MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WB
Syllabus of B. Sc. Gaming & Mobile Application Development
(Effective for 2020-2021 Admission Session)
Choice Based Credit System
140 Credit (3-Year UG) MAKAUT Framework
w.e.f 2020-21

5th semester

SubjectType	Course Name	Credit Points	Credit Distribution			Mode of Delivery			Proposed Moocs
			Theory	Practical	Tutorial	Offline	Online	Blended	
CC 11 **GAM 501 & 591**	Game AI	6	4	2	0	✓			As per MAKAUT Notification
CC 12 **GAM 502 & 592**	Computer Vision & Pattern Recognition	6	4	2		✓			
DSE 1 (Any One) **GAM-503**	A. Cloud Computing B. Information & Coding Theory C. Information Security	6	5	0	1			✓	
DSE 2 (Any One)									
GAM-504A	A. Introduction to Data Science	6	5	0	1			✓	
GAM-504B & GAM-594B	B. Introduction to AI and Machine Learning	**6**	**4**	**2**					
GAM-504C	C. Digital Image Processing	6	5	0	1				
SemesterCredits		**24**							

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Course: Game AI

Code: GAM 501/GAM 591

Course Objective: The course aims to introduce artificial intelligence for games. The students will learn the different building blocks that make up AI in various types of games, and they will be familiarised with the applicability of a technique for a particular situation. Further, the students will get practical experience while designing games using artificial intelligence based on the genre.

Sl. No.	Course Outcome	Mapped modules
1	Outline the importance of artificial intelligence in games.	M1, M2
2	Analyse the different steering behaviours in movement of characters.	M1, M2,M3
3	Examine and choose the path finding techniques for designing games.	M2, M3, M4
4	Build decision making methods for games	M2, M3, M4, M5
5	Create and design the strategies for the games using game theory.	M3,M4, M5
6	Develop the appropriate design for artificial intelligence games genre.	M3,M4, M5,M6

Theory- GAM(T) 501

Module Number	Content	Total Hours	%age of questions	Blooms Level	Remarks (If any)

M 1	Introduction	8	20	1,2	
M 2	Movement Algorithms	8	20	2,3	
M 3	Pathfinding and decision making	8	20	2,3	
M 4	Strategies Board games	8	20	2,3	
M5	Designing Game AI	8	10	4,5,6	
M6	Basic Graphics	8	10	2,3	
		48	**100**		

Practical- GAM 591

Module Number	**Content**	**Total Hours**	**%age of questions**	**Blooms Level**	**Remarks (If any)**
M 2	Movement Algorithms	7	30	2,3	
M3	Pathfinding and decision making	7	20	2,3,4	
M 4	Strategies Board games	7	20	2,3,4	
M 5	Designing Game AI	7	30	4,5,6	
		28	**100**		

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Paper: Game AI (including Lab)
Contacts Hours / Week: 4T + 2P

Module I: Introduction
Introduction to Artificial Intelligence: Model of Game AI- Algorithms- Data Structures and Representations- Game AI: The Complexity Fallacy- The kind of AI in Games-Speed and Memory- The AI Engine.

Module II: Movement Algorithms
Basics of Movement Algorithms: Kinematic Movement Algorithm- Steering behaviours- Combining Steering Behaviours- Jumping – Coordinated Movements- Movement in the Third Dimension.

Module III: Pathfinding and decision making
Path finding and decision making: Pathfinding Graph- Dijkstra- A*-Hierarchical Path Finding Continuous Time Pathfinding, Time Pathfinding –Movement Planning-Decision trees-Goal Oriented behaviour-Rule based systems, Decision tree learning- Reinforcement learning.

Module IV: Strategies Board games
Strategies Board games: Game Theory- Min Maxing-Transposition Tables and Memory- Memory Enhanced Test Algorithms.

Module V: Designing Game AI
Designing Game AI: The Design – Shooters and Driving – Real time strategy- Sports-Turn based strategy Games –AI based Game genres- Teaching characters -Flocking and Herding Games

Module VI: Basic Graphics
2D Graphics: Sprites, Tiled Images and Backgrounds; 3D Graphics: 3D Graphics Pipeline, 3D Math, Coordinates and Coordinate Systems.

