TULSIRAMJI GAIKWAD-PATIL College of Engineering & Technology

Mohgaon, Wardha Road, Nagpur - 441 108

DEPARTMENT OF CSE - DATA SCIENCE

Structure & Curriculum

From

Academic Year 2024-25

Tulsiramji Gaikwad-Patil College of Engineering & Technology, Nagpur

SCHEME OF INSTRUCTION & SYLLABI

Programme: Data Science

Scheme of Instructions: Third Year B.Tech. in Data Science

Semester – VI

Sr. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs./Wk	Credits	EXAM SCHEME				
									CT1	CT2	TA/CA	ESE	TOTAL
1	PCC	BDS3601	Cloud Computing	3	-	-	3	3	15	15	10	60	100
2	PCC	BDS3602	Web Technology Lab	-	-	2	2	1	-	-	25	25	50
3	PCC	BDS3603	Machine Learning for Data Science	3	1	-	4	4	15	15	10	60	100
4	PCC	BDS3604	Machine Learning for Data Science Lab	-	-	2	2	1	-	-	25	25	50
5	PROJ	BDS3605	Mini Project#	-	-	2	2	1+1@	-	-	50	50	100
6	PEC	BDS3606- 09	Program Elective-III	3	-	-	3	3	15	15	10	60	100
7	PEC	BDS3610- 13	Program Elective-IV	3	-	-	3	3	15	15	10	60	100
8	OEC	B$$XX01-19#	Open Elective –II	4	-	-	3	3	15	15	10	60	100
9	MCC	BAU3606	Social Awareness	2	-	-	2	Audit	-	-	-	-	-
10	HSMC	BDS36014	Engineering Economics & Management	3	-	-	3	3	15	15	10	60	100
			Total	**21**	**1**	**6**	**27**	**23**	**90**	**90**	**160**	**460**	**800**

L- Lecture T-Tutorial P-Practical CT1- Class Test 1 CT2- Class Test 2 TA/CA- Teacher Assessment/Continuous Assessment

ESE- End Semester Examination (For Laboratory End Semester performance)

*** Indicates out of the four course codes each student has to select any one PEC from the list provided at the end of structure.**

 # Indicates out of the 19 course codes each student has to select any one OEC except BDSXX17, BDSXX18 & BDSXX19 from the list provided at the end of structure.

@ Every Student will undergo Industrial Training/Internship of Two weeks in summer vacation after B.E.VI Sem. Examinations; upon successful completion of industrial training/internship 01 credit will be awarded after submission of the report in prescribed format.

Course Category	HSMC (Hum. Soc. Sc, Mgmt.)	BSC (Basic Sc.)	ESC (Engg. Sc.)	PCC (Programme Core courses)	PEC (Programme Elective courses)	OEC (Open Elective courses from other discipline)	Project / Seminar / Industrial Training	MCC (Mandatory Courses)
Credits	3	--	--	09	06	04	02	Yes
Cumulative Sum	12	25	23	42	12	08	03	--

PROGRESSIVE TOTAL CREDITS :101+23=124

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Dr. Premanand Naktode
Principal
TGPCET, Nagpur

List of Electives offered by Department of Data Science

Professional Elective Courses								
Sr. No	**Domain wise Cluster**		**PEC-I**	**PEC-II**	**PEC-III**	**PEC-IV**	**PEC-V**	**PEC-VI**
			Semester-V		Semester-VI		Semester-VI	
1	Domain -1	Course Code	**BDS3507**	**BDS3511**	**BDS3606**	**BDS3610**	**BDS4706**	**BDS4710**
		Data visualization and system Design	Computer Graphics	Digital Image Processing	Computer Vision	Design patterns	Compiler Design	Data Warehousing & ETL
2	Domain -2	Course Code	**BDS3508**	**BDS3512**	**BDS3607**	**BDS3611**	**BDS4707**	**BDS4711**
		Network Security	Wireless Security	Ethical hacking	Security in Wireless Ad Hoc Networks	Cyber Law in India	Block chain Security	Business Intelligence
3	Domain -3	Course Code	**BDS3509**	**BDS3513**	**BDS3608**	**BDS3612**	**BDS4708**	**BDS4712**
		Neural Network and Computing techniques	Soft Computing	Mobile Computing	Convolution Neural network	Quantum Computing	Natural Language Processing	Artificial Neural Network
4	Domain -4	Course Code	**BDS35010**	**BDS3514**	**BDS3609**	**BDS3613**	**BDS4709**	**BDS4713**
		Programming Languages	Python for Data Science	Client Side Scripting-Java Script	Server Side Scripting-PHP	R Programming	No SQL	Data Mining

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Program: Data Science

List of Open Electives Offered

Sr. No.	Name of Host Programme	Open Elective Course Code	Title of the Course
1.	Computer Science & Engineering	BCSXX01	Cyber Law and Ethics
2.	Computer Science & Engineering	BCSXX02	Blockchain Technology
3.	Information Technology	BITXX03	Cyber Security
4.	Information Technology	BITXX04	Artificial Intelligence
5.	Electronics and Communication Engineering	BECXX05	Internet of Things
6.	Electronics and Communication Engineering	BECXX06	Embedded Systems
7.	Civil Engineering	BCEXX07	Introduction to Art and Aesthetics
8.	Civil Engineering	BCEXX08	Metro Systems and Engineering
9.	Mechanical Engineering	BMEXX09	Nanotechnology and Surface Engineering
10.	Mechanical Engineering	BMEXX10	Automobile Engineering
11.	Electrical Engineering	BEEXX11	Power Plant Engineering
12.	Electrical Engineering	BEEXX12	Electrical Materials
13.	Aeronautical Engineering	BAEXX13	Avionics
14.	Aeronautical Engineering	BAEXX14	Unmanned Aerial Vehicles
15.	Biotechnology	BBTXX15	Biomaterials
16.	Biotechnology	BBTXX16	Food and Nutrition Technology
17	DATA SCIENCE	BDSXX17	Soft Computing Techniques
18	DATA SCIENCE	BDSXX18	Machine Leaning & Its Application
19	DATA SCIENCE	BDSXX19	Introduction of Data Science

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Semester	Course Code	Name of Course
VI	BDS3601	Cloud Computing

Teaching Scheme		Examination Scheme	
Lectures	3Hrs/week	**CT-1**	15
Tutorial	0	**CT-2**	15
Total Credit	3	**TA**	10
		ESE	60
		Total	100
		Duration of ESE: 03Hrs 00Min.	

Course Objective:

1	This Course provides an insight into cloud computing.
2	Topics Covered include distributed system models, different cloud services models, and services oriented architectures, cloud programming and software environments, resources management.

