

YESHWANTRAO CHAVAN COLLEGE OF ENGINEERING

(An Autonomous Institution affiliated to R T M Nagpur University Nagpur) Accredited by NAAC (1stCycle) with 'A' Grade (Score 3.25 on 4 Point Scale)

Wanadongri, Hingna Road, Nagpur-441110

Department of Information Technology (Honors in AIDP)



B.E. Honors in Artificial Intelligence and Deep Learning SoE & Syllabus 2021-22





(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

Department of Information Technology SoE and Syllabus

SoE No. HON-101

B.E. Honors in Artificial Intelligence and Deep Learning (NPTEL)

B.E Honors in Artificial Intelligence and Deep Learning (SWAYAM/NPTEL Courses)

Information Brochure of Honor Program

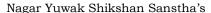
- Title of Program: B.E. Honors in Artificial Intelligence and Deep Learning (SWAYAM/NPTEL Courses)
- 2. Type of Program: Honor
- 3. Department offering the program: INFORMATION TECHNOLGY
- 4. Industry / Association / Collaboration:_____NPTEL- SWAYAM
- 5. Department/s eligible to opt for the program: Information Technology
- 6. General information about courses in program: (250 words)

Different Courses In This Program Are:

In order to develop new algorithms of machine/deep-learning, it is necessary to have knowledge of all such mathematical concepts included in this course :

- 1. Essential Mathematics For Machine Learning-The ability to create representations of the domain of interest and reason with these representations is a key to intelligence. following two courses explore a variety of representation formalisms and the associated algorithms for reasoning and problem solving
- 2. Artificial Intelligence: Knowledge Representation And Reasoning
- 3. Artificial Intelligence Search Methods For Problem Solving In following three courses course students will learn about the building blocks used in these Deep Learning based solutions. Specifically, feed-forward neural networks, convolutional neural networks, recurrent neural networks and attention mechanisms and also applications of deep neural network for computer vision
- 4. Deep Learning Part-1
- 5. Deep Learning Part-2
- 6. Deep Learning For Computer Vision
- 7. Advance knowledge or research orientation of Program: (100 words) (for Honor)

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Artificial intelligence is about problem solving, reasoning, and **learning** in general. **Machine** learning is specifically about learning—learning from examples, from definitions, from being told, and from behavior. Machine learning is a subset of AI, and it consists of the techniques that enable computers to figure things out from the data deliver AI applications. Deep learning, meanwhile, is a subset of machine learning that enables computers to solve more complex problems. Machine learning (ML) is one of the most popular topics of nowadays research having application in all the areas of engineering and sciences. Deep Learning also has received a lot of attention over the past few years and has been employed successfully by companies like Google, Microsoft, IBM, Facebook, Twitter etc. to solve a wide range of problems in Computer Vision and Natural Language Processing.

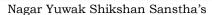
8. Employability potential of program: (100 words) (for both Honor /Minor)

List of Top AI Companies for Deep Learning

- MobiDev. AI apps
- Talentica Software. Startup's One-Stop Software Development Partner. ...
- SPEC INDIA. Enterprise Software, Mobility & BI Solutions. ...
- 7EDGE. Software and Product Development | Dedicated Teams. ...
- Anadea Inc
- SoluLab
- Cyber Infrastructure Inc.
- Arm.
- 9. Departmental Steering committee: For proper publicity / conduct of program

SN	Name of the	Post	Designation	e-mail ID	Contact
	Faculty Member				Number
1.	Dr. R. C. Dharmik	HOD, IT &	Asstt. Prof.	raj_dharmik@yahoo.com	9158003335
		Chairman			
2.	Prof. S.S.Chavhan	Member	Asst.prof	sschavhan@ycce.edu	8888832405
3.	Prof. S.W. Shende	Member	Asso. Prof.	shailendra.shende@gmail.com	9766698600
4.	Prof. A.D.	Member	Asst.prof	amolgaikwad.ag@gmail.com	9970743434
	Gaikwad				

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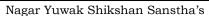
Department of Information Technology SoE and Syllabus

SoE No. HON-101

B.E. Honors in Artificial Intelligence and Deep Learning (NPTEL)

10. Program Coordinator:

SN	Name of the Faculty	Post	Designation	e-mail ID	Contact
	Member				Number
1	Prof. S.W. Shende	Member	Asso. Prof.	shailendra.shende@gmail.c	9766698600
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Department of Information Technology SoE and Syllabus