Suggested Readings:

1. Millington's Artificial Intelligence for Games and Buckland's Programming Game AI
2. Artificial Intelligence for Games, Millington and Funge, 2nd ed.Morgan Kaufmann

Publishers Inc. San Francisco, CA, USA ©2009, ISBN:0123747317 9780123747310

3. Artificial Intelligence and Games, Georgios N. Yannakakis and Julian Togelius, January 26, 2018, Springer

4. Game Graphics Programming, Allen Sherrod Publisher and General Manager, Course Technology PTR: Stacy L. Hiquet, 2008.

5. Game Design Foundations, Second Edition, Roger E. Pedersen, Jones & Bartlett Learning; 2009

6. Fundamentals of Game Design, 3rd Edition, Ernest Adams, New Riders; 2013

7.Game Graphics Programming, Allen Sherrod Publisher and General Manager, Course Technology PTR: Stacy L. Hiquet, 2008.

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Course: CC12
Paper: **Computer Vision and Pattern Recognition**
Code: **GAM 502/GAM 592**

Course Objective: The course is designed in order to provide an elaborate idea about different functional components of the Computer Vision and their various utilities. At the end of the course, the students are expected to know about various functional components of a vision system, their utilities, significance and practical applications through Python/Matlab, in order to solve real life computer vision problems.

Sl	Course Outcome	Mapped modules
1	Relate the structure, function and applications of basic vision systems	M1, M2
2	Outline the applications of various image handling utilities and operators in imaging	M2, M3
3	Assess the basic structure and implications of advanced attributes in images	M2, M3, M4
4	Infer the basic principles and utilities of image reconstruction	M3,M4, M5
5	Make use of the advanced principles and utilities of image reconstruction	M3,M4, M5
6	Examine the various pattern recognition and object detection utilities in computer vision	M3,M5, M6

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Module Number	Content	Total Hours	%age of questions	Blooms Level	Remarks (If any)
M1	Introduction to Computer Vision	4	10%	1,2,3	
M2	Imaging Basics	4	10%	1,2,3	
M3	Image Features	4	20%	1,2,3	
M4	Image Reconstruction-I	4	20%	1,2,3,4	
M5	Image Reconstruction-II	4	30%	1,2,3,4	
M6	Pattern Recognition and Perception	4	10%	3,4	
		24	**100**		

Module 1: Introduction to Computer Vision

Overview, What is Computer Vision?, What is Vision Used For?, How Do Humans Do it?, Topics to be Covered, *Introduction to Open CV/ Matlab for Computer Vision*

Module 2: Imaging Basics

Image Formation, Image Sensing, Binary Images, Image Processing I, Image Processing II, *Relevant Practical Exercises in Python/Matlab*

Module 3: Image Features

Edge Detection, Boundary Detection, SIFT Detector, Image Stitching, Face Detection, *Relevant Practical Exercises in Python/Matlab*

Module 4: Image Reconstruction-I

Radiometry and Reflectance, Photometric Stereo, Shape from Shading, Depth from Defocus, Active Illumination Methods, *Relevant Practical Exercises in Python/Matlab*

Module 5: Image Reconstruction-II

Camera Calibration, Uncalibrated Stereo, Optical Flow, Structure from Motion, *Relevant Practical Exercises in Python/Matlab*

Module 6: Pattern Recognition and Perception

Object Tracking, Image Segmentation, Appearance Matching, Neural Networks, *Relevant Practical Exercises in Python/Matlab*

References:

1. *First Principles of Computer Vision - Video Lecture Series, Shree Kumar Nayar, Columbia University, https://fpcv.cs.columbia.edu/*
2. Computer Vision: Algorithms and Applications, Richard Szeliski, Springer
3. Computer Vision: A Modern Approach, D. Forsyth and J. Ponce, Prentice Hall
4. Robot Vision, B. K. P. Horn, MIT Press
5. A Guided Tour of Computer Vision, V. Nalwa, Addison-Wesley
6. Digital Image Processing, R. Gonzalez and R. Woods, Prentice Hall

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Syllabus of B. Sc. Gaming & Mobile Application Development
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w.e.f 2020-21

DSE 1
Course: Cloud Computing
Code: GAM 503(A)

Course Objective: The course aims to introduce the principles of cloud computing. Understanding SaaS, PaaS etc. Further, the students will get practical knowledge of applications of cloud computing.