Course Contents

Unit I	Cloud Computing fundamentals: Essential characteristics, Architectural Influencers, Technological Influencers, and Operational Influencer.
Unit II	Cloud Computing Architecture: Cloud Delivery models, The SPI Framework, Cloud Software as a services(SaaS), Cloud Platform as a Services(PaaS), Cloud Infrastructure as a Services(IaaS), Cloud Deployment Models, Public Clouds, Community Clouds, Hybrid Clouds, Alternative Deployment model, Expected Benefits.
Unit III	Cloud Computing Software security fundamentals: Cloud Information, Security Objectives, Confidentiality, Integrity, Availability, Cloud Security Services, and Relevant Cloud Security Design. Principals, Secure Cloud Software Requirements, Secure Development practices, Approaches to Cloud Software Requirement Engineering, Cloud Security Policy Implementation.
Unit IV	Cloud Computing risk Issues: The CIA Traid, Privacy and Compliance Risks Threats to Infrastructure, Data and Access Control, Cloud Access Control Issues, Cloud Services Provider Risks. Cloud Computing Security Challenges: Security Policy Implementation, Policy Types, and Computer Security Incident response Team.(CSIRT)
Unit V	Cloud Computing Security Architecture: Architectural Considerations, General Issues, Trusted Cloud Computing, Secure Execution Environments and Communications, Microarchitecture, Identity Management and Access Control Autonomic Security.

Text Books

T.1	Ronald L. Krutz, Russell Dean Vines, —Cloud Security A Comprehensive Guide to secure Cloud Computing‖ Wiley.
T.2	Nikos Antonopoulos, Lee Gillam, —Clod Computing : Principals, Systems and Applications‖, Editor:, Springer, 2012

Reference Books

R.1	Chaeles Badcock, —Cloud Revolution‖, TMH
R.2	Borko Furht, Armando Escalante, —Handbook of Cloud Computing‖, Springer

Useful Links	
1	https://onlinecourses.nptel.ac.in/noc21_cs14/preview
2	https://nptel.ac.in/courses/106105167

Course Outcomes		CL	Class Session
After the completion of this course, students will be able to-			
BDS3601.1	Describe the main concept, key technology, strengths, limitations, of cloud computing and the possible applications for state – of – the art cloud computing.	2	9
BDS3601.2	Identify the architecture and infrastructure of cloud computing, including cloud delivery and deployment models.	5	9
BDS3601.3	Analyze the core issues of cloud computing such as security, privacy, and interoperability.	6	9
BDS3601.4	Identify problems, analyze, and evaluate various cloud computing solutions.	3	9
BDS3601.5	Analyze appropriate cloud computing solutions and recommendations according to the applications used.	4	9

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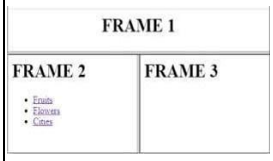
Semester	**Course Code**	**Name of Course**
VI	BDS3602	Web Technology Lab

Pre-Requisites: HTML

Teaching Scheme			**Examination Scheme**	
Practical	2 Hrs/week		**CA**	25 Marks
Total Credit	1		**ESE**	25 Marks
			Total	50 Marks
			Duration of ESE: 02 Hrs 00 Min.	

Sr. No.	**List of Experiment**	**COs**
1	Creating A Web Page Using Image Map using HTML.	CO1
2	Develop and demonstrate the usage of inline, internal and external style sheet using CSS.	CO1
3	Write an HTML page that contains following frame structure. Frame1 shows introductory web page. Frame2 has three links, Fruits, Flowers and Cities. When user clicks on any one link, information appears in Frame3. 	CO1
4	Write a web page using JavaScript that contains a selection box with a list of 5 countries. When the user selects a country, its capital should be printed next in the list.	CO2
5	Write a JavaScript program to make slide show of 10 images.	CO2
6	Write a program for implementing student information using XML	CO3
7	Write a program for implementing restaurant menu information using XML and XSLT	CO3
8	To study PHP and install Wamp/Xampp	CO4
9	Write a PHP program to validate registration form	CO4
10	Connect web form with database using PHP and insert record in database from through form	CO5

Text Books	
T.1	Mastering HTML, CSS & Java Script Web Publishing, Laura Lemay, Rafe Colburn, Jennifer Kyrnin, BPB Publications
T.2	Head First JavaScript Programming: A Brain-Friendly Guide, Elisabeth Robson, Eric Freeman, O'Reilly Publications
Reference Books	
R.1	JavaScript for Beginners: Master JS Programming from Basics to Advanced Level, Tim Simon, Kindle Edition
R.2	Web Technology: Theory and Practice, M. Srinivasan, Pearson, June 2012
Useful Links	
1	https://nptel.ac.in/courses/106106156
2	https://www.vlab.co.in/ba-nptel-labs-computer-science-and-engineering

Course Outcomes		CL	Class Session
After the completion of this course, students will be able to-			
BDS3602.1	Construct web pages using HTML and Cascading Styles sheets	6	9
BDS3602.2	Create dynamic web pages using JavaScript	6	9
BDS3602.3	Demonstrate XML documents and XML Schema	2	9
BDS3602.4	Apply and validate form data using JavaScript and PHP.	3	9
BDS3602.5	Apply and connect to MySQL using PHP and perform various operations	3	9

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Semester	Course Code	Name of Course
VI	BDS3603	Machine Learning for Data Science

Teaching Scheme		Examination Scheme	
Lectures	3Hrs/week	**CT-1**	15
Tutorial	0	**CT-2**	15
Total Credit	3	**TA**	10
		ESE	60
		Total	100
		Duration of ESE: 03Hrs 00Min.	

Course Objective:

1	To understand the need for machine learning for various problem solving.
2	To study the various supervised, semi – supervised and unsupervised learning algorithms in machine learning.
3	To understand the latest trend in machine learning.

Course Contents

Unit I	**Introduction:** ML Techniques and overview, Learn from data evaluation: Data Mining vs. Data Analysis Vs. Data Science, Version Space and Candidate Eliminations, Inductive Bias, Types of Machine Learning: supervised, Unsupervised, Semi supervised and Reinforcement Leaning, Decision Tree Learning - Representation & Algorithm, Hypothesis Evaluation, Heuristic Space Search
Unit II	**Neural Networks and Genetic Algorithms** Neural Network Representation, Problems, MP Neuron, Perceptron, Multilayer Networks , Forward processing, Back Propagation Algorithms, Genetic Algorithms, Model Evaluation and Learning
Unit III	**Bayesian and Computational Learning** Bayes Theorem, Concept Learning, Bayes Optimal Classifier, Gibbs Algorithm, Naive Bayes Classifier, Bayesian Belief Network, Probability Learning, Mistake bond Model, Linear vs Logistic Regression, Support Vector Machine (SVM)
Unit IV	**Instance Based Learning** K- Nearest Neighbor Learning, Locally Weighted Regression, Radial Basis Functions, Case Based Learning, Feature Extraction, Dimension Reduction, Out Lierdetection
Unit V	**Unsupervised Learning:** K means Clustering Algorithm, Reinforcement Learning, Elements of Reinforcement Learning, Exploration vs. Exploitation dilemma, Q – Learning, KDD Framework for Building ML System

