



TEERTHANKER MAHAVEER UNIVERSITY

(Established under Govt. of U. P. Act No. 30, 2008)

Delhi Road, Moradabad (U.P)

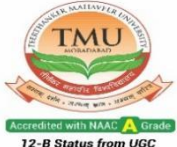
Website: www.tmu.ac.in

COURSE FILE

Faculty of Engineering

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Course Name	:	Neural Network
Course Code	:	ECS810
Faculty Member	:	Dr. Shalini Ninoria
Program	:	B.Tech CSE
Semester	:	VIII
Academic Year	:	2024-25

	Index	SESSION-2024-2025
		SEM- 8th Subject: Neural Network Code: ECS810 Dept. /Sec: CSE

Course&FacultyDetails	Page No.
Vision & Mission of the Institute	✓
Vision &Mission of Department	✓
Program Educational Objectives	✓
Program Specific Outcomes	✓
Program Outcomes	✓
Institute Academic Calendar	✓
Department Academic Calendar	✓
Course Evaluation Scheme	✓
Course Syllabus as per university	✓
Course Outcomes	✓
CO-PO Mapping	✓
CO-PO Mapping with Justification	✓
Lecture Plan & Course Coverage (E-Contents and Weblink)	✓
Time Table-Faculty	✓
Time Table-Sectionwise	✓
Student List(Sectionwise)	✓
List of Assignments/Quizzes	✓
Class Test Paper (CT1, CT2, and CT3)	✓
Class Test Marks (CT1, CT2, and CT3)	✓
Class Test Solution	✓
Assignments/Quizzes Solution	✓
Class Attendance Sheet (Month Wise)	✓
List of Slow Learner Students of Class test and action taken	✓
List of Fast Learner Students of Class test and action taken	✓
Previous Year Question Papers	
Question Bank	
Final Internal Marks	
End Semester Exam Analysis	
End Sem Question Paper	
Result & Analysis	
COAttainmentofEndSem	
DirectCOAttainment-CTs&EndSem	
IndirectCOAttainment-CourseExitSurvey	
OverallCOAttainment(DirectandIndirectAssessment)	
CourseFileClosureReport	

FACULTY OF ENGINEERING
B.Tech. CSE NBA Accreditation 2025

INSTITUTE

VISION

To be recognised as institute of excellence, promoting value based education in computer science and engineering with multidisciplinary research, innovation and consultancy services to the society.

MISSION

1. To provide holistic education through outcome based learning.
2. To promote interdisciplinary learning and research for serving the needs of entire global community.
3. To inculcate innovation in graduates using technological advancements for the development of computational solutions.
4. To prepare graduates to be continuous learners by inculcating people skills.

DEPARTMENT

VISION

To be recognised as department of excellence, promoting value-based education in computer science and engineering with multidisciplinary research, innovation and consultancy services to the society.

MISSION

1. To provide value based education by implementing outcome-based teaching and learning process.
2. To promote inter-disciplinary research that for serving the needs of entire global community.
3. To inculcate desire for innovation in graduates using technological advancements for the development of effective solutions.
4. To prepare graduates as continuous learners by inculcating professional skills and ethical responsibilities.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

1. **Fundamental:** To prepare the graduates for career and proficiency in Computer Science and Engineering.
2. **Industry Ready:** To imbibe technical and aptitude skills related to Computer Science and Engineering to provide the best solution to industrial and societal problems.
3. **Continuous Learning:** To prepare graduates for pursuing higher education and life-long learning.
4. **Entrepreneurship Skills:** To imbibe entrepreneurship, leadership, effective communication and business skills through innovation, incubation and start-up activities.
5. **Social and Moral Ethics:** To develop awareness among the graduates about the various social responsibilities related to engineering ethics, human values and ecological understanding.

PROGRAM-SPECIFIC OUTCOMES (PSO)

PSO–1: Developing skills for creating computational solutions with emerging technologies, programming languages, mathematical foundations, algorithmic principles and open source platforms to solve complex engineering problems.

PSO–2: Understanding the evolutionary changes in computing by applying standard practices and skills acquired through computer engineering to provide solutions with innovative ideas and interdisciplinary research.

PSO–3: Applying modern computer languages, environments, and platforms in creating innovative career paths to be an entrepreneur and pursue higher studies in their respective domains.

PROGRAM OUTCOMES FOR ENGINEERING:

PO – 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO – 2	Problem analysis& Solving: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO – 3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO – 4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO – 5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO – 6	Social Interaction & effective citizenship: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO – 7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO – 8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO – 9	Attitude (Individual and team work): Function effectively as an individual, and as member or leader in diverse teams, and in multidisciplinary settings.
PO – 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clean instructions.
PO – 11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO – 12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
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Academic Calendar



TEERTHANKER MAHAVEER UNIVERSITY

(Established under Govt. of U. P. Act No. 30, 2008)

Delhi Road, Moradabad (U.P)

Phone No.: +91 8218290992 Email : jointregistrar@tmu.ac.in
Ref. No : TMU/R.O./2024-25/Academic Calendar/001(R) Date : 23.12.2024

Circular

Subject: Revised Academic Calendar Session 2024-25 (Except Medical & Dental).

The Academic Calendar of the University for various programmes (except for Medical & Dental programmes) is proposed, herewith. The calendar is suggestive and the dates mentioned may change depending upon the unforeseen situations that may arise owing to causes beyond control.

For Semester System

For Semester System				
S. No.	Events/Particulars		Dates	
Odd Semester				
			For 1 st Year	For 2 nd Year Onwards
1	Course allocation and tagging on ERP for odd semester		July 15, 2024	July 15-20, 2024
2	Submission of time table and upload on ERP for odd Semester		July 25, 2024	
3	Upload of e-contents for odd semester on website		Up to July 31, 2024	
4	Commencement of classes	Nursing Programmes	August 01, 2024	August 01, 2024
		All other Programmes (Including Student Induction Program for 1-3 weeks, as applicable)	August 21, 2024	
5	Registration of semester course and open elective courses (if applicable) by the students	Nursing Programmes	August 01-05, 2024	August 01-05, 2024
		All other Programmes	August 21-30, 2024	
6	Sharing of Course Handouts with Students		August 30, 2024	
7	CT-I*	All Programmes and Programmes under NEP-2020 for batches admitted in session 2024-25	October 14-18, 2024	October 14-18, 2024
8	CT-II*	All Programmes except programmes under NEP-2020 for batches admitted in session 2024-25	November 18-22, 2024	November 18-22, 2024
9	End of odd semester Classes (For all programmes)		December 04, 2024	

10	CT-II*	All Programmes under NEP-2020 admitted in session 2024-25	December 05-10, 2024
11	CT-III*	All Programmes except programmes under NEP-2020 for batches admitted in session 2024-25	
12	Preparatory Leave		December 11-15, 2024
13	Doubt Clearing Sessions		December 16-24, 2024
14	Conduct of Odd semester Practical Examinations		December 26, 2024- December,31 2024 (As per the Schedule)
15	Conduct of Odd semester Theory Examinations		2 nd January 2025 onwards (As per the Schedule)
16	Declaration of results of odd semester End Examinations		Within 15 days of conduct of Examinations