Sl. No.	Course Outcome	Mapped modules
1	Infer and explain the knowledge of cloud computing.	M1,M2,M3
2	Identify and examine the knowledge of several application areas of cloud computing.	M1, M2,M3,M4
3	Appraise cloud computing platforms.	M1, M2, M3, M4,M5,M6

Paper: Cloud Computing
Contacts Hours / Week: 5T + 1T

Module I: Definition of Cloud Computing and its Basics (10 L)
Definition of Cloud Computing: Defining a Cloud, Cloud Types –NIST model, Cloud Cube model, Deployment models (Public, Private, Hybrid and Community Clouds), Service models –Infrastructure as a Service, Platform as a Service, Software as a Service with examples of services/ service providers, Cloud Reference model. Characteristics of Cloud Computing – a shift in paradigm-Benefits and advantages of Cloud Computing

Module II: Cloud Architecture (10 L)
Cloud Architecture: A brief introduction on Composability, Infrastructure, Platforms, Virtual Appliances, Communication
Protocols, Applications, Connecting to the Cloud by Clients. Services and Applications by Type IaaS – Basic concept, Workload, partitioning of virtual private server instances, Pods, aggregations, silos PaaS – Basic concept, tools and development environment with examples SaaS - Basic concept and characteristics, Open SaaS and SOA, examples of SaaS platform Identity as a Service (IDaaS) , Compliance as a Service (CaaS).

Module III: Use of Platforms in Cloud Computing (10 L)
Virtualization technologies: Types of virtualization (access, application, CPU, storage), Mobility patterns (P2V, V2V, V2P, P2P, D2C, C2C, C2D, D2D) Load Balancing and Virtualization: Basic Concepts, Network resources for load balancing, Advanced load balancing (including Application Delivery Controller and Application Delivery Network), Mention of The Google Cloud as an example of use of load balancing Hypervisors: Virtual machine technology and types, VMware vSphere Machine Imaging (including mention of Open Virtualization Format – OVF) Porting of applications in the Cloud: The simple Cloud API and AppZero Virtual Application appliance Definition of services, Distinction between SaaS and PaaS (knowledge of Salesforce.com and Force.com), Application development Use of PaaS Application frameworks.

Module IV: Discussion of Google Applications Portfolio (10 L)
Discussion of Google Applications Portfolio – Indexed search, Dark Web, Aggregation and disintermediation, Productivity applications and service, Adwords, Google Analytics, Google Translate, a brief discussion on Google Toolkit (including introduction of Google APIs in brief), major features of Google App Engine service. Amazon Web Service components and services: Amazon Elastic Cloud, Amazon Simple Storage system, Amazon Elastic Block Store, Amazon SimpleDB and Relational Database Service Windows Azure platform: Microsoft's approach, architecture, and main elements, overview of Windows Azure AppFabric, Content Delivery Network, SQL Azure, and Windows Live services

Module V: Cloud Infrastructure (10 L)
Cloud Management :An overview of the features of network management systems and a brief introduction of related products from large cloud vendors, Monitoring of an entire cloud computing deployment stack – an overview with mention of some products, Lifecycle management of cloud services (six stages of lifecycle)
Concepts of Cloud Security Cloud security concerns, Security boundary, Security service boundary Overview of security mapping Security of data: Brokered cloud storage access, Storage location and tenancy, encryption, and auditing and compliance Identity management (awareness of Identity protocol standards)