Text Books

T.1	Tom M Mitchell, Machine Learning, McGraw – Hill Education (India) Private Limited, 2013.
T.2	Machine Learning: An Algorithmic Prespective, CRC Press, 2009, by Stephen Marsland
T.3	Chris Bishop, Pattern Recognition and Machine Learning
T.4	Dr. NileshShelke, Dr. GopalSakarkar, Dr N V Choudhari, Introduction toMachine Learning, GanuPrakashan

Reference Books

R.1	Ethem Adpaydin, Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004
R.2	Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies by John D. Kelleher, Brian Mac Namee, and Aoife D'Arcy
R.3	Machine Learning for Beginners, by Chris Sebastian, Kindle Edition
Useful Links	
1	https://nptel.ac.in/courses/106106139
2	https://onlinecourses.nptel.ac.in/noc23_cs18/preview

Course Outcomes		**CL**	**Class Session**
After the completion of this course, students will be able to-			
BDS3603.1	Differentiate between supervised, unsupervised, semi supervised machine learning approaches	2	9
BDS3603.2	Discuss the decision tree algorithm and identity and overcome the problems.	5	9
BDS3603.3	Discuss and apply the back propagation algorithm and genetic algorithms to various problems.	6	9
BDS3603.4	Apply the Bayesian concepts to machine learning	3	9
BDS3603.5	Analyzes and suggest appropriate machine learning approaches for various types of problems.	4	9

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Semester	Course Code	Name of Course
VI	BDS3604	Machine Leaning for Data Science Lab

Pre-Requisites:

Teaching Scheme		Examination Scheme	
Practical	2 Hrs/week	**CA**	25
Total Credit	1	**ESE**	25
		Total	50
		Duration of ESE:	

Sr. No.	List of Experiment	COs
1	To implement Linear Regression Classification.	CO1
2	To implement Polynomial Linear Regression Classification for stack market	CO1
3	To implement Logistic Regression for prediction.	CO2
4	To implement KNN for Face Detection	CO2
5	To implement K-mean square for image processing	CO3
6	To implement SVM for Classification	CO3
7	To implement decision tree for the classification of UCI data set	CO4
8	To implement Naïve bias for UCI data sets	CO4
9	To implement ensemble model for classification of BCI data	CO5
10	To implement Perceptron for classification of AND gate.	CO5

Text Books

T.1	Introduction to machine learning, EthemAlpaydin. —2nd ed., The MIT Press, Cambridge, Massachusetts, London, England.
T.2	Dr. NileshShelke, Dr. GopalSakarkar, Dr N V Choudhari, Introduction toMachine Learning, GanuPrakashan

Reference Books

R.1	Richard O. Duda, Peter E. Hart, David G. Stork. Pattern classification, Wiley, New York, 2001
R.2	Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning Data Mining, Inference, and Prediction

Useful Links

1	https://nptel.ac.in/courses/106/105/106105152/

Course Outcomes		CL	Class Session
After the completion of this course, students will be able to-			
BDS3604.1	**Recognize** the characteristics of machine learning that make it useful to real-world problems.	3	9
BDS3604.2	**Characterize** machine learning algorithms as supervised, semi-supervised, and unsupervised.	3	9
BDS3604.3	**Design** and implement machine learning solutions to classification,regression, and clustering problems.	4	9
BDS3604.4	**Evaluate** and interpret the results of the algorithms	4	9
BDS3604.5	**Use** machine learning toolboxes.	2	9

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Semester	**Course Code**	**Name of Course**
VI	BDS3606	**PEC-III** Computer Vision

Teaching Scheme		**Examination Scheme**	
Lectures	3	**CT-1**	15
Tutorial	0	**CT-2**	15
Total Credit	3	**TA**	10
		ESE	60
		Total	100
		Duration of ESE: 3 Hours	

Course Objective:

1	Student shall be able to understand the computer vision and image analysis
2	Student shall be able to understand the image formation models
3	Student shall be able to understand the object recognition and tracking
4	Student shall be able to understand the visual surveillance

Course Contents

Unit I	Introduction: Purpose of computer vision, history of computer vision, applications of computer vision, computer imaging system, image formation and sensing, preprocessing and binary image analysis
Unit II	Image Formation Models: Monocular imaging system, binocular imaging system, orthographic and perspective projection, Image representation, color representation, edge detection, Motion estimation, structure from motion, stereo vision, optical flow computation
Unit III	Object Recognition: Shape representation, shape descriptors, obhect representation using low and high level features Object Tracking: Basics of Object Tracking, single and multiple Object Tracking, slow moving and fast moving objects, object trajectory analysis
Unit IV	Visual Surveillance: basics of Surveillance, single and multiple camera based surveillance, Surveillance using moving camera, public place Surveillance, health care Surveillance,
Unit V	3D vision: Projective geometry, single perspective camera, strereopsis, Epipolargeometry in vision, correlation based and feature based stereo correspondence, shape from motion, optical flow.

Text Books

T.1	Computer Vision: A Modern Approach by David Forsyth and Jean Ponce, Pearson, 1 January 2015
T.2	Digital Image Processing and Computer Vision , Schalkoff, John Wiley and Sons, John Wiley and Sons, 1989

Reference Books

R.1	Image Processing, Analysis and Machine Vision, Sonka, Hlavac and Boyle Brooks, , Thomson Asia Pvt Ltd Singapore,1999
R.2	Machine Vision, Jain and Rangachar, McGraw Hill International Edition, 1999

Useful Links	
1	https://archive.nptel.ac.in/courses/106/105/106105216/
2	https://nptel.ac.in/courses/106105216

Course Outcomes		CL	Class Session
After the completion of this course, students will be able to-			
BDS3606.1	Identify basic concepts, terminology, theories, models and methods in the field of computer vision	1	9
BDS3606.2	Discriminate the basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition.	3	9
BDS3606.3	Analyze and demonstrate various image segmentation techniques.	4	9
BDS3606.4	Distinguish the methods to use for solving a given problem and analyze the accuracy.	2	9
BDS3606.5	Utilize the techniques, skills and modern computer engineering tools, software and techniques necessary for engineering practice	2	9

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Semester	Course Code	Name of Course
VI	BDS3607	**PEC-III** Security in Wireless Ad Hoc Networks

Teaching Scheme		Examination Scheme	
Lectures	3Hrs/week	**CT-1**	15
Tutorial	0	**CT-2**	15
Total Credit	3	**TA**	10
		ESE	60
		Total	100
		Duration of ESE: 03Hrs 00Min.	

Course Objective:

1	Explain fundamental principles of Ad-hoc Networks.
2	Discuss Comprehensive Understanding of Ad-hoc network Protocols.
3	Outline current and emerging trends in Ad-hoc Wireless Networks.
4	Analyze energy management in Ad-hoc Wireless networks.