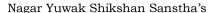
SoE No. HON-101

B.E. Honors in Artificial Intelligence and Deep Learning (NPTEL)

Scheme of Examinations B.E. Honors in Artificial Intelligence and Deep Learning

S N	Sem	Sub. Code	Course Name	T/ P	L	Hrs	Credits	NPTEL Certificate with	WEB-LINKS
1	V	ITHN01	Essentials Mathematics for Machine Learning	Т	3	3	3	Valid Score This is SWAYAM / NPTEL based program and subjects with 12-	https://nptel.ac.in/cours es/111/107/111107137/
2	V	ITHN02	Artificial Intelligence Search Methods for Problem Solving	Т	3	3	3	14-week syllabus are expected to be available on SWAYAM/NPTEL platform.	https://nptel.ac.in/cours es/106/106/106106140/
3	VI	ITHN11	Artificial Intelligence: Knowledge Representation And Reasoning	T	3	3	3	If they are not available before the commencement of semester, Similar /	https://nptel.ac.in/cours es/106/106/106106126/
4	VI	ITHN12	Deep Learning Part	Т	3	3	3	Equivalent Subjects shall be	https://nptel.ac.in/cours es/106/106/106106184/
5	VII	ITHN21	Data Analytics with Python	Т	3	3	3	notified by BoS of the Department.	https://nptel.ac.in/cours es/106/106/106106201/
6	VIII	ITHN31	Deep learning for Computer Vision	Т	3	3	3	Chairman BoS will notify all the subjects which are 12-14 week duration before the commencement of academic session.	https://nptel.ac.in/cours es/106/106/106106224/
	Total			18	18	18			

Styl	Det .	May 2021	1.00	Applicable for AY2021-22 Onwards
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V Semester

ITHN01	ESSENTIAL MATHEMATICS FOR MACHINE LEARNING			L= 3	T = 0	P = 0	Credits = 3
Evaluation Scheme	MSE-I*	MSE-II*	MSE-III*	TA	ESE	Total	ESE Duration
*Best Two out of three MSE's would be considered	15	15	15	30	40	100	3 Hrs

Prerequisites

Course Objective
Students should be able to

Course Outcome

Students will be able to

COURSE PLAN: (8 Weeks)

- Week 1: Linear Independence and dependence of vectors, Basis, Vector Space and Subspaces
- Week 2: Linear Maps, Matrix Representation, Eigenvalues and Eigenvectors, Least Square approximation, Minimum normed solution
- Week 3: Singular Value Decomposition, Dimensionality Reduction Algorithms
- Week 4: Manifold Learning algorithms, Computations with Large and Sparse Matrices in Machine Learning
- Week 5: Calculus: Gradients, Jacobian, Hessian Matrix, Conditions for extremum, Convexity
- Week 6: Numerical Optimization in Machine Learning, Gradient Descent and other optimization algorithms in machine learning
- Week 7: Lagrangian Multiplier method, dual problems and other mathematical Optimization related topics in Support Vector Machines and other Linear Classifiers
- Week 8: Conditional probability, chain rule, Bayes theorem, Random Variables and introduction to distributions

Site Link: https://nptel.ac.in/courses/111/107/111107137/

Course Instructors: PROF. SANJEEV KUMAR & PROF. S.K. Gupta, Department of Mathematics IIT Roorkee

St.	Det -	May 2021	1.00	Applicable for AY2021-22 Onwards
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V Semester

ITHN02	Artificial Methods fo	Intelligence r Problem So		L= 3	T = 0	P = 0	Credits = 3
Evaluation Scheme	MSE-I*	MSE-II*	MSE-III*	TA	ESE	Total	ESE Duration
*Best Two out of three MSE's would be considered	15	15	15	30	40	100	3 Hrs

Prerequisites

Course Objective Students should be able to

Course Outcome

Students will be able to

Course Plan: (12 Weeks)

Week 01: Introduction: Overview and Historical Perspective, Turing Test, Physical Symbol Systems and the scope of Symbolic AI, Agents.