Module VI: Concepts of Services and Applications (10 L)
Concepts of Services and Applications Service Oriented Architecture: Basic concepts of message-based transactions, Protocol stack for an SOA architecture, Event-driven SOA, Enterprise Service Bus, Service catalogs Applications in the Cloud: Concepts of cloud transactions, functionality mapping, Application attributes, Cloud service attributes, System abstraction and Cloud Bursting, Applications and Cloud APIs Cloud-based Storage: Cloud storage definition – Manned and
Unmanned Webmail Services: Cloud mail services including Google Gmail, Mail2Web, Windows Live Hotmail, Yahoo mail, concepts of Syndication services

Suggested Readings:1. Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd

2. Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, McGraw Hill Education (India) Private Limited

3. Cloud computing: A practical approach by Anthony T. Velte, Tata Mcgraw-Hill

DSE 1
Course: Information and Coding Theory
Code: GAM 503(B)

Course Objective: The course aims to introduce how error control coding techniques are applied in communication systems. The students are able to understand the basic concepts of cryptography. Further, the students will be able to enhance the knowledge of probabilities, entropy, measures of information.

Sl. No.	Course Outcome	Mapped modules
1	Relate the basic notions of information and channel capacity.	M1,M2,M3
2	Outline information theory, the fundamentals of error control coding techniques and their applications, and basic cryptography.	M1, M2,M3,M4
3	Examine U/G physical layer communication to convolutional and block codes, decoding techniques, and automatic repeat request (ARQ) schemes..	M1, M2, M3, M4,M5,M6

Paper: Information and Coding Theory
Contacts Hours / Week: 5T + 1T

Module I: Information entropy fundamentals (10L)
Uncertainty, Information and Entropy – Source coding Theorem – Huffman coding –Shannon Fano coding – Discrete Memory less channels – channel capacity – channel coding Theorem – Channel capacity Theorem.

Module II: Data and voice coding (10L)
Differential Pulse code Modulation – Adaptive Differential Pulse Code Modulation – Adaptive subband coding – Delta Modulation – Adaptive Delta Modulation – Coding of speech signal at low bit rates (Vocoders, LPC).

Module III: Denial of Service Attacks (10L)
Denial of Service Attacks, DOS-proof network architecture, Security architecture of World Wide Web, Security Architecture of Web Servers, and Web Clients

Module IV: Web Application Security (10L)
Web Application Security – Cross Site Scripting Attacks, Cross Site Request Forgery, SQL Injection Attacks, Content Security Policies (CSP) in web, Session Management and User Authentication, Session Integrity, Https, SSL/TLS, Threat Modeling, Attack Surfaces, and other comprehensive approaches to network design for security.

Module V: Error control coding (10L)
Linear Block codes – Syndrome Decoding – Minimum distance consideration – cyclic codes

Module VI: Generator Polynomial (10L)
Generator Polynomial – Parity check polynomial – Encoder for cyclic codes – calculation of syndrome – Convolutional codes.

Suggested Readings:

1. Communication Systems by Simon Haykin, John Wiley and Sons, 2001

2. Multimedia Communications, Applications Networks Protocols and Standards by Fred Halsall, Pearson Education, Asia 2002

3. Data Compression Book by Mark Nelson, Publication 1992

4. Compression in Video and Audio by Watkinson J, Focal Press, London,1995

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Syllabus of B. Sc. Gaming & Mobile Application Development
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DSE 1
Course: Information Security
Code: GAM 503(C)
Course Objective: The course aims to develop an understanding of information assurance as practiced in computer operating systems, distributed systems, networks and representative applications. The students will gain familiarity with prevalent network and distributed system attacks, defences against them, and forensics to investigate the aftermath. This will also develop a basic understanding of cryptography, how it has evolved, and some key encryption techniques used today. Moreover, it will develop an understanding of security policies (such as authentication, integrity and confidentiality), as well as protocols to implement such policies in the form of message exchanges

Sl. No.	Course Outcome	Mapped modules
1	Evaluate basic understanding about system security.	M1,M2,M3
2	Evaluate real-life examples to create system security interest in the students	M1, M2,M3,M4
3	Examine the salient facets of information security basics and the basics of risk management.	M1, M2, M3, M4,M5,M6