Even Semester		
1	Course allocation and tagging on ERP for even semester	January 10, 2025
2	Submission of time table and upload on ERP for even Semester	January 20, 2025
3	Commencement of Even Semester classes (for all programmes)	January 27, 2025
4	Registration for semester course and open elective courses (if applicable) by the students	January 27-30, 2025
5	Upload of e-contents for Even semester on website	February 03, 2025
6	Sharing of Course Handouts with Students	February 03, 2025
7	CT-I* for all Programmes except programmes under NEP-2020 for batches admitted in session 2024-25	March 04-08, 2025
8	CT-I* for Programme under NEP-2020 for batches admitted in session 2024-25	April 08-12,2025
	CT-II* for all Programmes except programmes under NEP-2020 admitted in session 2024-25.	
9	End of Even Semester Classes	May 10, 2025
10	CT-II* Programme under NEP-2020 admitted in session 2024-25	May 12-15, 2025
	CT-III* for all Programmes except programmes under NEP-2020 for batches admitted in session 2024-25	
11	Preparatory Leave	May 16-19, 2025
12	Conduct of Even Semester Examinations	May 20 -June 10, 2025
13	Declaration of results of Even semester End Examinations	Within 15 days of conduct of examinations
14	Summer vacations/Internship (Wherever applicable)	June 11- July 31, 2025
15	Commencement of next academic session	August 01, 2025

For Annual System

S. No	Events/Particulars	Dates
1	Course allocation and tagging on ERP	July 01- July 15, 2024
2	Submission of time table and upload on ERP	July 15, 2024
3	Commencement of Classes 1 st year Nursing Students including induction programme (01 week) for newly admitted students.	August 01, 2024
	Commencement of Classes (2 nd Year onwards)	August 08, 2024
4	Registration of semester courses and open elective courses and backlogs (if any) by the students- 1 st Year Nursing Programmes	August 01-05, 2024
	Registration of semester courses and open elective courses and backlogs (if any) by the 1 st Year students (rest of the programmes)	August 08-30, 2024
	Registration of semester courses and open elective courses and backlogs (if any) by the students- (2 nd Year onwards)	August 08-12,2024
5	Sharing of Course Handouts with Students	August 30, 2024
6	Upload of e-contents on the website	Up to July 31, 2024
7	CT-I*	October 14-18, 2024
8	CT-II*	February 18-22, 2025
9	End of classes	May 05, 2025
10	CT-III*	May 06-10, 2025
11	Preparatory Leave	May 12-17, 2025
12	Conduct of Examinations	May 19-June 06, 2025
13	Declaration of Results	Within 15 days of conduct of examination
14	Summer Vacations	June 09-July 31, 2025
15	Commencement of next academic session	August 01, 2025

Notes-

1. * The CT of the concerned course should be conducted within the given window as per the scheduled time table. The Principals may draft the CT schedule according to the dates given by the concerned course faculty with maximum 2 CTs on a given date. Rest of the classes should remain unaffected with regard to teaching work.
 2. Student Induction program to be planned as per the guidelines of UGC, AICTE, INC or other statutory bodies as applicable.
 3. Academic Assignments including Internship/Education Tours/Training, wherever applicable, to be planned within the duration from end of last exam till the start of the next semester.
 4. 15 days orientation to Internship for Physiotherapy Students to be planned during summer break.
 5. Provision for supplementary examination, wherever applicable, to be made by the examination office and submitted to the competent authority for approval to schedule the same in line with the academic calendar.
- This is issued with the approval of Hon'ble Vice Chancellor


(Dr. Vaibhav Rastogi)
Dr. Vaibhav Rastogi
Joint Registrar
Teerthanker Mahaveer University
Moradabad

Copy to

- I
1. OSD to Hon'ble Chancellor for info. Please
2. P.S. to Hon'ble Chancellor for info. Please
3. P.S. to Hon'ble Group Vice Chairman for info. Please
4. Hon'ble Executive Director
5. Director (Administration)
6. Registrar
7. Director (Hospital Administration)
8. Director- Governance (Dental & Allied Health Sciences)
9. Director HR
10. Director (Accounts)
11. Director (Admissions)
12. Chief Warden
13. Chief Proctor
14. Finance Officer
15. Jt. Registrar (Alumni Relations)
16. Jt. Registrar (Administration)
17. Jt. Director (Security, Students Welfare & Admin.)
18. Jt. Director (TMU Entrance Test)
19. General Manager (IT)
20. Assistant Registrar (Registration & Migration)
21. Head (Social Media, Media, Digital Marketing & ERP)
22. Manager (Payroll)
23. Manager (Transport)
24. Hostel Warden(s)
25. Guard File

- II
1. Hon'ble Vice Chancellor
2. Dean (Academics)
3. Controller of Examinations
4. Deans/ Principals/ HoDs
5. Dean Students' Welfare
6. Director (IQAC)
7. Director (CTLD)
8. Associate Dean (R&D)
9. Associate Dean (Academics)
10. Associate Dean (Ph.D. Cell)
11. University Librarian
12. Joint Director (CRC)

Individual Faculty Time Table

ODD Semester Time Table (w.e.f. Sept. 2024)

Faculty Name: Dr. Shalini Ninoria

Mobile No: 9755223869

Session: 2024-25

Room NO: 1104

Day/ Timings	9:30 –10:25	10:30– 11:25	11:30-12:25	12:30-01:25	01:25-2:25	2:25-3:10	3:10-3:55
MON					L U N C H		ECS810
TUE				ECS810			
WED							
THU		ECS810					
FRI							
SAT							

Sr. No.	COURSE CODE	SEM	COURSE NAME	SECTION	ROOM NO. / LAB NO.	THEORY	TUTORIAL	LAB	CONTACT HRS.
1	ECS810	8	Neural Network		1104	3			3

Evaluation Scheme

Study & Evaluation Scheme

SUMMARY

Institute Name	Faculty of Engineering
Programme	Bachelor of Technology(Computer Science & Engineering)
Duration	Four Years full time(Eight Semesters)
Medium	English
Minimum Required Attendance	75%

Credits

Minimum Credits Required for Degree	186
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Assessment:

Evaluation			Internal	External	Total
Theory			40	60	100
Practical/ Dissertations/ Project Reports/ Viva-Voce			50	50	100
Class Test-1	Class Test-2	Class Test-3	Assignment(s)	Attendance & Participation	Total
Best two out of three					
10	10	10	10	10	40
Duration of Examination			External	Internal	
			3 Hours	1.5 Hours	

To qualify the course a student is required to secure a minimum of 45% marks in aggregate including the semester end examination and teachers continuous evaluation.(i.e. both internal and external).A candidate who secures less than 45% of marks in a course shall be deemed to have failed in that course. The student should have at least 45% marks in aggregate to clear the semester.

Evaluation of practical course [From Second Year Onwards]

Practical Courses Internal Evaluation (50 marks)

TWO EXPERIMENTS	ATTENDANCE	VIVA	TOTALINTERNAL
30	10	10	50

Practical Courses External Evaluation (50 marks)

TWO EXPERIMENTS	FILE WORK	VIVA	TOTALINTERNAL
30	10	10	50

Class participation 10 % (regular basis) and attendance

Individual Assignment 10% (after 20 sessions)

CT1 Exam	10 %	(Refer Academic Calendar)
CT2 Exam	10 %	(Refer Academic Calendar)
CT3 Exam	10 %	(Refer Academic Calendar)

Note: there is a consideration of best two CT's.

