YESHWANTRAO CHAVAN COLLEGE OF ENGINEERING
(An Autonomous Institution affiliated to R T M Nagpur University Nagpur)
Accredited by NAAC (1st Cycle) 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

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

Information Brochure of Honor Program

1. 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)

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 and 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 Faculty Member	Post	Designation	e-mail ID	Contact Number
1.	Dr. R. C. Dharmik	HOD, IT & Chairman	Asstt. Prof.	raj_dharmik@yahoo.com	9158003335
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. Gaikwad	Member	Asst.prof	amolgaikwad.ag@gmail.com	9970743434

10. Program Coordinator:

SN	Name of the Faculty Member	Post	Designation	e-mail ID	Contact Number
1	Prof. S.W. Shende	Member	Asso. Prof.	shailendra.shende@gmail.com	9766698600

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

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

V Semester

ITHN02	Artificial Intelligence Search Methods for Problem Solving			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 Madras

VI Semester

ITHN11	Artificial Intelligence: Knowledge Representation And Reasoning			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 Madras

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

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

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 Students should be able to	**Course Outcome** 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: Deep Learning Review: Review of Deep Learning, Multi-layer Perceptrons, Backpropagation

Week 5: Convolutional Neural Networks (CNNs): Introduction to CNNs; Evolution of CNN Architectures: AlexNet, ZFNet, VGG, InceptionNets, ResNets, DenseNets

Week 6: Visualization and Understanding CNNs: Visualization of Kernels; Backprop-to-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

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