Paper: Information Security
Contacts Hours / Week: 5T + 1T

Module I: Overview of Networking Concepts (10L)
Basics of Communication Systems, Transmission Media, Topology and Types of Networks, TCP/IP Protocol, Wireless Networks, The Internet

Module II: Information Security Concepts (10L)
Information Security Overview: Background and Current Scenario, Types of Attacks, Goals for Security, E-commerce Security

Module III: Security Threats and Vulnerabilities (10L)
Overview of Security threats, Weak / Strong Passwords and Password Cracking, Insecure Network connections, Malicious Code Cybercrime and Cyber terrorism, Cryptography, Introduction to Cryptography, Digital Signatures, Public Key infrastructure, Applications of Cryptography, Tools and techniques of Cryptography

Module IV: Security Management (10L)
Security Management Practices, Overview of Security Management, Security Policy, Risk Management, Ethics and Best Practices Security Laws and Standards Security Assurance, Security Laws, International Standards, Security Audit

Module V: Information and Network Security (10L)
Server Management and Firewalls, User Management, Overview of Firewalls, Types of Firewalls, DMZ and firewall features
Security for VPN and Next Generation Technologies VPN Security, Security in Multimedia Networks, Various
Computing Platforms: HPC, Cluster and Computing Grids, Virtualization and Cloud Technology and Security

Module VI: System and Application Security (10L)
Security Architectures and Models Designing Secure Operating Systems, Controls to enforce security services, Information Security Models, System Security, Desktop Security, Email security, Database Security

Suggested Readings:

1. Data Communications and Networking by B. A. Forouzan, TMH

2. Computer Networks by A. S. Tanenbaum, Pearson Education/PHI

3. Data and Computer Communications by W. Stallings, PHI/ Pearson Education

4. Cryptography & Network Security by Atul Kahate, TMH

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DSE 2
Course: Introduction to Data Science
Code: GAM 504(A)
Course Objective: The course aims to gain basic knowledge of data and information. The students will gain basic knowledge of data science. This will also develop a basic understanding of the history, potential application area and future of data science. Moreover, it will develop an understanding of basic knowledge in machine learning.

Sl. No.	Course Outcome	Mapped modules
1	Understand the knowledge of data, information and data science.	M1,M2,M3
2	Understand to identify problems related to data science.	M1, M2,M3,M4
3	Create logical thinking .	M1, M2, M3, M4,M5,M6
4	Understand basic machine learning principles and apply the knowledge in appropriate domains.	M1, M2, M3, M4,M5,M6

Paper: Introduction to Data Science
Contacts Hours / Week: 5T + 1T

Module I: Introduction (10L)
What is Data Science? - Big Data and Data Science hype – and getting past the hype - Why now? – Datafication - Current landscape of perspectives - Skill sets needed.

Module II: Introduction to Statistics Data Analysis (10L)
Statistical Inference - Populations and samples – Statistical modelling, probability distributions, fitting a model - Intro to R. Exploratory Data Analysis and Data Science Process - Basic tools (plots, graphs and summary statistics) of EDA - Philosophy of EDA - The Data Science Process - Case Study: RealDirect (online real estate firm).

Module III: Machine Learning & Application of Machine Learning (10L)
Three Basic Machine Learning Algorithms - Linear Regression - k- Nearest Neighbors (k-NN) - k-means.
One More Machine Learning Algorithm and Usage in Applications -Motivating application: Filtering Spam - Why Linear Regression and k-NN are poor choices for Filtering Spam - Naive Bayes and why it works for Filtering Spam - Data Wrangling: APIs and other tools for scrapping the Web.

Module IV: Introduction to Feature & Recommendation Systems (10L)
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 – Filters; Wrappers; Decision Trees; Random Forests Building a User-Facing Data Product - Algorithmic ingredients of a Recommendation Engine - Dimensionality Reduction – Singular Value Decomposition - Principal Component Analysis - Exercise: build your own recommendation system.

Module V: Social-Network Graphs & Data Visualization (10L)
Mining Social-Network Graphs - Social networks as graphs -Clustering of graphs - Direct discovery of communities in graphs -Partitioning of graphs - Neighborhood properties in graphs.
Data Visualization - Basic principles, ideas and tools for data visualization 3 - Examples of inspiring (industry) projects -
Exercise: create your own visualization of a complex dataset.

