KRISHNA UNIVERSITY

BOARD OF STUDIES (BoS) – DEPARTMENT OF COMPUTER SCIENCE

MINUTES OF THE BOARD OF STUDIES MEETING

Agenda:

To discuss and approve the proposed **curriculum, course structure and syllabus for I and II Semesters of the following PG programmes**:

- **Computer Applications**
- **Artificial Intelligence and Robotics**
- **Artificial Intelligence and Machine Learning**
- **Cybercrime and Cyber Security**
- **Data Analytics**

Members Present:

S. No.	Name	Designation	Role
1	Prof. R. Kiran Kumar	Dept. of Computer Science, Krishna University	Chairman
2	Smt. P. Durga Bhavani	HOD, Dept. of Computer Science, Nalanda Degree College, Vijayawada	Member
3	Kondapalli Ramkumar	HOD, Dept. of Electronics and Internet of Things, Nalanda Degree College, Vijayawada	Member
4	Bommareddy Sudheer Reddy	Lecturer, Dept. of Computer Science, Nalanda Degree College & PG Centre, Vijayawada	Member
5	Prof. P. Suresh Varma	Dept. of CSE, Adikavi Nannaya University, Rajahmundry	Member
6	Dr. M.H.M. Krishna Prasad	Dept. of CSE, JNTUK, Kakinada	Member
7	Prof. D. Lalitha Bhaskari	Dept. of CS & Systems Engineering, Andhra University	Member
8	Assoc. Prof. M. Babu Reddy	HOD, Dept. of Computer Science, Krishna University	Member

Proceedings

The meeting commenced with the Chairman welcoming all the members. The proposed curriculum and syllabi for the **I and II Semesters of the PG programmes** were placed before the Board for discussion and consideration.

The members discussed the proposed **course structure, syllabus , credits, teaching scheme, practical components, Course Outcomes and assessment pattern** of the above programmes. The members suggested that the curriculum should be practical, application-oriented and aligned with current technological and industry requirements.

Resolution

After detailed discussion, the **Board of Studies approved/recommended the proposed curriculum and syllabus for the I and II Semesters** of the following PG programmes:

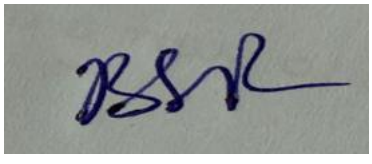
1. **Computer Applications**
2. **Artificial Intelligence and Robotics**
3. **Artificial Intelligence and Machine Learning**
4. **Cybercrime and Cyber Security**
5. **Data Analytics**

The Board recommended that the curriculum, syllabus, Course Outcomes, credits, teaching scheme and assessment pattern be finalized by incorporating the suggestions of the members and submitted to the competent academic authority for approval and implementation.

Conclusion

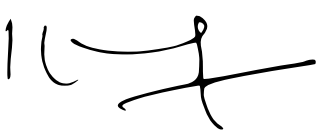
The Chairman thanked all the members for their valuable suggestions and active participation. The meeting concluded with a vote of thanks.











Model Syllabus for PG Diploma in Artificial Intelligence and Robotics

COURSE STRUCTURE (for Semester I to II)

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	I	1	Neural networks & Deep Learning	3	3
			Neural networks & Deep Learning Practical	2	1
	II	2	Robotics Kinematics & Dynamics	3	3
			Robotics Kinematics & Dynamics Practical	2	1

SEMESTER-1

COURSE 1: NEURAL NETWORKS & DEEP LEARNING

Theory **Credits: 3** **3 hrs/week**

Course Objectives:

1. Introduce the fundamental concepts of Artificial Neural Networks and Deep Learning, along with their historical and biological inspirations.
2. Provide an in-depth understanding of different neural network architectures including Perceptron, DNN, CNN, RNN, and advanced models.
3. Develop hands-on skills to design, train, and evaluate deep learning models using popular frameworks such as TensorFlow and Keras.
4. Expose students to applications of deep learning in computer vision, natural language processing, and generative modeling.
5. Enable students to critically analyze challenges in deep learning such as overfitting, bias, and ethical concerns.

Course Outcomes:

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

1. Explain the principles of neural networks, perceptrons, activation functions, and the evolution of deep learning.
2. Apply concepts of forward/backward propagation, weight initialization, and optimization techniques to train deep neural networks.
3. Design and implement convolutional neural networks (LeNet, AlexNet, VGG) for image classification tasks.
4. Build and analyze recurrent neural networks (RNN, LSTM, GRU) for sequential data and natural language processing applications.
5. Experiment with advanced deep learning concepts such as transfer learning, generative models, and transformers using pre-trained models.