Course Contents

Unit I	Ad-hoc Wireless Networks Introduction, Issues in Ad-hoc Wireless Networks, Ad-hoc Wireless Internet, MAC protocols for Ad-hoc Wireless Networks, Issues in designing a MAC protocol, Design goals of MAC Protocols, Classification of MAC Protocols, Contention-Based Protocols, Contention-Based Protocols with Reservation Mechanisms, Contention -Based protocols With Scheduling Mechanisms, MAC Protocols that use directional Antennas.
Unit II	Routing Protocols for Ad-hoc Wireless Networks Introduction, Issues in designing a Routing Protocol for Ad-hoc Wireless Networks, Classification of Routing Protocols, Table Driven Routing Protocols, On-Demand Routing Protocols, Hybrid Routing Protocols, Hierarchical Routing Protocols and Power - Aware Routing Protocols.
Unit III	Multicast Routing in Ad-hoc Wireless Networks Introduction, Issues in Designing a Multicast routing Protocol, Operation of Multicast Routing Protocols Architecture Reference Model for Multicast Routing protocols, Classification of Multicast Routing Protocols, Tree based Multicast Routing Protocols and Mesh-Based Multicast Routing Protocols.
Unit IV	Transport Layer and Security Protocols for Ad-hoc Networks Introduction, Issues in Designing a Transport Layer Protocol, Design Goals of Transport Layer Protocol, Classification of Transport Layer Solution, TCP over Transport Layer Solutions, Other Transport Layer Protocols for Ad-hoc Networks, Security in Ad-hoc Wireless Networks, Issues and Challenges in security provisioning, Network Security attacks, Key Management and Secure Touting Ad-hoc Wireless Networks.
Unit V	Quality of Service and Energy Management in Ad-hoc Wireless Networks Introduction, Issues and Challenges In Providing Quality of Service in Ad-hoc Wireless Networks, Classification of QOS Solutions, MAC Layer Solutions, Network Layer Solutions, Energy Management in Ad-hoc Wireless Networks Introduction, Need for Energy Management in Ad-hoc Wireless Networks, Classification of Energy Management Schemes, Battery management schemes, Transmission Management Schemes, System Power Management Schemes

Text Books

T.1	C.Siva Ram Murthy & B.S. Manoj: Ad-hoc Wireless Networks, Second Edition,Pearson Education 2011
T.2	Y.Xiao, L.Chen and W.Wu: Ad Hoc Network Security and Privacy 2008
T.3	F.A. Khan , M.A. Khan: Security in Wireless Ad-Hoc and Sensor Networks 2016
Reference Books	
R.1	Ozan K.Tonguz and Gianguigi Ferrari: Ad-hoc Wireless Networks, John Wiley,2007
R.2	Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du: Ad-hoc Wireless Networking, Kluwer Academic Publishers, 2004
R.3	C.K. Toh: Ad-hoc Mobile Wireless Networks Protocols and Systems, Pearson Education,2002
Useful Links	
1	https://archive.nptel.ac.in/courses/106/105/106105160/
2	https://nptel.ac.in/courses/106105160

Course Outcomes		**CL**	**Class Session**
After the completion of this course, students will be able to-			
BDS3607.1	Design their own wireless network.	6	9
BDS3607.2	Evaluate the existing network and improve its quality of service.	5	9
BDS3607.3	Choose appropriate protocol for various applications.	5	9
BDS3607.4	Examine security measures present at different levels.	1	9
BDS3607.5	Analyze energy consumption and management.	4	9

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Semester	**Course Code**	**Name of Course**
VI	BDS3608	**PEC-III** Convolution Neural Network

Teaching Scheme	
Lectures	3Hrs/week
Tutorial	0
Total Credit	3

Examination Scheme	
CT-1	15
CT-2	15
TA	10
ESE	60
Total	100
Duration of ESE: 03Hrs 00Min.	

Course Objective:

1	The main characteristics of CNNs that make them so useful for image processing, their inner workings, and how to build them from scratch to complete image classification tasks.
2	Understand the design choices and optimizations made in each architecture.
3	Will able to learn image recognition and processing, due to its ability to recognize patterns in images.
4	Finding patterns in images to recognize objects, classes, and categories.

Course Contents

Unit I	**Introduction to Convolution Neural Network:** Basic Introduction, Importance of CNN, Inspiration behind CNN and Parallels with The Human Visual System, Key Components of a CNN, Activation function.
Unit II	**Architecture of CNN: Convolution Neural Network:** Layers and Functionality, CNN Architecture, Mathematical Overview of Convolution, Layers used to build convents', Overfitting and Regularization in CNNs.
Unit III	**Machine Learning Pipelines**: Machine Learning Pipeline, Linear classifiers, Classifier Evaluation, Loss Functions, Optimization, Gradient Descent**.**
Unit IV	**Neural Network:** Neural Networks, Perceptron Layers, Backpropagation, Convolutional, Pooling and Soft-Max Layers, Convolutional Neural Networks (CNN).
Unit V	**Application of Convolution Neural Network:** Decoding Facial Recognition, Analyzing Documents, Collecting Historic and Environmental Elements, Understanding Climate, Understanding Gray Areas, Advertising**.**

Text Books

T.1	Guide to Convolution Neural Network by Hamed Habibi Aghdam, Elnaz Jahani Heravi.
T.2	Convolution Neural Network in Visual Computing Ragav Venkatesan , Baoxin Li

Reference Books

R.1	Deep learning from scratch Seth Weidman
R.2	Artificial vision and language processing for robotics Alvaro Morena Alberola, Gonzalo Molina Gallego, Unai Garay Maestre
R.3	Hands-on computer vision with Tensor Flow 2 Benjamin Planche and Eliot Andres w
R.4	Hands-on neural networks Leonardo De Marche and Laura Mitchell.

Useful Links

1	https://archive.nptel.ac.in/courses/106/106/106106184/
2	https://nptel.ac.in/courses/106106184

Course Outcomes		CL	Class Session
After the completion of this course, students will be able to-			
BDS3608.1	Understand image recognition and classification.	2	9
BDS3608.2	Design spatial hierarchies of features through a backpropagation algorithm.	6	9
BDS3608.3	Understand converts all the pixels in its receptive field into a single value.	2	9
BDS3608.4	Compare the three signals of interest: the input signal, the output signal, and the impulse response.	2	9
BDS3608.5	Apply probability, statistics, acoustics, spectroscopy, signal processing and image processing, geophysics, engineering, physics, computer vision and differential equations.	3	9

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Semester	Course Code	Name of Course
VI	BDS3609	**PEC-III** Sever Side Scripting PHP

Teaching Scheme		Examination Scheme	
Lectures	3Hrs/week	**CT-1**	15 Marks
Tutorial	0	**CT-2**	15 Marks
Total Credit	3	**TA**	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE: 03Hrs 00Min.	

