	1	2	2	0	0	1	3	1	1
CO2	3	1	2	0	2	1	3	1	0	0	0	2	2	1
CO3	2	0	3	3	2	1	2	0	2	0	0	2	2	2
CO4	1	3	2	2	3	3	1	3	1	1	3	3	1	3
CO5	1	3	3	3	3	1	1	3	1	1	2	1	1	3

Unit-I **6 hrs.**

Introduction: Definition and Characteristics of IoT, Physical Design of IoT – IoT Protocols, IoT communication models, IoT Communication APIs, IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates, Domain Specific IoTs – Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle.

Unit-II **10 hrs.**

Introduction to Python: Language features of Python, Data types, data structures, Control of flow, functions, modules, packaging, file handling, data/time operations, classes, Exception handling. Python packages

Unit-III **8 hrs.**

IoT Physical Devices and Endpoints: Introduction to Arduino and Raspberry Pi - Architecture, Programming and Application, Python program with Raspberry Pi with focus of interfacing external gadgets, controlling output, reading input from pins.

Unit-IV **8 hrs.**

IoT Physical Servers and Cloud Offerings: Introduction to Cloud Storage models and communication APIs. Webserver – Web server for IoT, Cloud for IoT, Various IoT security issues and need, challenges and algorithms

RECOMMENDED BOOKS		
Title	**Author**	**Publisher**
1. Internet of Things with Raspberry Pi and Arduino	Rajesh Singh, Anita Gehlot	CRC Press
2. Raspberry Pi for Arduino Users: Building IoT and Network Applications and Devices	James Strickland	Apress
3. Internet of Things: Architecture and Design Principle	Raj Kamal	McGraw Hill Education
4. "Internet of Things (A Hands-on-Approach)",	Vijay Madisetti and Arshdeep Bagha	1stEdition, VPT, 2014. (ISBN: 978-8173719547)