Unit 1. Foundations of Deep Learning:

What is Artificial Intelligence, Machine Learning, and Deep Learning? History and applications of deep learning, Biological vs. Artificial Neurons

Introduction to Neural Networks, Perceptron and activation functions (Linear, ReLU, Sigmoid, Tanh, Softmax), Types of Neural Networks (shallow vs. deep, feedforward vs.

recurrent), Gradient descent and backpropagation (conceptual only), Concept of loss functions (MSE, cross-entropy) at intuitive level

Unit 2. Deep Neural Networks:

Forward and backward propagation, Weight initialization, learning rate, and optimization algorithms (SGD, Adam, RMSProp), Overfitting & underfitting: Regularization, Dropout, Batch normalization, Activation functions in deep networks, Loss functions in detail (MSE, cross-entropy, hinge loss) Introduction to Keras/TensorFlow framework

Unit 3. Convolutional Neural Networks (CNNs):

Introduction to images and pixels, Filters/kernels, padding, and pooling, CNN architecture and layers (Conv, Pooling, Fully Connected, Softmax), Classical CNN architectures: LeNet-5 (digit recognition - first CNN model), AlexNet (ImageNet breakthrough - deeper CNN), VGG (concept of depth, simplicity)

Applications in image classification, object detection, facial recognition

Unit 4. Recurrent Neural Networks (RNNs) and NLP

Sequences and time series data, Introduction to RNNs: vanishing/exploding gradient issue LSTM and GRU (intuitive and architectural view), Word embeddings: Word2Vec, GloVe, introduction to contextual embeddings (BERT at high level)

Applications: Sentiment analysis, text generation, simple time-series forecasting

Unit 5. Advanced & Emerging Topics:

Generative models: GANs (Generator & Discriminator intuition), VAEs (introduction only), Transformers: attention mechanism (intuitive), BERT, GPT family (overview), Transfer learning & fine-tuning pre-trained models (vision & NLP), AI ethics: Bias, fairness, privacy, safety, explainability

Textbooks:

1. Chollet, F. (2018). *Deep Learning with Python* (1st ed.). Manning Publications.
2. Nielsen, M. A. (2015). *Neural Networks and Deep Learning*. Determination Press. *(Available free online: http://neuralnetworksanddeeplearning.com)*

Reference Books:

1. Géron, A. (2019). *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow* (2nd ed.). O'Reilly Media.
2. Howard, J., & Gugger, S. (2020). *Practical Deep Learning for Coders*. O'Reilly Media. *(Based on the fast.ai course)*
3. Shane, J. (2019). *You Look Like a Thing and I Love You: How AI Works and Why It's Making the World a Weirder Place*. Voracious / Hachette Book Group.

Activities:

Outcome: Explain the principles of neural networks, perceptrons, activation functions, and the evolution of deep learning.

Activity: *Concept Mapping Exercise* - Students work in small groups to draw a timeline-based concept map linking biological neurons → perceptron → multilayer perceptron → activation functions → deep learning.

Evaluation Method: Rubric-based evaluation of concept maps (clarity, correctness, and depth of connections).

Outcome: Apply concepts of forward/backward propagation, weight initialization, and optimization techniques to train deep neural networks.

Activity: *Hands-on Coding Task* - Students implement a simple 3-layer neural network from scratch in Python/NumPy (without Keras/TensorFlow) to observe propagation and optimization effects.

Evaluation Method: Code demonstration + oral viva where students explain how changing initialization/learning rate affects training.

Outcome: Design and implement convolutional neural networks (LeNet, AlexNet, VGG) for image classification tasks.

Activity: *Mini Project (Image Classification)* - Students form teams to train CNNs (LeNet, AlexNet, VGG) on a dataset like MNIST/CIFAR-10 and compare results.

Evaluation Method: Project report + presentation with accuracy comparison, confusion matrix, and discussion of design choices.

Outcome: Build and analyze recurrent neural networks (RNN, LSTM, GRU) for sequential data and natural language processing applications.

Activity: *Case Study on Sentiment Analysis* - Students use IMDB reviews dataset to build RNN/LSTM/GRU models for sentiment classification and analyze performance.
Evaluation Method: Submission of case study report with experimental setup, evaluation metrics (accuracy/F1-score), and reflection on differences among models.

Outcome: Experiment with advanced deep learning concepts such as transfer learning, generative models, and transformers using pre-trained models.
Activity: *Model Exploration & Demonstration* - Students choose one advanced technique (Transfer Learning on ResNet, GAN for image generation, or Transformer for text classification) and prepare a live demo in class.
Evaluation Method: Evaluation of demo + short reflective note (1–2 pages) on challenges, benefits, and application potential of the chosen technique.