Syllabus

Neural Network

Course Code: ECS810 **B. Tech- Semester-VIII**

Course Outcomes:

On completion of the course, the students will be :

CO1. Understanding the human brain, role of neurons, neuroscience, neuro-computing and learning process in neurons

CO2. Understanding the basic models and functions of neurons & perceptrons

CO3. Analyzing the role of mean square and gradient descent algorithm for non linearly separable problems

CO4. Analyzing the model consisting of multilayer neurons using back propagation for better reliability and approximation

CO5. Applying the principal component, features of Recurrent network and temporal feed forward network and display their computer simulation

Course Content:

Unit-1:

Neuro computing and Neuroscience Historical notes, human Brain, neuron Mode, Knowledge representation, N.N Learning process: Supervised and unsupervised learning, Error correction learning, competitive learning, adaptation. **8 Hour**

Unit-2:

Basic Models of Artificial neurons, activation Functions, aggregation function, single neuron computation, multilayer perceptron, least mean square algorithm, gradient descent rule, nonlinearly separable problems in NN. **8 Hour**

Unit-3:

Multilayered network architecture, back propagation algorithm, heuristics for making BP algorithm performs better, approximation properties of RBF networks and comparison with multilayer perceptron. **8Hour**

Unit-4:

Recurrent network and temporal feed-forward network, implementation with BP, self organizing map and SOM algorithm, properties of feature map and computer simulation. Principal component and Independent component analysis. **8 Hour**

Unit-5:

Analyticity of activation function, Complexity analysis of network models, Soft computing, Neuro-Fuzzy-genetic algorithm Integration. **8 Hour**

Text Books:

A. Course Perspective

The Neural Network course introduces students to the fundamental principles of artificial neural networks, mimicking the human brain's functionality for intelligent computing. The course starts with an understanding of neuroscience, neurons, and learning processes, emphasizing both supervised and unsupervised learning techniques. Students will explore artificial neuron models, activation functions, and key algorithms like gradient descent for solving non-linearly separable problems. Advanced topics include multilayer perceptrons, backpropagation, radial basis function (RBF) networks, and their comparative analysis. Additionally, the course covers recurrent networks, self-organizing maps (SOMs), and temporal feed-forward networks for real-world applications. A significant focus is placed on analyzing network complexity, soft computing approaches, and Neuro-Fuzzy-genetic algorithm integration. By the end of the course, students will be equipped with both theoretical knowledge and practical skills to implement and optimize neural network architectures for various machine learning applications.

C. The Course Learning Outcomes (COs).

On completion of the course the participants will be able to:

CO1.	Understanding the human brain, role of neurons, neuroscience, neuro-computing and learning process in neurons
CO2.	Understanding the basic models and functions of neurons & perceptrons
CO3.	Analyzing the role of mean square and gradient descent algorithm for non linearly separable problems
CO4.	Analyzing the model consisting of multilayer neurons using back propagation for better reliability and approximation
CO5.	Applying the principal component, features of Recurrent network and temporal feed forward network and display their computer simulation

CO = Course Outcomes. (A student is expected to have learnt concepts and demonstrated/developed abilities or skills related to strategic management at the end of the course)

D. Course Outline

Unit-1: Neuro-computing and neuroscience historical notes, the human brain, neuron mode, knowledge representation, NN learning process: Supervised and unsupervised learning, error correction learning, competitive learning, adaptation.

Unit-2: Basic models of artificial neurons, activation functions, aggregation functions, single neuron computation, multilayer perceptron, least mean square algorithm, gradient descent rule, non-linearly separable problems in NN.

Unit-3: Multilayered network architecture, backpropagation algorithm, heuristics for making BP algorithm better, approximation properties of RBF networks, and comparison with multilayer perceptron.

Unit-4: Recurrent network and temporal feedforward network, implementation with BP, self-organizing maps and SOM algorithm, properties of feature maps, and computer simulation. Principal component and independent component analysis.

Unit-5: Analyticity of activation function, complexity analysis of network models, soft computing, Neuro-Fuzzy genetic algorithm integration.

E. LESSION PLAN:

Sessions Nos.	Topics	Pedagogy /Teaching Method	Book/Web References	Session outcome (Bloom's Taxonomy)	Course Outcome (COs)
1.	Neuro computing and Neuroscience Historical notes	C&T, S/P, GD	T1& R1	L1,L2	CO1
2.	Human Brain	C&T, S/P, GD	T1& R1	L1,L2	CO1
3.	Neuron Mode,	C&T, S/P, GD	T1& R1	L1,L2	CO1
4.	Knowledge representation	C&T, S/P, GD	T1& R2,	L1,L2	CO1
5.	N.N Learning process: Supervised and unsupervised learning	C&T, S/P, GD	T1& R2	L1,L2	CO1
6.	Error correction learning	C&T, S/P, GD	T1&R1,	L1,L2	CO1
7.	Competitive learning	C&T, S/P, GD	T1& R2	L1,L2	CO1
8.	Adaptation.	C&T, S/P, GD	T1& R1, R2	L1,L2,L4	CO1
9.	Basic Models of Artificial neurons	C&T, S/P, GD	T1& R1, R2	L3,L4,L5	CO2
10.	Activation Functions	C&T, S/P, GD	T1& R2	L3,L4,L5	CO2
11.	Aggregation function,	C&T, S/P, GD	T1 & R2	L3,L4,L5	CO2
12.	Single neuron computation	C&T, S/P, GD	T1& R2	L1,L2	CO2
13.	Multilayer perceptron	C&T, S/P, GD	T1 & R1, R2	L1,L2	CO2
14.	Least mean square algorithm	C&T, S/P, GD	T2 & R2	L4,L5	CO2
15.	Gradient descent rule	C&T, S/P, GD	T1 & R1, R2	L4,L5	CO3
16.	Non-linearly separable problems in NN.	C&T, S/P, GD	T1 & R2	L4,L5	CO3
17.	Multilayered network architecture	C&T, S/P, GD	T1 & R1, R2	L4,L5	CO3
18.	Backpropagation algorithm	C&T, S/P, GD	T1 & R1, R2	L4,L5	CO3
19.	Heuristics for making BP algorithm perform better	C&T, S/P, GD	T1 & R2	L4,L5	CO3
20.	Approximation properties of RBF networks	C&T, S/P, GD	T1 & R2	L4,L5	CO3
21.	Comparison with multilayer	C&T, S/P, GD	R1, R2	L1,L2	CO3

	perceptron				
22.	Recurrent network	C&T, S/P, GD	R1, R2	L1,L2	CO4
23.	Temporal feedforward network	C&T, S/P, GD	R1, R2	L1,L2,L5	CO4
24.	Implementation with BP,	C&T, S/P, GD	R1	L1,L2,L5	CO4
25.	self-organizing maps	C&T, S/P, GD	R1, R2	L1,L2	CO4
26.	SOM algorithm	C&T	T1 & R2	L1,L2	CO4
27.	Properties of feature maps,	C&T	R2	L1,L2,L5	CO4
28.	Computer simulation	C&T	R1, R2	L1,L2	CO4
29.	Principal component analysis	C&T	T1 & R2	L1,L2	CO4
30.	Independent component analysis	C&T	R2	L1,L2,L5	CO5
31.	Analyticity of activation function	C&T	T1 & R1	L4,L5	CO5
32.	Complexity analysis of network models	C&T, S/P, GD	R2, R1	L1,L2,L4	CO5
33.	Soft computing	C&T, S/P, GD	R1 & R2	L1,L2,L4	CO5
34.	Neuro-Fuzzy	C&T, S/P, GD	R1, R2	L1,L2,L4	CO5
35.	Neuro-Fuzzy genetic algorithm integration	C&T, S/P, GD	R2	L1,L2,L4	CO5
36.	Revision	C&T, S/P, GD	T1, R1, R2	L1, L2, L3, L4, L5	CO1, CO2, CO3, CO4, CO5
37.	Revision	C&T, S/P, GD	T1, R1, R2	L1, L2, L3, L4, L5	CO1, CO2, CO3, CO4, CO5
38.	Revision	C&T, S/P, GD	T1, R1, R2	L1, L2, L3, L4, L5	CO1, CO2, CO3, CO4, CO5
39.	Revision	C&T, S/P, GD	T1, R1, R2	L1, L2, L3, L4, L5	CO1, CO2, CO3, CO4, CO5
40.	Revision	C&T, S/P, GD	T1, R1, R2	L1, L2, L3, L4, L5	CO1, CO2, CO3, CO4, CO5