Course Objective:

1	Understand the role of PHP in web development as a server-side scripting language.
2	Design the process of handling HTTP requests and responses using PHP.
3	Implement techniques to manage user sessions and cookies in PHP.
4	Introduce debugging tools and practices to troubleshoot PHP applications efficiently.
5	Promote collaboration, version control (using Git), and project management practices.

Course Contents

Unit I	**Introduction to PHP:** History and evolution of PHP, Features and advantages of PHP, PHP vs. other server-side languages, And Setting Up the Development Environment: Installation of XAMPP/WAMP/LAMP Overview of IDEs and code editors (e.g., VSCode, PHPStorm).
Unit II	**Basic Syntax and Structure:** PHP tags and syntax, Variables and data types, Operators and expressions, Conditional Statements: f, else, elseif statements, Switch statements, Looping Constructs: for, while, and do-while loops, foreach loop for arrays, Functions in PHP: Function parameters and return values, Scope of variables and global variables, Built-in PHP functions.
Unit III	**Working with Forms and User Input:** HTML Forms and PHP Integration: Creating forms with HTML, Sending data using GET and POST methods, Form Validation and Security: validating user input, Sanitizing and escaping data, Handling file uploads, Sessions and Cookies: Understanding sessions and their importance, Using cookies to store user preferences, Session management in PHP.
Unit IV	**PHP and Databases:** Database Concepts: Introduction to databases and SQL, setting up MySQL with PHP, connecting **to a Database:** Using PDO and MySQLi to connect to databases, Performing Database Operations: CRUD operations using PHP, Prepared statements for security, Error handling in database interactions, Object-Oriented Programming in PHP: Creating subclasses and inheritance hierarchy, Method overriding and polymorphism, Autoloading classes in PHP.
Unit V	**Advanced PHP Techniques:** Error Handling and Debugging: PHP error types, Error handling with try-catch blocks, Using error logs for debugging, **Working with External APIs,** Consuming RESTful APIs in PHP, Sending and receiving JSON data, File Handling: Reading and writing files in PHP, PHP Frameworks and Libraries: Overview of popular PHP frameworks (e.g., Laravel, Symfony, CodeIgniter), Securing PHP applications against attacks.

Text Books

T.1	The Complete Refernce Php, Holzner, Steven, Mc Graw Hill.
T.2	Securing Php Web Applications, Ballad, Tricia;Ballad,William, Tata Mcgraw Hill.

Reference Books

R.1	Programming PHP – by Kevin Tatroe, Peter MacIntyre & Rasmus Lerdorf ―Foreword By: Michael Bourque‖
R.2	PHP & MySQL Web Development – by Luke Welling & Laura Thompson
R.3	PHP: A Beginner's Guide – by Vikram Vaswani
R.4	Programming in PHP, Rasmus Lerdorf, O'reilly publication
Useful Links	
1	https://onlinecourses.swayam2.ac.in/aic20_sp32/preview
2	https://nptel.ac.in/courses/106105175

Course Outcomes		**CL**	**Class Session**
After the completion of this course, students will be able to-			
BDS3609.1	Understand the basic concepts of server side scripting PHP	2	9
BDS3609.2	Develop dynamic web applications by using programming concepts.	6	9
BDS3609.3	Implement HTML forms and handle user inputs effectively using PHP	3	9
BDS3609.4	Elaborate the connectivity of PHP applications to relational databases using Object-Oriented Programming concepts.	5	9
BDS3609.5	Apply the debugging tools and practices to identify and resolve coding errors.	3	9

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Semester	Course Code	Name of Course
VI	BDS3610	**PEC-IV** Design Pattern

Teaching Scheme		Examination Scheme	
Lectures	3Hrs/week	**CT-1**	15 Marks
Tutorial	0	**CT-2**	15 Marks
Total Credit	3	**TA**	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE: 03Hrs 00Min.	

Course Pre-requisite:

Course Objective:

1	Demonstration of patterns related to object oriented design
2	Describe the design patterns that are common in software applications.
3	Analyze a software development problem and express it.
4	Design a module structure to solve a problem, and evaluate alternatives.

Course Contents

Unit I	What is a Design Pattern?, Design Patterns in Smalltalk MVC, Describing Design Patterns, The Catalogue of Design Patterns, Organizing The Cato log, How Design Patterns solve Design Problems, How to Select a Design pattern, How to Use a Design Pattern.
Unit II	A Case Study: Designing a Document Editor, Design Problems, Document Structure, Formatting, Embellishing the User Interface, Supporting Multiple Look-and-Feel Standards, Supporting Multiple Window Systems, User Operations Spelling Checking and Hyphenation, Summary, Creational Patterns, Abstract Factory, Builder, Factory Method, Prototype, Singleton, Discussion of Creational Patterns.
Unit III	Structural Pattern Part-I, Adapter, Bridge, Composite. Structural Pattern Part-II, Decorator, Facade, Flyweight, Proxy
Unit IV	Behavioral Patterns Part: I, Chain of Responsibility, Command, Interpreter, Iterator. Behavioral Patterns Part: II, Mediator, Memento, Observer, Discussion of Behavioral Patterns.
Unit V	Behavioral Patterns Part: III, State, Strategy, Template Method, Visitor, Discussion of Behavioral Patterns. What to Expect from Design Patterns, A Brief History, The Pattern Community, An Invitation, A Parting Thought.

Text Books

T.1	Design Pattern s By Erich Gamma, Pearson Education.
T.2	Pattern s in JAVA Volume -I By Mark Grand, Wiley Dream Tech.
T.3	Java Enterprise Design Patterns Vol-III By Mark Grand Wiley Dream Tech.

Reference Books

R.1	Design Patterns Small talk Companion by Sherman alpert,kyle brown, Bobby Woolf
R.2	Design patterns in ruby Russ Olsen.
R.3	Design Patterns in JAVA Steven metsker William C. Wake

Useful Links

1	https://nptel.ac.in/courses/106105224
2	http://nptelvideos.com/video.php?id=916

Course Outcomes		CL	Class Session
After the completion of this course, students will be able to-			
BDS3610.1	Design consisting of a collection of modules. Create	6	9
BDS3610.2	Exploit well-known design patterns (such as Iterator, Observer, Factory and Visitor).	2	9
BDS3610.3	Distinguish between different categories of design patterns. Analyze	4	9
BDS3610.4	Understand and apply common design patterns to incremental/iterative development	2	9
BDS3610.5	Identify appropriate patterns for design of given Problem.	1	9

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Semester	**Course Code**	**Name of Course**
VI	BDS3611	**PEC-IV** Cyber Law in India

Teaching Scheme		**Examination Scheme**	
Lectures	3Hrs/week	**CT-1**	15 Marks
Tutorial	0	**CT-2**	15 Marks
Total Credit	3	**TA**	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE: 03Hrs 00Min.	