Week 02: State Space Search: Depth First Search, Breadth First Search, DFID

Week 03: Heuristic Search: Best First Search, Hill Climbing, Beam Search

Week 04: Traveling Salesman Problem, Tabu Search, Simulated Annealing

Week 05: Population Based Search: Genetic Algorithms, Ant Colony Optimization

Week 06: Branch & Bound, Algorithm A, Admissibility of A

Week 07: Monotone Condition, IDA, RBFS, Pruning OPEN and CLOSED in A

Week 08: Problem Decomposition, Algorithm AO, Game Playing

Week 09: Game Playing: Algorithms Minimax, Alpha Beta, SSS

Week 10: Rule Based Expert Systems, Inference Engine, Rete Algorithm

Week 11: Planning: Forward/Backward Search, Goal Stack Planning, Sussman's Anomaly

Week 12: Plan Space Planning, Algorithm Graph plan

Site Link: https://nptel.ac.in/courses/106/106/106106126/

Course Instructor: PROF. DEEPAK KHEMANI Dept. of Computer Science and Engineering IIT

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Sty	Det .	May 2021	1.00	Applicable for AY2021-22 Onwards
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SoE No. HON-101

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VI Semester

ITHN11		Intelligence: tion And Rea	_	L= 3	T = 0	P = 0	Credits = 3
Evaluation Scheme	MSE-I*	MSE-II*	MSE-III*	TA	ESE	Total	ESE Duration
*Best Two out of three MSE's would be considered	15	15	15	30	40	100	3 Hrs

Prerequisites

Course Objective
Students should be able to

Course Outcome

Students will be able to

COURSE PLAN: (12 Weeks)

Week 1: Introduction, Propositional Logic, Syntax and Semantics

Week 2: Proof Systems, Natural Deduction, Tableau Method, Resolution Method

Week 3: First Order Logic (FOL), Syntax and Semantics, Unification, Forward Chaining

Week 4: The Rete Algorithm, Rete example, Programming Rule Based Systems

Week 5: Representation in FOL, Categories and Properties, Reification, Event Calculus

Week 6: Deductive Retrieval, Backward Chaining, Logic Programming with Prolog Week 7:

Resolution Refutation in FOL, FOL with Equality, Complexity of Theorem Proving

Week 8: Description Logic (DL), Structure Matching, Classification

Week 9: Extensions of DL, The ALC Language, Inheritance in Taxonomies

Week 10: Default Reasoning, Circumscription, The Event Calculus Revisited

Week 11: Default Logic, Autoepistemic Logic, Epistemic Logic, Multi Agent Scenarios

Week 12: Optional Topics A: Conceptual Dependency (CD) Theory, Understanding Natural Language

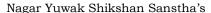
Optional Topics B: Semantic Nets, Frames, Scripts, Goals and Plans

Site Link:: https://nptel.ac.in/courses/106/106/106106140/

Course Instructor: PROF. DEEPAK KHEMANI Dept. of Computer Science and Engineering IIT

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Sty	Det	May 2021	1.00	Applicable for AY2021-22 Onwards
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VI Semester

ITHN12	DEEP LEARNING			L=3	T = 0	P = 0	Credits = 3
Evaluation Scheme	MSE-I*	MSE-II*	MSE-III*	TA	ESE	Total	ESE Duration
*Best Two out of three MSE's would be considered	15	15	15	30	40	100	3 Hrs

Prerequisites

Course Objective
Students should be able to

Course Outcome

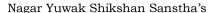
Students will be able to

- Week 1: History of Deep Learning, Deep Learning Success Stories, McCulloch Pitts Neuron
- Week 2: Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent
- Week 3: Feed Forward Neural Networks, Back propagation
- Week 4: Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD
- Week 5: Principal Component Analysis and its interpretations, Singular Value Decomposition
- Week 6: Autoencoders and relation to PCA, Regularization in autoencoders, Denoising autoencoders, Sparse autoencoders
- Week 7: Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation
- Week 8: Greedy Layer-wise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization
- Week 9: Learning Vectorial Representations Of Words
- Week 10: Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet
- Week 11: Recurrent Neural Networks, Back-propagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs
- Week 12: Encoder Decoder Models, Attention Mechanism, Attention over images

Text Books: https://onlinecourses.nptel.ac.in/noc21_cs76

Course Instructor: PROF. SUDARSHAN IYENGAR, Department of Department of Computer Science and Engineering IIT Ropar

Staf	Det .	May 2021	1.00	Applicable for AY2021-22 Onwards
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VII Semester

ITHN21	Data Analytics with Python			L= 3	T = 0	P = 0	Credits = 3
Evaluation Scheme	MSE-I*	MSE-II*	MSE-III*	TA	ESE	Total	ESE Duration
*Best Two out of three MSE's would be considered	15	15	15	30	40	100	3 Hrs