L1= Remember, L2= Understand, L3= Apply, L4= Analyze, L5= Evaluate and L6= Create

Pedagogy/Teaching Method:

C&T:-Chalk & Talk; S/P:-Slides/PPT;Videos; SEM: Seminar; Demo; CHART; ET/GL: Expert Talk/Guest Lecture; QUIZ; CPS: Class room problem solving; GD:-Group discussion; RTCS: Real time case studies; JAR:-Journal article review; PD:-Poster design; OL:-Online lecture/Google class room; Industrial Visit (IV), Assignment (ASG), Quiz/Puzzle (Q), Brain storming (BS), Think-Pair-Share (TPS), Certification(CERT), SIM: Simulation, P/G: Pledge/Greeting, Q/R: Quotes, references, LS: Literature Survey, RW: Report Writing, MM:Model making, PED: Professional/ethical dilemma, Coding, Activity/Event, FV: Filed Visit etc.

G. Alignment/Mapping of COs & POs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	CT-1	CT-2	CT-3	Assignment	Quiz	Semester End Theory Exam
CO1	✓		✓	✓		✓
CO2	✓		✓	✓		✓
CO3	✓	✓	✓	✓		✓
CO4		✓	✓	✓		✓
CO5		✓	✓	✓		✓

(b) Mapping /Alignment of COs with POs (Programme Articulation Matrix)

Programme Outcomes	CO1	CO2	CO3	CO4	CO5
PO 1	3	3	3	3	3
PO2	2	2	3	3	2
PO3	1	2	2	3	3
PO4	1	1	2	3	2
PO5	1	2	2	2	3
PO6					
PO7					
PO8					
PO9					
PO10					
PO11					
PO12	2	2	2	2	1

CO	PSO1	PSO2	PSO3
CO1	3	2	
CO2	3	2	
CO3	3	2	2
CO4	3	3	2
CO5	3	3	3

Justification of CO-PO Alignment Matrix

Course Name: Neural Network

Course Code: ECS810

PO/PSO No	Program Objective	Course Outcome	Relevance	Justification
PO1	Engineering Knowledge	CO1	High	Focuses on understanding neural network basics, architecture, and algorithms, requiring strong foundational knowledge in mathematics and engineering principles.
		CO2	High	Involves learning activation functions, network models, and concepts like bias and thresholds, rooted in engineering fundamentals.
		CO3	High	Covers learning laws (Hebbian, Delta, Perceptron, etc.) that rely on algorithmic foundations. .
		CO4	High	Application of backpropagation and gradient-based algorithms demands solid understanding of calculus and system design.
		CO5	High	Understanding PCA, recurrent networks, and temporal

				models builds upon engineering concepts.
PO2	Problem Analysis	CO1	Medium	Involves learning activation functions, network models, and concepts like bias and thresholds, rooted in engineering fundamentals.
		CO2	Medium	Involves learning activation functions, network models, and concepts like bias and thresholds, rooted in engineering fundamentals.
		CO3	High	Evaluates learning rules for given problem scenarios.
		CO4	High	Analyzes nonlinear problems using backpropagation and MLPs.
		CO5	Medium	Analyzes temporal behavior of data using dynamic neural models.
PO3	Design/Development of solutions	CO1	Low	Students design and evaluate learning models based on error analysis.
		CO2	Medium	Requires analytical thinking to evaluate compression effectiveness.
		CO3	Medium	Designs learning-based architectures using supervised/unsupervised models.
		CO4	High	Develops multi-layered neural architectures.
		CO5	High	Designs recurrent and PCA-based systems for temporal and feature-reduction tasks.
PO4	Conduct Investigations of Complex problems	CO1	Low	Involves analyzing gradient descent, backpropagation, .
		CO2	Low	Handling nonlinear separability, requiring in-depth problem-solving skills.
PO4	Conduct Investigations of Complex problems	CO3	Medium	Involves analysis of error performance and learning rates. Advanced topics (e.g., performance metrics, predictive coding, vector quantization) require students to interpret, compare, and test different approaches using investigative methods.
		CO4	High	Evaluates performance through experiments on classification problems.
			Medium	Experiments with real datasets to validate temporal models.

		CO5		
PO5	Modern Tool Usage	CO1	Low	Deal with mathematical models, algorithms, and architectures of neural networks requiring fundamental engineering knowledge using modern programming tools.
		CO2	Medium	Use of computational tools and frameworks to understand and simulate neural behavior enhances this CO.
		CO3	Medium	Uses software tools to simulate and verify learning models.
		CO4	Medium	Applies TensorFlow/Keras for simulation and evaluation.
		CO5	High	Utilizes deep learning frameworks to build and simulate temporal networks.
PO6	The Engineer and Society	CO1		
		CO2		
		CO3		
		CO4		
		CO5		
PO7	Environment and Sustainability	CO1		
		CO2		
		CO3		
		CO4		
		CO5		
PO8	Ethics	CO1		
		CO2		
		CO3		
		CO4		

		CO5		
PO9	Individual and Team Work	CO1		
		CO2		
		CO3		

		CO4		
		CO5		
PO10	Communication	CO1		
		CO2		
		CO3		
		CO4		
		CO5		
PO11	Project Management and Finance	CO1		
		CO2		
		CO3		
		CO4		
		CO5		
PO12	Life-Long Learning	CO1	Medium	Introduces rapidly evolving AI techniques, fostering continuous learning.
		CO2	Medium	Encourages learning of diverse activation functions and real-world relevance.
		CO3	Medium	Promotes understanding of advanced and alternative learning techniques.
		CO4	Medium	Encourages understanding of backpropagation variants and enhancements.
		CO5	Low	Promotes engagement with emerging deep learning techniques and architectures.

PSO	Course Outcome	Relevance	Justification
PSO1	CO1	High	Students gain fundamental computational skills through mathematical modeling of neurons.
	CO2	High	Develops capabilities in modeling neuron behavior computationally.
	CO3	High	Implements and validates multiple neural learning algorithms.
	CO4	High	Designs solutions using optimization and error feedback.
	CO5	High	Solves advanced AI problems using temporal models and feature reduction techniques.
PSO2	CO1	Medium	Explores historical development of neural models contributing to evolution in computing.
	CO2	Medium	Understands conceptual evolution in neural computation.
	CO3	Medium	A strong understanding of solid-state physics, including bonding in solids and semiconductors, forms the backbone of semiconductor technology, microprocessors, and chip design.
	CO4	High	Explores the evolution of multi-layer networks.
	CO5	High	Studies advanced architectures representing state-of-the-art computing models.
PSO3	CO1		
	CO2		
	CO3	Medium	Builds strong base for AI/ML careers or higher education.
	CO4	Medium	Prepares students for research or technical roles in deep learning.
	CO5	High	Equips students for industry or academia with hands-on simulation and model analysis.