Module VI: Data Science and Ethical Issues (10L)
Discussions on privacy, security, ethics - A look back at Data Science - Next-generation data scientists, Policy Issues, Concerns and Challenges, Future of data led economy.

Suggested Readings:

1. Mining of Massive Datasets. v2.1 by Jure Leskovek, AnandRajaraman and Jeffrey Ullman, Free Online

2. Machine Learning: A Probabilistic Perspective by Kevin P. Murphy, ISBN 0262018020

3. Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking by Foster Provost and Tom Fawcett, ISBN 1449361323.
2013

4. Elements of Statistical Learning by Trevor Hastie, Robert Tibshirani and Jerome Friedman, Second Edition. ISBN 0387952845. 2009.(free online)

5. Doing Data Science, Straight Talk from the Frontline by Cathy O'Neil and Rachel Schutt, O'Reilly

DSE 2
Course: Introduction to AI and Machine Learning
Code: GAM 504(B) & GAM 594(B)

Course Objective: The course aims to gain a historical perspective of AI and its foundations. The students will become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning. They will learn to investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models. They will experience AI development tools such as an 'AI language', expert system shell, and/or data mining tool. Moreover, they can experiment with a machine learning model for simulation and analysis and explore the current scope, potential, limitations, and implications of intelligent systems

Sl. No.	Course Outcome	Mapped modules
1	Discuss Artificial Intelligence (AI) and its relationship with data	M1,M2,M3
2	Outline Machine Learning approach and its relationship with data science	M1, M2,M3,M4
3	Identify the application	M1, M2, M3, M4,M5,M6
4	Relate Machine Learning (ML) with Artificial Intelligence	M1, M2, M3, M4,M5,M6

MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WB
Syllabus of B. Sc. Gaming & Mobile Application Development
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140 Credit (3-Year UG) MAKAUT Framework
w.e.f 2020-21

Paper: Introduction to AI and Machine Learning
Contacts Hours / Week: 4L+2P

Module I: Artificial intelligence fundamentals (10L)
A.I. systems integrating approaches and methods- Advanced search- Constraint satisfaction problems - Knowledge representation and reasoning - Non-standard logics – Uncertain and probabilistic reasoning (Bayesian networks, fuzzy sets).- Foundations of semantic web: semantic networks and description logics. - Rules systems: use and efficient implementation- Planning systems

Module II: Machine learning (10L)
Computational learning tasks for predictions, learning as function approximation, generalization concept. - Linear models and Nearest-Neighbors (learning algorithms and properties, regularization). - Neural Networks (MLP and deep models, SOM). - Probabilistic graphical models. - Principles of learning processes: elements of statistical learning theory, model validation. - Support Vector Machines and kernel-based models. - Introduction to applications and advanced models. Applicative project: implementation and use of ML/NN models with emphasis to the rigorous application of validation techniques

Module III: Human language technologies (10L)
Formal and statistical approaches to NLP. Statistical methods: Language Model, Hidden Markov Model, Viterbi Algorithm, Generative vs Discriminative Models Linguistic essentials (tokenization, morphology, PoS, collocations, etc.). Parsing (constituency and dependency parsing).Processing Pipelines. Lexical semantics: corpora, thesauri, gazetteers. Distributional Semantics: Word embeddings, Character embeddings. Deep Learning for natural language.
Applications: Entity recognition, Entity linking, classification, summarization. Opinion mining, Sentiment Analysis. Question answering, Language inference, Dialogic interfaces. Statistical Machine Translation. NLP libraries: NLTK, Theano, Tensorflow.

Module IV: Intelligent Systems for Pattern Recognition (10L)
Particular focus will be given to pattern recognition problems and models dealing with sequential and time-series data-Signal processing and time-series analysis-Image processing, filters and visual feature detectors-Bayesian learning and deep learning for machine vision and signal processing-Neural network

models for pattern recognition on non-vectorial data (physiological data, sensor streams, etc)-Kernel and adaptive methods for relational data-Pattern recognition applications: machine vision, bio informatics, robotics, medical imaging, etc.-ML and deep learning libraries overview: e.g. scikit-learn, Keras, Theano.