SEMESTER-I

COURSE 1: NEURAL NETWORKS & DEEP LEARNING

Practical **Credits: 1** **2 hrs/week**

1. Build a perceptron from scratch in Python
2. Use Google Teachable Machine or TensorFlow Playground
3. Visualize various Activation Functions and their Gradients
4. Build and train a deep neural network for classification (e.g., MNIST digits)
5. Experiment with dropout, batch normalization, and different activations
6. Train a CNN to classify fashion images (Fashion-MNIST)
7. Visualize filters and feature maps
8. Fine-tune a pre-trained CNN (MobileNet, VGG) for a small dataset
9. Build an LSTM model for movie review sentiment analysis (IMDb dataset)
10. Generate text using a simple character-level RNN
11. Use a pre-trained model (like MobileNet or BERT) for a simple task
12. Use Huggingface to deploy a Sentiment Analysis App for Swiggy Reviews

SEMESTER- II

COURSE 2 : ROBOTICS KINEMATICS & DYNAMICS

Theory **Credits: 3** **3 hrs/week**

Course Objectives

1. Introduce fundamental concepts of robot kinematics and dynamics.
2. Develop ability to analyze robot motion through forward and inverse kinematics.
3. Understand velocity and acceleration relations via Jacobian matrices.
4. Derive robot dynamics equations using Newton-Euler and Lagrangian methods.
5. Learn trajectory planning and control techniques for robotic manipulators.

Course Outcomes

By the end of the course, students will be able to:

1. Identify robot components, degrees of freedom, and use Denavit-Hartenberg convention for kinematic modeling.
2. Solve forward and inverse kinematics problems for serial manipulators.
3. Compute Jacobians and analyze velocity kinematics and singularities.
4. Apply Newton-Euler and Lagrangian formulations to derive dynamic equations of robot manipulators.
5. Develop trajectory plans and implement basic control strategies for robot motion.

Unit 1: Introduction to Robot Kinematics

Introduction to robotics: types and applications, Robot components and coordinate frames, Degrees of freedom and workspace, Homogeneous transformations and spatial transformations, Denavit-Hartenberg (D-H) convention for link representation

Unit 2: Forward and Inverse Kinematics

Forward kinematics: computing end-effector position and orientation

Inverse kinematics: analytical and numerical solutions

Workspace analysis and tool configurations, Redundancy and multiple solutions in inverse kinematics

Unit 3: Velocity and Jacobian Analysis

Linear and angular velocities of rigid bodies, Differential motions and velocity propagation through robot links, Jacobian matrix: formulation and interpretation, Singularity analysis and dexterity measures, Kinematic duality and manipulator velocity control

Unit 4: Robot Dynamics

Basics of kinetics: work-energy, momentum principles, Newton-Euler formulation of robot dynamics, Lagrangian mechanics and derivation of equations of motion, Dynamic modeling of serial manipulators, Inclusion of actuator dynamics and nonrigid effects

Unit 5: Trajectory Planning and Control

Trajectory planning in joint and Cartesian spaces, Path interpolation and smooth motion generation, Control strategies: PD control, computed torque, inverse dynamics control, Force and hybrid control, Introduction to robot programming languages and simulation

Suggested Textbooks & References

1. John J. Craig, Introduction to Robotics: Mechanics and Control, Pearson
2. Mark W. Spong, Seth Hutchinson, M. Vidyasagar, Robot Modeling and Control, Wiley
3. Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, Giuseppe Oriolo, Robotics: Modelling, Planning and Control, Springer
4. Robert J. Schilling, Fundamentals of Robotics: Analysis and Control, Prentice Hall
5. Haruhisa Kawasaki, Robot Kinematics and Dynamics, Encyclopedia of Life Support Systems
6. MATLAB Robotics Toolbox Documentation and Tutorials for practical work

Activities:

Unit 1: Introduction to Robot Kinematics

Activities:

- Study robot types and components
- Setup coordinate frames and assign Degrees of Freedom
- Practice homogeneous and spatial transformations
- Apply Denavit-Hartenberg parameters modeling on simple mechanisms

Outcomes: Ability to model robots in terms of coordinate frames and D-H parameters.

Evaluation: Quiz and assignment on D-H parameter assignments and transformations.

Unit 2: Forward and Inverse Kinematics

Activities:

- Compute end-effector position and orientation forward kinematics
- Solve inverse kinematics analytically and numerically for basic robots
- Analyze robot workspace and tool configurations

Outcomes: Skill in solving forward/inverse kinematic problems and workspace analysis.

Evaluation: Problem-solving assignment and class test.

Unit 3: Velocity and Jacobian Analysis

Activities:

- Calculate linear and angular velocities of robot links
- Derive Jacobian matrices and interpret their significance
- Study singularity and robot dexterity measures

Outcomes: Understanding of velocity propagation and kinematic influence on manipulator control.

Evaluation: Lab exercises on Jacobian calculation and singularity analysis.