Designed By Subject Faculty:

Faculty Signature

Faculty Signature

Reviewed By:

Approved/ Not Approved					
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Comments					
Role	Senior Subject Expert	Departmental Senior Faculty	Departmental Senior Faculty	Departmental Senior Faculty	Other Department Senior Faculty
Faculty Name					
Sig. with Date					

1 indicates the strength of correlation between CO and PO is Weak,

2 indicates the strength of correlation between CO and PO is Medium,

3 indicates the strength of correlation between CO and PO is High

H. Book and References

R-1: R.L. Harvey, *Neural Network Principles*, PHI

R-2: Kosko, *Neural Network and Fuzzy Sets*, PHI

Web references should be used from:

W-1: <https://nptel.ac.in/courses/106/106/106106184/>

W-2: <https://www.youtube.com/watch?v=O5xeyoRL95U>

E-contents Web Links

- University website subject notes link
 - <https://www.tmu.ac.in/college-of-computing-sciences-and-it/study-material>
- Personal google website link
 - <https://sites.google.com/view/vivekkc/home>

I. Additional Reading

Guidelines: The guidelines are available as record with the institution project based learning and departmental library rading.

J. Student's roles & responsibilities

Guidelines: All students must read these guidelines carefully and understand them fully

1. All students must be seated in the class within 05 minutes of the commencement of the session. The class room will be bolted from inside after this time period.
2. He/ She is expected to read all topics/cases etc. before coming to the class.
3. All students are expected to participate actively in discussions that take place in the class room.
4. He/ She will have to maintain regular attendance in classes as per University Ordinance.
5. He/ She will submit all types of assignments within given time frame.
6. He/ She will work in team & contribute to the team functions.
7. He/ She will be asked to teach in his/her class.
8. He/ She will actively engage himself/herself in all classroom activities. Student will be responsible him/herself for his/her absence.
9. He will come in the class properly dressed and neatly trimmed hair and clean shaven. The dress code is: As per university decided.

Student List

Course Name : Neural Network

Course Code : ECS810

S.No.	Univ. Roll No.	Name
1	TCA2109007	AKSHIT KUMAR
2	TCA2109009	AMAN BARANWAL
3	TCA2109016	ARPIT JAIN
4	TCA2109017	ARUN JAIN
5	TCA2109019	ASHMIT KUMAR SAXENA
6	TCA2109023	DEEPANSHU
7	TCA2109027	DIVYANSH POOTHIYA
8	TCA2109031	HARSH AGARWAL
9	TCA2109032	HARSH VISHNOI
10	TCA2109033	HARSH YADAV
11	TCA2109035	HIMANSHU KUMAR
12	TCA2109036	HIMANSHU VERMA
13	TCA2109038	KHUSHI SAXENA
14	TCA2109047	PALASH JAIN
15	TCA2109055	ROHIT KUMAR
16	TCA2109056	SAMEEP AGARWAL
17	TCA2109057	SAMYAK JAIN
18	TCA2109058	SANKET CHOUDHARY

19	TCA2109063	SHOBHIT RAJPUT
20	TCA2109065	SNEHA CHOUDHRY
21	TCA2109066	SUJAL KUMAR
22	TCA2109069	VIDIT VASHISTH
23	TCA2109071	WAJID ALI
24	TCA2109078	LAKSHY JAIN
25	TCA2109079	MOHD AMAAN
26	TCA2109081	GAYUR HUSSAIN
27	TCA2109082	ADARSH JAIN
28	TCA2159025	MOHD AZEEM
29	TCAM2211033	WAJID ALI
30	TCA2211002	AMAN KUMAR
31	TCA2211004	ANURAG TRIPATHI
32	TCA2211012	HARSHIT KAUSHIK
33	TCA2211027	SANDEEP SINGH
34	TCA2211028	SANDESH KUMAR SHAILLY
35	TCA2211030	SONU KUMAR
36	TCA2211032	TESU GAUR
37	TCA2211034	SUMIT SINGH

Class Test Papers

CT1



Faculty of Engineering

FIRST INTERNAL EXAMINATION (CT-1)

Program Name: B. Tech. (CSE)

Year: 4th	Semester: 8th	Academic Session: 2024-25
Course Code: ECS810	Course Name: Neural Network	
Duration: 90 minutes	Max. Marks: 30	

*Bloom Level {1-Remembering, 2-Understanding, 3-Appling, 4-Analyzing, 5-Evaluating, 6-Creating}

Attempt all questions.

Q.	SHORT QUESTION		MM	Unit	BTL	CO
1.	<u>Answer any five questions</u>					
	A.	What is Multilayer Perceptron?	(2)	II	II	II
	B.	What is the difference between supervised and unsupervised learning?	(2)	I	IV	I
	C.	Explain the PreRelu function.	(2)	II	I	II
	D.	What is the McCulloch-Pitts Model?	(2)	II	I	II
	E.	Explain the Structure and Function of Neurons.	(2)	I	II	I
	F.	Explain the AI Models that are Inspired by the Brain.	(2)	I	II	I
	G.	Explain the structure of the Human brain.	(2)	I	IV	I
	H.	Explain the CNNs.	(2)	II	II	II
LONG QUESTIONS						
2.	A	Explain neurocomputing and neuroscience in their historical context. Discuss the human brain and knowledge representation.	(10)	I	IV	I
	OR					
	B	Explain the least mean square algorithm and gradient descent rule.	(10)	I	III	I
3.	A	What is the neural network learning process?	(10)	II	IV	II
	OR					
	B	Explain the various activation and aggregation functions	(10)	II	III	II

CT2



Faculty of Engineering

FIRST INTERNAL EXAMINATION (CT-2)

Program Name: B. Tech. (CSE)

Year: 4th	Semester: 8th	Academic Session: 2024-25
Course Code: ECS810	Course Name: Neural Network	
Duration: 90 minutes	Max. Marks: 30	

*Bloom Level {1-Remembering, 2-Understanding, 3-Applying, 4-Analyzing, 5-Evaluating, 6-Creating}

Attempt all questions.

1.	SHORT QUESTION	MM	Unit	BTL	CO
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	Answer any five questions					
	A.	Explain the properties of feature maps	(2)	II	II	III
	B.	What is Principal Component Analysis (PCA) used for?	(2)	IV	IV	IV
	C.	What is a multilayered network architecture?	(2)	III	I	IV
	D.	What is the purpose of the backpropagation algorithm in neural networks?	(2)	III	I	IV
	E.	What is the main difference between a Radial Basis Function (RBF) network and a Multilayer Perceptron (MLP)?	(2)	III	II	III
	F.	What is a Recurrent Neural Network (RNN), and how does it differ from a feedforward network?	(2)	IV	II	IV
	G.	Explain the aggregation functions	(2)	II	IV	II
	H.	What is the supervised and unsupervised learning?	(2)	II	II	II
	LONG QUESTIONS					
2.	A.	Explain the gradient descent algorithm with a step-by-step example. How is it used to update weights in a neural network?	(10)	II	IV	III
	OR					
	B.	Describe the backpropagation algorithm in detail. Explain its role in training a multilayer perceptron (MLP).	(10)	III	III	IV
3.	A.	What is a Self-Organizing Map (SOM)? Explain its working principle and applications.	(10)	IV	IV	III
	OR					
	B.	Compare Principal Component Analysis (PCA) and Independent Component Analysis (ICA) in terms of their objectives and applications.	(10)	IV	III	IV

CT3



Faculty of Engineering

THIRD INTERNAL EXAMINATION (CT-3)

Program Name: B. Tech. (CSE)

Year: 4th	Semester: 8th	Academic Session: 2024-25
Course Code: ECS810	Course Name: Neural Network	
Duration: 90 minutes	Max. Marks: 30	