Course Objective:

1	To Understand the Cyber Law Fundamentals in the digital age.
2	Examine Data Protection and Privacy by Identifying Cyber Crimes.
3	To Analyze Intellectual Property Rights in Cyberspace.
4	Develop E-commerce Regulations and Explore Cyber security Frameworks**.**
5	To Promote Awareness and Ethical Practices in protecting digital data and infrastructure.

Course Contents

Unit I	**Introduction to Cyber Law:** Overview of Cyber Law: Definition and scope, Importance of Cyber Law, History of Cyber Law in India: Evolution of Cyber Law, Key developments and milestones, Cyber Crime and Related Offenses: Types of cybercrimes (hacking, identity theft, phishing, etc.).
Unit II	**Hackers, Attacks And Crimes:** Hackers and Hacking: Introduction, Representation, myths and realities, hacking and the law, Attacks and Crimes: Introduction, types of abuse, Evolving forms of cybercrimes, Attacks and Conflict: Computer abusers and cybercriminals.
Unit III	**Theoretical and Social perspectives on Cybercrime:** Introduction, classical criminology: trait theories, social process theories, social structure, Theories: Conflict theories, integrated theories, the social and economic impacts of cybercrime, Emerging crime: related issues and controversies.
Unit IV	**Managing Cybercrime:** Cyber laws and Regulations: Introduction, Rational and reach of cyber laws and regulations**,** Cybercrime laws and Infosec regulations, Investigating and prosecuting cybercrime, Introduction of criminal justice system components, legal issues governing investigative procedures: crime scene**,** processing and evidence management, prosecuting cybercriminals.
Unit V	**Preventing Cybercrime via Information Security:** Introduction: personal and organizational information, Security protocols: Advancing the security posture of organizations, the purpose and the value of auditing, future opportunities for managing cybercrime.

Text Books

T.1	Cyber laws and it protection, Chander Harish, Prentice hall of india,
T.2	Information security and cyber laws, Sharma,Pankaj, S.K.Kataria and sons.

Reference Books

R.1	Information security and cyber laws, Sharma,Saurabh, Vikas Publication.
R.2	Handbook of cyber laws, sharma vakul, narosa publishing house
R.3	Handbook of cyber laws, sharma vakul,mcmillan india ltd.
R.4	Cyber law simplified, sood vivek, tata mcgraw hill.
Useful Links	
1	https://onlinecourses.swayam2.ac.in/cec24_cs14/preview
2	https://onlinecourses.nptel.ac.in/noc23_cs127/preview

Course Outcomes		**CL**	**Class Session**
After the completion of this course, students will be able to-			
BDS3611.1	Understanding the key legal frameworks governing cyber law.	2	9
BDS3611.2	Analyze basics of hacking and evolving forms of cybercrimes.	4	9
BDS3611.3	Explore the ethical implications of technology use, data privacy and online behavior.	5	9
BDS3611.4	Categorize the implications of cybercrimes for individuals, organizations, and society.	2	9
BDS3611.5	Simulate the challenges posed by evolving technologies to existing legal frameworks.	6	9

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Semester	Course Code	Name of Course
VI	BDS3612	**PEC-IV** Quantum Computing

Teaching Scheme		Examination Scheme	
Lectures	3Hrs/week	**CT-1**	15 Marks
Tutorial	0	**CT-2**	15 Marks
Total Credit	3	**TA**	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE: 03Hrs 00Min.	

Course Pre-requisite:

Course Objective:

1	Demonstration of patterns related to object oriented design
2	Describe the design patterns that are common in software applications.
3	Analyze a software development problem and express it.
4	Design a module structure to solve a problem, and evaluate alternatives.

Course Contents

Unit I	Introduction: Elementary quantum mechanics: linear algebra for quantum mechanics, Quantum states in Hilbert space, The Bloch sphere, Density operators, generalized measurements, no-cloning theorem
Unit II	Quantum correlations: Bell inequalities and entanglement, Schmidt decomposition, super dense coding, teleportation.
Unit III	Quantum cryptography: quantum key distribution, no-cloning theorem.
Unit IV	Quantum gates and algorithms: Universal set of gates, quantum circuits, Solovay-Kitaev theorem, Deutsch-Jozsa algorithm, factoring
Unit V	Programming a quantum computer: The IBMQ, coding a quantum computer using a Simulator to carry out basic quantum measurement and state analysis.

Text Books

T.1	Phillip Kaye, Raymond Laflamme et. al., An introduction to Quantum Computing, Oxford University press, 2007
T.2	Chris Bernhardt, Quantum Computing for Everyone, The MIT Press, Cambridge, 2020
T.3	David McMahon-Quantum Computing Explained-Wiley-Interscience, IEEE Computer Society (2008)

Reference Books

R.1	Quantum Computation and Quantum Information, M. A. Nielsen &I.Chuang, Cambridge University Press (2013).
R.2	Quantum Computing, A Gentle Introduction, Eleanor G. Rieffel and Wolfgang H. Polak MIT press (2014)
R.3	Quantum Computing for everyone Chris Bernhardt

Useful Links

1	https://nptel.ac.in/courses/106106232
2	https://elearn.nptel.ac.in/shop/iit-workshops/completed/quantum-computing/?v=c86ee0d9d7ed

Course Outcomes		CL	Class Session
After the completion of this course, students will be able to-			
BDS3612.1	Design the framework of quantum computation, and how that may be useful for future quantum technologies.	6	9
BDS3612.2	Analyze simple quantum algorithms and argue optimality.	4	9
BDS3612.3	Understand gate operators and design simple quantum circuits.	2	9
BDS3612.4	Understand recent results as well as research papers on quantum algorithms	2	9
BDS3612.5	Understand about the various optical nonlinear phenomena.	2	9

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Semester	Course Code	Name of Course
VI	BDS3613	**PEC-IV** R Programming

Teaching Scheme		Examination Scheme	
Lectures	3Hrs/week	**CT-1**	15
Tutorial	0	**CT-2**	15
Total Credit	3	**TA**	10
		ESE	60
		Total	100
		Duration of ESE: 03Hrs 00Min.	

Course Objective:

1	To Study the fundamentals of R programming to apply in quantitative analysis.
2	Handling Data with R
3	Extracting and Analyzing data from different resources
4	Learn powerful R tools for solving data problems with greater clarity and ease.

Course Contents

Unit I	**Introduction to R Programming:** Basic features, the R – Environment, R – Package, R – Object, Design of the R System, Limitation of R Mixing R Object – creating Vectors, Lists, Matrices, Explicit coercion, Factors, Data Frames handling Missing values
Unit II	**R Statements:-** I/O Statements, Control Statements, Looping Statements, **Functions and Statements:** Sub setting a Matrices, Vector, List Data Function Time Functions, Custom Functions. Reading Data from a File: Storing Textual & Binary Formats of Data. Other interfaces to outside data (URL , bz file, gz file)
Unit III	Managing Data Frames, Data Visualization in 'R', Basic Statics using 'R', Correlation t test, ANNOVA: 1 way, 2 way ANNOVA
Unit IV	**Building Linear Models for Predictive Analysis:** Linear Simple and multiple regression Model diagnostics, Multiple regression, Logistic regression Model Diagnostics model performance evaluation, cross validatation
Unit V	**Building Non-linear models for Predictive Analysis** : Decision trees, Random forests, Clustering - K means, Hierarchical Clustering using Time Series data, Generalization additive models, generating random sample with different distribution to be used for different model, Bootstrapping

Text Books

T.1	R Programming for Data Science, Roger D.Peng, Lean Publishing.
T.2	R for Data Science, Hadley Wickham &amp, Garrett Grolemund, O'Reilly Publishing.