Prerequisites

Course Objective

Students should be able to

Course Outcome

Students will be able to

Course Plan:

Week 1 : Introduction to data analytics and Python fundamentals

Week 2 : Introduction to probability

Week 3 : Sampling and sampling distributions

Week 4 : Hypothesis testing

Week 5 : Two sample testing and introduction to ANOVA

Week 6 : Two way ANOVA and linear regression
 Week 7 : Linear regression and multiple regression
 Week 8 : Concepts of MLE and Logistic regression
 Week 9 : ROC and Regression Analysis Model Building
 Week 10 : c2 Test and introduction to cluster analysis

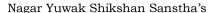
Week 11 : Clustering analysis

Week 12 : Classification and Regression Trees (CART)

Site Link: https://onlinecourses.nptel.ac.in/noc21_cs45/preview

Course Instructor: By Prof. A Ramesh | IIT Roorkee

Sty	Det	May 2021	1.00	Applicable for AY2021-22 Onwards
Chairperson	Dean (Acad. Matters)	Date of Release	Version	





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VII Semester

ITHN22	DEEP LEARNING FOR COMPUTER VISION			L= 3	T = 0	P = 0	Credits = 3
Evaluation Scheme	MSE-I*	MSE-II*	MSE-III*	TA	ESE	Total	ESE Duration
*Best Two out of three MSE's would be considered	15	15	15	30	40	100	3 Hrs
Prerequisites		·					
Course Objective			Course Out	tcome			

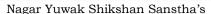
Students should be able to

Students will be able to

COURSE PLAN: (12 Weeks)

- Week 1: Introduction and Overview: Course Overview and Motivation; Introduction to Image Formation, Capture and Representation; Linear Filtering, Correlation, Convolution
- Week 2: Visual Features and Representations: Edge, Blobs, Corner Detection; Scale Space and Scale Selection; SIFT, SURF; HoG, LBP, etc.
- Week 3: Visual Matching: Bag-of-words, VLAD; RANSAC, Hough transform; Pyramid Matching; Optical Flow
- Week 4: Learning Review: Review of Deep Learning, Multi-layer Perceptrons, Deep **Backpropagation**
- Week 5: Convolutional Neural Networks (CNNs): Introduction to CNNs; Evolution of CNN Architectures: AlexNet, ZFNet, VGG, InceptionNets, ResNets, DenseNets
- Visualization and Understanding CNNs: Visualization of Kernels; Backprop-to-Week 6: image/Deconvolution Methods; Deep Dream, Hallucination, Neural Style Transfer; CAM, Grad-CAM, Grad-CAM++; Recent Methods (IG, Segment-IG, Smooth Grad)
- Week 7: CNNs for Recognition, Verification, Detection, Segmentation: CNNs for Recognition and Verification (Siamese Networks, Triplet Loss, Contrastive Loss, Ranking Loss); CNNs for Detection: Background of Object Detection, R-CNN, Fast R-CNN, Faster R-CNN, YOLO, SSD, RetinaNet; CNNs for Segmentation: FCN, SegNet, U-Net, Mask-RCNN
- Week 8: Recurrent Neural Networks (RNNs): Review of RNNs; CNN + RNN Models for Video

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Understanding: Spatio-temporal Models, Action/Activity Recognition

Week 9: Attention Models: Introduction to Attention Models in Vision; Vision and Language: Image

Captioning, Visual QA, Visual Dialog; Spatial Transformers; Transformer Networks

Week 10: Deep Generative Models: Review of (Popular) Deep Generative Models: GANs, VAEs;

Other Generative Models: Pixel RNNs, NADE, Normalizing Flows, etc

Week 11: Variants and Applications of Generative Models in Vision: Applications: Image Editing,

Inpainting, Super resolution, 3D Object Generation, Security; Variants: CycleGANs

,Progressive GANs, StackGANs, Pix2Pix, etc

Week 12: Recent Trends: Zero-shot, One-shot, Few-shot Learning; Self-supervised Learning;

Reinforcement Learning in Vision; Other Recent Topics and Applications

Site Link: https://nptel.ac.in/courses/106/106/106106224/

Course Instructor: PROF. VINEETH N BALASUBRAMANIAN, Department of Computer Science and

Engineering IIT Hyderabad

Styl	Met .	May 2021	1.00	Applicable for AY2021-22 Onwards
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