***Bloom's Taxonomy Level(BTL): {1-Remembering, 2-Understanding, 3-Applying, 4-Analyzing, 5-Evaluating, 6-Creating}**

1.	SHORT QUESTION		M M	Unit	BTL	CO
	<u>Answer any five questions</u>					
	A.	Explain the human Brain, and neuron Mode	(2)	I	II	I
	B.	What is Error correction learning, and competitive learning?	(2)	I	IV	I
	C.	What is an aggregation function, and single neuron computation?	(2)	II	I	II
	D.	What is the gradient descent rule?	(2)	II	I	II
	E.	What is the main difference between a Radial Basis Function (RBF) network and a Multilayer Perceptron (MLP)?	(2)	III	II	III
	F.	What is Multilayered network architecture?	(2)	III	II	III
	G.	Explain the temporal feed-forward network	(2)	IV	IV	IV
	H.	What is the Principal component and independent component analysis?	(2)	IV	II	IV
	LONG QUESTIONS					
2.	A.	What is a recurrent neural network (RNN), and how is it implemented using the backpropagation (BP) algorithm? Explain with an example.	(10)	II	IV	IV
	OR					
	B.	What is a Self-Organizing Map (SOM)? Describe the SOM algorithm and its key properties.	(10)	III	III	IV
3.	A.	What is the analyticity of an activation function, and why is it important in neural networks? Give an example of an analytic and a non-analytic activation function.	(10)	IV	IV	V
	OR					
	B.	What is Neuro-Fuzzy-Genetic Algorithm (GA) integration, and how is it used in soft computing applications? Give a simple example of its use.	(10)	IV	III	V



Solution Set for ECS810 Neural Networks - CT1 (2025)

Course Code: ECS810

Course Name: Neural Networks

Max Marks: 30

Duration: 90 Minutes

Academic Session: 2024–25

Bloom's Levels: 1–Remembering, 2–Understanding, 3–Applying, 4–Analyzing, 5–Evaluating, 6–Creating

Section A: Short Answer Questions (2 marks each)

(Bloom Levels: 1-Remembering, 2-Understanding, 3-Applying, 4-Analyzing, 5-Evaluating, 6-Creating)

A. What is a Multilayer Perceptron (MLP)?

Answer:

A **Multilayer Perceptron (MLP)** is a **feedforward artificial neural network (ANN)** that consists of multiple layers of interconnected neurons. It is designed to solve complex, non-linear problems by learning from labeled training data.

Key Components:

1. **Input Layer:**
 - Receives raw input features (e.g., pixel values in an image).
 - No computation occurs here; it merely passes data to the next layer.
2. **Hidden Layers:**
 - One or more layers between the input and output layers.
 - Each neuron applies a **weighted sum** of inputs followed by an **activation function** (e.g., ReLU, Sigmoid).
 - Enables the network to learn hierarchical representations (e.g., edges → shapes → objects in images).
3. **Output Layer:**
 - Produces the final prediction (e.g., class label in classification or continuous value in regression).
 - Activation function depends on the task:
 - **Sigmoid/Softmax** for classification.
 - **Linear** for regression.

Training Process:

- Uses **backpropagation** and **gradient descent** to minimize the loss function (e.g., Mean Squared Error, Cross-Entropy).
- Adjusts weights iteratively to reduce prediction error.

Advantages:

- Can approximate any continuous function (Universal Approximation Theorem).
- Suitable for both classification and regression tasks.

Limitations:

- Prone to overfitting (requires regularization like Dropout or L2 penalty).
- Computationally expensive for very deep networks.

Applications:

- Handwritten digit recognition (MNIST).
- Credit scoring in finance.

Bloom Level: II (Understanding)

B. Difference Between Supervised and Unsupervised Learning

Answer:

Aspect	Supervised Learning	Unsupervised Learning
Data Requirement	Requires labeled data (input-output pairs).	Uses unlabeled data (only input).
Objective	Predict outcomes (classification/regression).	Discover hidden patterns (clustering, dimensionality reduction).
Training Process	Model learns by comparing predictions to true labels.	Model infers structure from data without guidance.
Examples	Linear Regression, SVM, Neural Networks.	K-Means, PCA, Autoencoders.
Evaluation Metrics	Accuracy, Precision, Recall, MSE.	Silhouette Score, Reconstruction Error.

Example Scenarios:

- **Supervised:** Predicting house prices (regression) or spam detection (classification).
- **Unsupervised:** Customer segmentation (clustering) or topic modeling in text (Latent Dirichlet Allocation).

Bloom Level: I (Remembering)

C. Explain the PreReLU Function

Answer:

The **Parametric Rectified Linear Unit (PreReLU)** is an advanced activation function that generalizes the standard ReLU by introducing a learnable parameter α for negative inputs.

Mathematical Definition:

$$f(x) = \begin{cases} x & \text{if } x > 0 \\ \alpha x & \text{if } x \leq 0 \end{cases} \quad f(x) = \begin{cases} x & \text{if } x > 0 \\ \alpha x & \text{if } x \leq 0 \end{cases}$$

Key Properties:

1. **Adaptive Negatives:** Unlike ReLU (which outputs 0 for $x \leq 0$), PreReLU allows a small, learnable slope (α) for negative inputs.
2. **Mitigates "Dying ReLU":**
 - ReLU neurons can "die" (output 0 forever) if gradients become zero during training.
 - PreReLU avoids this by permitting gradient flow for negative inputs.
3. **Training Dynamics:**
 - α is updated via backpropagation (typically initialized to 0.25).
 - Balances sparsity and information retention.

Advantages Over ReLU:

- Better performance in deep networks (e.g., ImageNet classification).
- Robust to initialization and learning rates.

Limitations:

- Slightly higher computational cost due to the additional parameter.

Bloom Level: II (Understanding)

D. McCulloch-Pitts Model

Answer:

The **McCulloch-Pitts Neuron (1943)** is the **first computational model of a biological neuron**, laying the groundwork for modern neural networks.

Key Features:

1. **Binary Threshold Logic:**
 - Outputs **1** if the weighted sum of inputs $\sum w_i x_i \geq \theta$ (threshold), else **0**.
 - No activation function (step function).
2. **Deterministic:** No probabilistic or learning component.
3. **Limitations:**
 - Cannot learn from data (fixed weights).
 - Only solves linearly separable problems (e.g., AND/OR gates but not XOR).

Historical Significance:

- Inspired Rosenblatt's Perceptron (1958) and later backpropagation.
- Demonstrated that simple units could perform logical computations.

Bloom Level: II (Understanding)

Section B: Long Answer Questions (10 marks each)

2A. Neurocomputing & Neuroscience in Historical Context

Answer:

1. Historical Evolution of Neurocomputing:

- **1943:** McCulloch-Pitts model proposed binary neurons.
- **1958:** Frank Rosenblatt's Perceptron (first learning algorithm).
- **1969:** Minsky & Papert exposed Perceptron's limitations (XOR problem), leading to the "AI winter."
- **1986:** Backpropagation revived neural networks (Rumelhart & Hinton).
- **2010s:** Deep Learning boom (GPUs, big data, architectures like CNNs/RNNs).

2. Human Brain and Knowledge Representation:

- **Parallel Processing:** The brain processes information via ~86 billion neurons firing in parallel.
- **Synaptic Plasticity:**
 - **Hebbian Learning:** "Neurons that fire together, wire together."
 - Basis for weight updates in ANNs (e.g., gradient descent).
- **Hierarchical Representation:**
 - Visual cortex detects edges → shapes → objects (analogous to CNN layers).
 - Hippocampus encodes episodic memory (similar to RNNs).

3. AI Implications:

- **Distributed Representations:** Embeddings in word2vec/GPT mimic semantic memory.
- **Lifelong Learning:** Catastrophic forgetting remains a challenge (cf. brain's neurogenesis).