Unit 4: Robot Dynamics

Activities:

- Learn basic kinetics principles relevant to robotics
- Derive equations of motion with Newton-Euler and Lagrangian methods
- Model dynamics of serial manipulators including actuator effects

Outcomes: Ability to formulate dynamic models for robot motion analysis.

Evaluation: Assignment on dynamics derivation and mid-term written exam.

Unit 5: Trajectory Planning and Control

Activities:

- Generate and simulate robot trajectories in joint and Cartesian spaces
- Explore control schemes: PD, computed torque, inverse dynamics control
- Understand force and hybrid control approaches; introduction to programming and simulation tools

Outcomes: Skills in planning trajectories and designing control strategies for robot manipulators.

Evaluation: Project work and final exam practicals.

SEMESTER- II

COURSE 2 : ROBOTICS KINEMATICS & DYNAMICS

Practical **Credits: 1** **2 hrs/week**

Practical 1: MATLAB Basics for Robotics

- Learn basic MATLAB operations and plotting
- Visualize points, vectors, and coordinate frames in 2D and 3D

Practical 2: Coordinate Transformations

- Create rotation and translation matrices
- Build homogeneous transformation matrices
- Apply transformations to points and visualize the results

Practical 3: Denavit-Hartenberg Parameters and Forward Kinematics

- Assign DH parameters for a simple 2-DOF planar arm
- Compute forward kinematics using DH transformation
- Plot end-effector positions for given joint angles

Practical 4: Inverse Kinematics of Planar Manipulator

- Solve analytical inverse kinematics for 2-DOF arm
- Verify solutions by forward kinematics plotting

Practical 5: Jacobian and Velocity Kinematics

- Calculate Jacobian matrix for 2-DOF arm
- Compute end-effector velocity from joint velocities
- Analyze singular configurations

Practical 6: Basic Trajectory Planning

- Generate joint trajectories with linear interpolation
- Plot joint angle, velocity, acceleration profiles
- Simulate end-effector path

Practical 7: Simple Dynamic Calculations

- Calculate torque requirements for joint movements
- Plot torque vs. time for simple motion profiles

Practical 8: Robot Motion Animation

- Animate arm movement following generated trajectories
- Visualize workspace and reachable points

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PG DIPLOMA Model Paper for Core Subjects

Semester :I

Paper Title : Neural Networks & Deep learning

Time : 3hrs **Max. Marks:70**

Section –A(20 Marks)

Answer any *Five* questions. All questions carry equal marks. 5X4=20M

1. Define AI
2. Explain Gradient descent.
3. Describe Forward Propagation
4. Write a short note on **TensorFlow**.
5. What is Sentiment Analysis
6. Write about facial recognition
7. What is LSTM
8. Define BERT.

Section–B (50Marks)

Answer ALL Questions. All questions carry equal marks. 5 X 10 = 50M

9. a) Explain the history and evolution of Deep Learning

OR

b) Explain the different types of Neural Networks.

10. a) Discuss about Optimization Algorithms with suitable examples.

OR

b) How to findout entropy value ? Explain

11. a) Discuss about CNN.

OR

b) Explain Applications in image classification

12. a) Explain Recurrent Neural Networks.

OR

b) **Explain Word Embeddings in NLP** and discuss Word2Vec and GloVe..

13. a) Explain GANs with example.

OR

b) Explain ethics in AI.

KRISHNA UNIVERSITY

PG DIPLOMA Model Paper for Core Subjects

Semester :II

Paper Title : Robotics kinematics & Dynamics

Time : 3hrs **Max. Marks:70**

Section –A(20 Marks)

Answer any *Five* questions. All questions carry equal marks. 5X4=20M

1. Define Robotics
2. What is Denavit-Hartenberg (D-H) convention?
3. What is tool configuration?
4. Explain the relationship between joint variables and end-effector pose.
5. Define the Jacobian matrix.
6. Define robot dynamics
7. What is Lagrangian mechanics?
8. What is PD control?

Section–B (50Marks)

Answer ALL Questions. All questions carry equal marks. 5 X 10 = 50M

9. a) Explain the **types and applications of robots** in detail.

OR

b) Explain **Degrees of Freedom and workspace** of a robot with suitable examples.

10. a) Explain **forward kinematics** and describe how the end-effector position and orientation are calculated.

OR

b) Explain **inverse kinematics** and discuss analytical and numerical solutions.

11. a) Explain linear and angular velocities of rigid bodies and their significance in robot motion.

OR

b) Explain singularity analysis in robot manipulaton.

12. a) Explain the Newton-Euler formulation for deriving robot dynamic equations.

OR

b) Explain dynamic modeling of serial manipulators in detail.

13. a) Explain trajectory planning in joint space and Cartesian space with suitable examples.

OR

b) Explain robot programming languages.