Reference Books

R.1	Jared P.L. R for Everyone - Advanced Analytics and Graphics, Addition Wesley Data and Analytics series, 2015
R.2	Data Visualization and Exploration with R, by Eric Pimpler ,Geospatial Training Services.
R.3	SandipRakshit, R Programming for Beginners, McGraw Hill Education, 2017

Useful Links

1	https://onlinecourses.nptel.ac.in/noc23_ma96/preview
2	https://onlinecourses.nptel.ac.in/noc19_ma33/preview

Course Outcomes		CL	Class Session
After the completion of this course, students will be able to-			
BDS3613.1	Discuss history, basic concepts ,and packages of R.	2	9
BDS3613.2	Apply R language concept such as control structures and functions on applications	3	9
BDS3613.3	Use R language to analyze and manipulate data.	4	9
BDS3613.4	Use R programming to solve linear model decision problems.	3	9
BDS3613.5	Use R programming to solve nonlinear model decision problems.	3	9

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Semester	Course Code	Name of Course
VI	BAU3606	Social Awareness

Teaching Scheme		Examination Scheme	
Lectures	2 Hrs/Week	**CT-1**	-
Tutorial	0	**CT-2**	-
Total Credit	Audit	**TA**	-
		ESE	-
		Total	-
		Duration of ESE: -	

Course Objective:

1	To Educate about Contemporary, National and International affairs.
2	Identify the tools to analyse the divided society scientifically through rights based approach.
3	Identify and discuss the issues and problems prevalent in the society.
4	To bring awareness about the responsibility towards society.

Course Contents

Unit I	World trends today: Some basic data-Globalization- World Social Forum vs. World Economic Forum-the North South divide Emerging challenges in contemporary India- (social, political, economic and cultural issues) India : A land of cultural and religious diversity - secularism-communalism-fundamentalism-Indian politics and religion-problems of the minority and women empowerment
Unit II	Major social problems and Mindset in India a) Indian resources and Poverty; Manifestation and Measurement; Incidence and Magnitude; Causes, problems of poor and pains of poverty b) Ignorance in Governance and corruption- The Concept; Causes and Impact of Corruption; Combating Corruption- Right to information act. c) Indian education system and illiteracy Illiteracy-Magnitude, Causes and Consequences -Functional illiteracy.
Unit III	Role of the youth in social engineering a) Concept of Youth Unrest; Youth Protests, Agitations and Movements; Important Youth Agitations in India; Youth Leadership b) Youth and politics effective intervention by youth c) Effective intervention by youth Emerging alternatives a) Participation in governance and Social Activism - Discovering social roles of individuals and groups b) Human rights: Know your rights: Human rights (Universal Declaration of Human Rights- Concepts in human rights- Human rights violations.) and Economic, Social, Cultural rights.

Text Books

T.1	A. Alavudeen, M. Jayakumaran, and R Kalil Rahman, ―Professional Ethics and Human Values‖
T.2	Ram Ahuja, ―Social Problems in India‖ (third edition)
T.3	Shastry, T. S. N., ―India and Human rights: Reflections‖, Concept Publishing Company India Pvt. Ltd., 2005.

Reference Books

R.1	Nirmal, C.J., ―Human Rights in India: Historical, Social and Political Perspectives (Law in India)‖, Oxford India
R.2	Rangarajan, ―Environmental Issues in India‖, Pearson Education
R.3	David Mandelbaum, Society in India, 1990, Popular.
R.4	University of Delhi, The Individual and Society, Pearson Education.

Useful Links

1	https://nptel.ac.in/courses/109/103/109103023/
2	https://nptel.ac.in/courses/109/107/109107131/

Course Outcomes		CL	Class Session
After the completion of this course, students will be able to-			
BAU3606.1	Explores global trends and key issues in contemporary India.	5	9
BAU3606.2	Examines causes of poverty, corruption, illiteracy and their impacts.	3	9
BAU3606.3	Analyzes youth roles in social change, activism, and human rights.	3	9

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Semester	Course Code	Name of Course
VI	BDS3614	Engineering Economics & Management

Teaching Scheme		Examination Scheme	
Lectures	3 Hrs/Week	**CT-1**	15 Marks
Tutorial	0	**CT-2**	15 Marks
Total Credit	3	**TA**	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE: 03 Hrs 00 Min.	

Course Objective:

1	To analyze and minimize costs while maximizing value in engineering projects.
2	To efficiently allocate and manage resources for timely project completion.
3	To identify and mitigate risks, ensuring successful project outcomes.
4	To apply financial analysis for sound investment and project decisions.

Course Contents

Unit I	**Fundamentals of Economics:** Wealth, Welfare and Scarce Definitions of Economics; Micro and Macro Economics; Demand- Law of Demand, Elasticity of Demand, Types of Elasticity and Factors determining price elasticity of Demand: Utility- Law of Diminishing Marginal Utility, its limitations and exceptions.
Unit II	**Forms of Business Organizations:** Features, merits and demerits of Sole Proprietorship, Partnership and Joint Stock Company- Public Enterprises and their types.
Unit III	**Introduction to Management:** Functions of Management- Taylor's Scientific Management; Henry Fayol's Principles of Management; Human Resource Management –Basic functions of Human Resource Management (in brief). **Production Management:** Production Planning and Control, Plant Location, Break-Even Analysis-Assumptions, limitations and applications.
Unit IV	**Financial Management:** Types of Capital: Fixed and Working Capital and Methods of Raising Finance; Final Accounts- Trading Account, Statement of Profit and Loss and Balance Sheet (simple problems)
Unit V	**Marketing Management and Entrepreneurship:** Marketing Management: Functions of marketing and Distribution Channels. **Entrepreneurship:** Definition, Characteristics and Functions of an Entrepreneur

Text Books

T.1	A.R. AryaSri, Managerial Economics and Financial Analysis, TMH Publications, new Delhi, 2014
T.2	S.C. Sharma and Banga T. R., Industrial Organization & Engineering Economics, khanna Publications, Delhi-6, 2006
T.3	S.N.Maheswari, SK Maheswari, Financial Accounting Fifth Edition, Vikas Publishing House Pvt. Ltd., New Delhi, 2012