Bloom Level: IV (Analyzing)

2B. Least Mean Square (LMS) Algorithm & Gradient Descent

Answer:

1. Least Mean Square (LMS) Algorithm:

- **Objective:** Minimize the mean squared error (MSE) between predictions and targets.
- **Weight Update Rule:**

$$w_{new} = w_{old} + \eta \cdot (y - y^{\wedge}) \cdot x \quad w_{new} = w_{old} + \eta \cdot (y - y^{\wedge}) \cdot x$$

- η : Learning rate (step size).
- $y - y^{\wedge}$: Prediction error.
- **Applications:** Adaptive filters (noise cancellation), linear regression.

2. Gradient Descent:

- **Concept:** Iteratively adjust weights to minimize a loss function $J(w)$.
- **Update Rule:**

$$w := w - \eta \nabla J(w) \quad w := w - \eta \nabla J(w)$$

- $\nabla J(w)$: Gradient (direction of steepest ascent).
- **Variants:**
- **Stochastic GD (SGD):** Updates weights per sample (noisy but fast).
- **Mini-batch GD:** Balances speed and stability (e.g., batch size=32).

Comparison:

- LMS is a special case of SGD for linear models.
- Gradient descent generalizes to non-linear models (e.g., neural nets).

Bloom Level: I (Remembering), II (Understanding)

3A. Neural Network Learning Process

Answer:

1. Initialization:

- Weights initialized randomly (e.g., Xavier/Glorot initialization).

2. Forward Pass:

- Input propagates through layers:

$$z = Wx + b \text{ (weighted sum)}, a = f(z) \text{ (activation)} \quad z = Wx + b \text{ (weighted sum)}, a = f(z) \text{ (activation)}$$

3. Loss Computation:

- **Regression:** Mean Squared Error (MSE).
- **Classification:** Cross-Entropy Loss.

4. Backpropagation:

- Chain rule computes gradients layer-by-layer:

$$\frac{\partial J}{\partial w} = \frac{\partial J}{\partial a} \cdot \frac{\partial a}{\partial z} \cdot \frac{\partial z}{\partial w} \quad \frac{\partial J}{\partial w} = \frac{\partial J}{\partial a} \cdot \frac{\partial a}{\partial z} \cdot \frac{\partial z}{\partial w}$$

5. Weight Update:

- Optimizers (SGD, Adam) adjust weights:

$$w := w - \eta \frac{\partial J}{\partial w} \quad w := w - \eta \frac{\partial J}{\partial w}$$

Challenges:

- Vanishing/exploding gradients (solved via ReLU, BatchNorm).
- Overfitting (addressed by Dropout, L2 regularization).

Bloom Level: IV (Analyzing)

3B. Activation & Aggregation Functions

Answer:

1. Activation Functions:

- **Sigmoid:**
 - Range: (0, 1).
 - Issues: Vanishing gradients, not zero-centered.
- **ReLU:**
 - $f(x) = \max\{0, x\}$
 - Pros: Sparsity, faster convergence.
 - Cons: Dying ReLU.
- **Softmax:**
 - Normalizes outputs to probabilities (multi-class classification).

2. Aggregation Functions:

- **Summation:** $\sum w_i x_i$ (standard in dense layers).
- **Max-Pooling:**
 - Reduces spatial dimensions in CNNs.
 - Preserves dominant features (e.g., edges).

Role in Deep Learning:

- Non-linearities enable learning complex mappings.
- Pooling improves translation invariance.

Bloom Level: II (Understanding)



Solution Set for ECS810 Neural Networks – CT2 (2025)

Course Code: ECS810

Course Name: Neural Networks

Max Marks: 30

Duration: 90 Minutes

Academic Session: 2024–25

Bloom's Levels: 1–Remembering, 2–Understanding, 3–Applying, 4–Analyzing, 5–Evaluating, 6–Creating

Section A: Short Answer Questions (2 marks each)

(Bloom Levels indicated for each question)

A. Properties of Feature Maps

Answer:

Feature maps in CNNs have three key properties:

1. **Local Connectivity:** Each neuron connects only to a local region of the input (receptive field), reducing parameters.
2. **Weight Sharing:** The same filter/kernel slides across the input, detecting patterns regardless of position (translation invariance).
3. **Hierarchical Abstraction:**
 - Early layers detect edges/textures (low-level features).
 - Deeper layers recognize complex patterns (e.g., object parts).

Example: In AlexNet, the first convolutional layer generates 96 feature maps using 11×11 filters.

Bloom Level: II (Understanding)

B. Principal Component Analysis (PCA)

Answer:

PCA is used for:

1. **Dimensionality Reduction:** Projects data onto orthogonal axes (eigenvectors) of maximum variance.
 - Retains top k principal components (e.g., reducing 100D $\rightarrow$ 3D).
2. **Data Visualization:** Enables 2D/3D plots of high-dimensional datasets.
3. **Noise Reduction:** Discards low-variance components (assumed to be noise).

Math:

$$\text{Transformed Data} = \text{Original Data} \times \text{Eigenvector Matrix}$$

Bloom Level: IV (Analyzing)

C. Multilayered Network Architecture

Answer:

A multilayered network consists of:

1. **Input Layer:** Receives raw data (e.g., pixels).
2. **Hidden Layers:**
 - Multiple layers with nonlinear activation functions (e.g., ReLU).
 - Each layer transforms inputs into higher-level representations.
3. **Output Layer:** Produces predictions (e.g., Softmax for classification).

Key Benefit: Can approximate any continuous function (Universal Approximation Theorem).

Bloom Level: I (Remembering) + II (Understanding)

D. Backpropagation Algorithm

Answer:

Backpropagation:

1. **Purpose:** Computes gradients of the loss function w.r.t. weights for optimization.
2. **Steps:**
 - **Forward Pass:** Calculate predictions and loss.
 - **Backward Pass:** Apply chain rule to propagate errors layer-by-layer.
3. **Output:** Gradient updates for weights (used by optimizers like SGD).

Why Essential? Enables training of deep networks by efficiently distributing error corrections.

Bloom Level: I (Remembering) + II (Understanding)

E. RBF Network vs. MLP

Answer:

Aspect	RBF Network	MLP
Basis Function	Gaussian radial basis functions	Sigmoid/ReLU activations
Training	Faster (single hidden layer)	Slower (requires backpropagation)
Interpretability	Localized feature detection	Global feature learning

Use Case: RBF for interpolation problems, MLP for complex nonlinear tasks.

Bloom Level: II (Understanding)

F. Recurrent Neural Networks (RNNs)

Answer:

Definition: RNNs process sequential data via loops (hidden state persistence).

Differences from Feedforward Networks:

1. **Memory:** Maintains hidden state across time steps (for temporal dependencies).
2. **Architecture:** Input at step t depends on output at $t-1$.
3. **Applications:** Time-series prediction, NLP (e.g., LSTM for text generation).

Bloom Level: IV (Analyzing)

G. Aggregation Functions

Answer:

Aggregation functions combine inputs in neural networks:

1. **Summation:** Standard weighted sum $\sum w_i x_i$ (used in dense layers).
2. **Max-Pooling:** Selects maximum value in a window (reduces spatial dimensions in CNNs).
3. **Average-Pooling:** Computes mean over a region (smoother downsampling).

Purpose: Preserve critical features while reducing computational complexity.