Module V: Smart applications (10L)
Common designs for smart applications examples: fuzzy logic in control systems or cloud analysis of field sensors data
streams Make or buy: selecting appropriate procurement strategies example: writing your own RRN architecture vs. using cloud services Development platforms for smart objects examples: Brillo (IoT devices) or Android TV (Smart TVs)
Development platforms for smart architectures examples: TensorFlow (server-side RNNs), or the Face Recognition API
(mobile) Cloud services for smart applications examples: Google Cloud Machine Learning API, Google Cloud Vision API, Google Cloud Speech API, or Deploying Deep Neural Networks on Microsoft Azure GPU VMs Deployment and operations examples: cloud hosting vs. device hosting, or harnessing user feedback to drive improvement Measuring success: methods and metrics examples: defining user engagement and satisfaction metrics, or assessing the naturalness of smart interactions

Module VI: Introduction to robotics (10L)
main definitions, illustration of application domains-Mechanics and kinematics of the robot-Sensors for robotics-Robot Control-Architectures for controlling behavior in robots-Robotic Navigation-Tactile Perception in humans and robots-Vision in humans and robots-Analysis of case studies of robotic systems-Project laboratory: student work in the lab with robotic systems

Suggested Readings:

1. Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig

2. Artificial Intelligence: A New Sythesis by Nils J Nilsson

3. Artificial Intelligence by Negnevitsky

4. Intro. to artificial intelligence by Akerkar Rajendr

5. Artificial Intelligence and Machine Learning by AnandHareendran S and Vinod Chandra S

DSE 2
Course: Digital Image Processing
Code: GAM 504(C)
Course Objective: The course aims to introduce and discuss the fundamental concepts and applications of Digital Image Processing. The students will become familiar with various basic operations in Digital Image Processing. They will also learn to know various transform domains.

Sl. No.	Course Outcome	Mapped modules
1	Build the knowledge of digital image .	M1,M2,M3
2	Explain the knowledge of image processing techniques.	M1, M2,M3,M4
3	Apply programming skills to implement image processing algorithms.	M1, M2, M3, M4,M5,M6

Paper: Digital Image Processing
Contacts Hours / Week: 5T + 1T

Module I: Introduction (10L)
Background, Digital Image Representation, Fundamental steps in Image Processing, Elements of Digital Image Processing – Image Acquisition, Storage, Processing, Communication, Display.

Module II: Digital Image Formation (10L)
A Simple Image Model, Geometric Model- Basic Transformation (Translation, Scaling, Rotation), Perspective Projection, Sampling & Quantization - Uniform & Non uniform.

Module III: Image Enhancement (10L)

Spatial Domain Method, Frequency Domain Method, Contrast Enhancement -Linear & Nonlinear Stretching, Histogram Processing; Smoothing - Image Averaging, Mean Filter, Low-pass Filtering; Image Sharpening. High-pass Filtering, High-boost Filtering, Derivative Filtering, Homomorphic Filtering; Enhancement in the frequency domain - Low pass filtering, High pass filtering.

Module IV: Image Restoration (10L)
Degradation Model, Discrete Formulation, Algebraic Approach to Restoration - Unconstrained & Constrained;
Constrained Least Square Restoration, Restoration by Homomorphic Filtering, Geometric Transformation - Spatial Transformation, Gray Level Interpolation.

Module V: Image Segmentation (10L)
Point Detection, Line Detection, Edge detection, Combined detection, Edge Linking & Boundary Detection- Local Processing, Global Processing via The Hough Transform

Module VI: Thresholding - Foundation (10L)
Thresholding - Foundation, Simple Global Thresholding,; Region Oriented Segmentation – Basic Formulation, Region Growing by Pixel Aggregation, Region Splitting & Merging.

Suggested Readings:

1. Digital Image Processing by Gonzalves, Pearson

2. Digital Image Processing by S. Sridhar, Oxford