Reference Books

R.1	"Engineering Economics" by J. L. Riggs, McGraw-Hill Education, 5th Edition.
R.2	"Engineering Economics: Theory and Practice" by Donald G. Newnan, Ted G. Eschenbach, Jerome P. Lavelle, Pearson, 8th Edition.
R.3	"Engineering Economy" by William G. Sullivan, Elin M. Wicks, and C. Patrick

	Koelling, Pearson, 16th Edition.
R.4	"Principles of Engineering Economics" by E. Paul DeGarmo, William G. Sullivan, and Richard S. S., Prentice Hall, Latest Edition.
Useful Links	
1	https://archive.nptel.ac.in/courses/112/107/112107209/
2	https://archive.nptel.ac.in/courses/112/107/112107209/#

Course Outcomes		**CL**	**Class Session**
After the completion of this course, students will be able to-			
BDS3614.1	Understand demand elasticity and marginal utility.	5	9
BDS3614.2	Learn about different business types and their characteristics.	3	9
BDS3614.3	Skills to learn management, HRM, and production concepts.	3	9
BDS3614.4	Identify capital types and apply finance methods.	4	9
BDS3614.5	Define marketing functions and entrepreneurship roles.	4	9

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Semester	Course Code	Name of Course
VI	BDS XX17	**Open Elective-II** Soft Computing Techniques

Pre-Requisites:

Teaching Scheme		Examination Scheme	
Lectures	4Hrs/week	**CT-1**	15 Marks
Tutorial	0	**CT-2**	15 Marks
Total Credit	4	**TA**	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE: 03Hrs 00Min.	

Course Contents

Unit I	Introduction to Soft Computing: Artificial Neural Networks- Biological neurons, Basic models of Artificial Neural Networks- Connections, Learning, Activation functions, Mc Culloch and pitts neurons, Hebb Networks.
Unit II	Perceptron networks- Learning rule- Training and testing algorithms, Adaptive Linear Neurons, Back Propagation Networks- Architecture, Training algorithm
Unit III	Fuzzy Logic- fuzzy sets –properties-operations on fuzzy sets, fuzzy relations, operations on fuzzy relations. Fuzzy membership functions, fuzzification, Methods of membership value assignments- intuition-inference-rank ordering, Lambda-cuts for fuzzy sets, defuzzification methods
Unit IV	Truth values and tables in fuzzy Logic, fuzzy propositions, Formation of fuzzy rules Decomposition of rules- Aggregation of rules, Fuzzy inference System- Mamdani and Sugeno types, Neuro-fuzzy hybrid systems – Characteristics- classification
Unit V	Introduction to Genetic Algorithm, operators in genetic algorithm- coding – selection- cross-over mutation, Stopping condition for Genetic algorithm flow, Genetic-neuro hybrid systems, Genetic fuzzy rule based system

Text Books

1	S. N. Sivanandam and S. N. Deepa, Principal of Soft computing –John Wiely & sons 2007
2	Timothy J. Ross, Fuzzy Logic with engineering applications John Wiley & Sons 2016

Reference Books

1	K. Sinha and M.M. Gupta, Soft Computing and Intelligent Systems: Theory & Applications Academics Press/Elsevier 2009
2	Driankov D., Hellenoorn H. and Reinfrank M. An Introduction to Fuzzy Control Narosa pub. 2001

Useful Links

1	https://archive.nptel.ac.in/courses/106/105/106105173/
2	https://onlinecourses.nptel.ac.in/noc22_cs54/preview

Course Outcomes		CL	Class Session
After the completion of this course, students will be able to-			
BDS XX17.1	Understand soft computing techniques and their applications	2	9
BDS XX17.2	Analyze various neural networks architectures	3	9
BDS XX17.3	Implement the fuzzy system based on the fuzzy rules	4	9
BDS XX17.4	Evaluate the fuzzy propositions and decomposition rules	4	9
BDS XX17.5	Generalize the genetic algorithm based on fuzzy rule	5	9

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Tulsiramji Gaikwad-Patil College of Engineering and Technology
Wardha Road, Nagpur-441108
NAAC Accredited (A+ Grade)
An Autonomous Institute affiliated to RTMNU Nagpur

Semester	Course Code	Name of Course
VI	BDSXX18	**Open Elective-II** Machine Learning and its Application

Pre-Requisites:

Teaching Scheme	
Lectures	4Hrs/week
Tutorial	0
Total Credit	4

Examination Scheme	
CT-1	15 Marks
CT-2	15 Marks
TA	10 Marks
ESE	60 Marks
Total	100 Marks
Duration of ESE: 03Hrs 00Min.	

Course Objective:

1	To understand the need for machine learning for various problem solving.
2	To study the various supervised, semi – supervised and unsupervised learning algorithms in machine learning.
3	To understand the latest trend in machine learning.

Course Contents

Unit I	**Introduction:** ML Techniques and overview, Version Space and Candidate Eliminations, Inductive Bias, Decision Tree Learning - Representation & Algorithm, Hypothesis Evaluation, Heuristic Space Search
Unit II	**Neural Networks and Genetic Algorithms** Neural Network Representation, Problems, Perceptron, Multilayer Networks and Back Propagation Algorithms, Genetic Algorithms, Model Evaluation and Learning
Unit III	**Bayesian and Computational Learning** Bayes Theorem, Concept Learning, Bayes Optimal Classifier, Gibbs Algorithm, Naive Bayes Classifier, Bayesian Belief Network, Probability Learning, Mistake bond Model, Support Vector Machine
Unit IV	**Instance Based Learning** K- Nearest Neighbor Learning, Locally Weighted Regression, Radial Basis Functions, Case Based Learning
Unit V	**Unsupervised Learning:** K means Clustering Algorithm, Reinforcement Learning, Elements of Reinforcement Learning, Exploration vs. Exploitation dilemma, Q – Learning.

Text Books

1	Tom M Mitchell, Machine Learning, McGraw – Hill Education (India) Private Limited, 2013.
2	Machine Learning: An Algorithmic Prespective, CRC Press, 2009, by Stephen Marsland

Reference Books

1	Ethem Adpaydin, Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004
2	Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies by John D. Kelleher, Brian Mac Namee, and Aoife D'Arcy

3	Machine Learning for Beginners, by Chris Sebastian, Kindle Edition
Useful Links	
1	https://nptel.ac.in/courses/106106139
2	https://onlinecourses.nptel.ac.in/noc23_cs18/preview

Course Outcomes		**CL**	**Class Session**
After the completion of this course, students will be able to-			
BDSXX18.1	Differentiate between supervised, unsupervised, semi supervised machine learning approaches	2	9
BDSXX18.2	Discuss the decision tree algorithm and identity and overcome the problems.	2	9
BDSXX18.3	Discuss and apply the back propagation algorithm and genetic algorithms to various problems.	2	9
BDSXX18.4	Apply the Bayesian concepts to machine learning	3	9
BDSXX18.5	Analyzes and suggest appropriate machine learning approaches for various types of problems.	4	9

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