Bloom Level: II (Understanding)

H. Supervised vs. Unsupervised Learning

Answer:

Aspect	Supervised Learning	Unsupervised Learning
Data	Labeled (input-output pairs)	Unlabeled (only inputs)
Goal	Predict outputs	Discover hidden patterns
Examples	Classification, Regression	Clustering, Dimensionality Reduction

Bloom Level: II (Understanding)

Section B: Long Answer Questions (10 marks each)

2A. Gradient Descent Algorithm

Answer:

Step-by-Step Process:

1. **Initialize Weights:** Random values (e.g., Gaussian distribution).
2. **Compute Loss:**
$$J(w) = \frac{1}{2N} \sum (y_i - \hat{y}_i)^2 \quad (\text{MSE})$$
3. **Calculate Gradients:**
$$\nabla J(w) = -\frac{1}{N} \sum x_i (y_i - \hat{y}_i)$$

4. Update Rule:

$$w := w - \eta \nabla J(w) \quad (\eta = \text{learning rate})$$

Neural Network Application:

- Backpropagation uses gradient descent to update weights layer-by-layer (chain rule).
- **Variants:**
 - **SGD:** Faster but noisy updates.
 - **Adam:** Adaptive learning rates.

Example: Updating weights in a 3-layer MLP for XOR classification.

Bloom Level: IV

2B. Backpropagation Algorithm in Multilayer Perceptrons (MLPs)

Answer:

1. Overview of Backpropagation

- **Purpose:** Computes gradients of the loss function with respect to all weights in the network for optimization.
- **Core Idea:** Applies the **chain rule** from calculus to distribute error corrections backward through layers.

2. Step-by-Step Process

Phase 1: Forward Pass

1. **Input Propagation:**
 - For each layer l , compute weighted sum $z_l = W_l a_{l-1} + b_l$.
 - Apply activation: $a_l = \sigma(z_l)$ (e.g., ReLU/Sigmoid).
2. **Final Output:**
 - At output layer L , compute loss J (e.g., MSE for regression).

Phase 2: Backward Pass

1. **Output Layer Error:**
 - Calculate error gradient:

$$\delta_L = \nabla_a J \odot \sigma'(z_L)$$

- $\odot$: Hadamard product; σ' : derivative of activation.
2. **Hidden Layer Errors (Backpropagate):**
 - For layer $l = L-1$ to 1 :

$$\delta_l = (W_{l+1})^T \delta_{l+1} \odot \sigma'(z_l)$$

3. **Weight Updates:**
 - Compute gradients for weights and biases:

$$\frac{\partial J}{\partial W_l} = \delta_l (a_{l-1})^T, \frac{\partial J}{\partial b_l} = \delta_l$$

- Update parameters via gradient descent:

$$W_l := W_l - \eta \frac{\partial J}{\partial W_l} \quad W_l := W_l - \eta \frac{\partial J}{\partial W_l}$$

3. Role in Training MLPs

- **Efficiency:** Avoids recomputing gradients for each weight individually.
- **Deep Learning Enabler:** Allows training of networks with hundreds of layers (e.g., ResNet).

4. Practical Example

- **Task:** Binary classification with 3-layer MLP (Input $\rightarrow$ Hidden $\rightarrow$ Output).
- **Activations:** ReLU (Hidden), Sigmoid (Output).
- **Loss:** Cross-entropy.
- **Backpropagation Steps:**
 1. Compute $\delta_3 = (a_3 - y)$ (output error).
 2. Backpropagate to hidden layer: $\delta_2 = (W_3)^T \delta_3 \odot \text{ReLU}'(z_2)$
 3. Update weights using $\eta = 0.01$

5. Common Challenges & Solutions

- **Vanishing Gradients:** Use ReLU/LeakyReLU or skip connections.
- **Overfitting:** Regularization (Dropout, L2).

Mathematical Formulation Key:

- Always show derivatives (e.g., $\sigma'(z)$).
- Explicitly link chain rule to weight updates.

Bloom Level:

- **I (Remembering):** Recall algorithm steps.
- **II (Understanding):** Explain gradient flow.
- **IV (Analyzing):** Debug vanishing gradients.

3A. Self-Organizing Maps (SOM)

Answer:

Working Principle:

1. **Competitive Learning:**
 - Input vector $\mathbf{x}$ activates the "winning" neuron (Best Matching Unit) with closest weights.

$$BMU = \arg \min_i \| \mathbf{x} - \mathbf{w}_i \|$$

2. **Cooperative Adaptation:**
 - BMU and neighbors update weights toward $\mathbf{x}$ (Gaussian neighborhood function).

$$\mathbf{w}_i := \mathbf{w}_i + \eta \cdot h(i, BMU) \cdot (\mathbf{x} - \mathbf{w}_i)$$

Applications:

- Customer segmentation (2D topology preserves market clusters).
- Missing data imputation (e.g., gene expression analysis).

Advantage: Preserves topological relationships unlike k-means.

Bloom Level: IV

3B. PCA vs. ICA

Answer:

Aspect	PCA	ICA
Objective	Maximize variance	Maximize statistical independence
Assumptions	Gaussian data	Non-Gaussian sources
Output	Orthogonal components	Independent components
Applications	Face recognition, Noise reduction	EEG signal separation, Blind source separation

Math Comparison:

- **PCA:** Diagonalizes covariance matrix ($\mathbf{X}^T\mathbf{X}$).
- **ICA:** Finds $\mathbf{W}$ such that $\mathbf{s} = \mathbf{W}\mathbf{x}$ ($\mathbf{s}$ = independent sources).

Bloom Level: IV



Solution Set for ECS810 Neural Networks – CT3 (2025)

Course Code: ECS810

Course Name: Neural Networks

Max Marks: 30

Duration: 90 Minutes

Academic Session: 2024–25

Bloom’s Levels: 1–Remembering, 2–Understanding, 3–Applying, 4–Analyzing, 5–Evaluating, 6–Creating

Section A: Short Answer Questions (2 marks each)

(Bloom Levels: I-Remembering, II-Understanding, IV-Analyzing)

A. Human Brain and Neuron Model

Answer:

The human brain comprises ~86 billion neurons with:

- **Dendrites:** Receive signals.
- **Soma:** Processes inputs (threshold: -55mV).
- **Axon:** Transmits outputs via synapses.

Artificial Neuron Model:

$y=f(\sum w_ix_i+b)$ (e.g., McCulloch-Pitts model)
 $y=f(\sum w_ix_i+b)$ (e.g., McCulloch-Pitts model)

Bloom Level: I

B. Error Correction vs. Competitive Learning

Answer:

Error Correction (Supervised)	Competitive Learning (Unsupervised)
Updates weights to minimize loss (e.g., MSE).	Neurons compete to respond to inputs (e.g., SOM).
Example: Backpropagation in MLPs.	Example: K-means clustering.

Bloom Level: IV

C. Aggregation Function & Single Neuron Computation

Answer:

- **Aggregation:** Sum of weighted inputs $z=\sum w_ix_i$
 $z=\sum w_ix_i$
 - **Neuron Output:** $y=\sigma(z+b)$
 $y=\sigma(z+b)$ (σ = activation, e.g., Sigmoid).
- Example:** Perceptron for AND gate ($w_1=1, w_2=1, b=-1.5$)
 $w_1=1, w_2=1, b=-1.5$.

Bloom Level: II

D. Gradient Descent Rule

Answer:

Updates weights to minimize loss $J(w)$
 $J(w)$:

$w:=w-\eta \nabla J(w)$
 $w:=w-\eta \nabla J(w)$

- **η :** Learning rate (e.g., 0.01).

- **$\nabla J(\mathbf{w})$:** Gradient of loss w.r.t. weights.

Types: SGD, Mini-batch.

Bloom Level: II

E. RBF Network vs. MLP

Answer:

RBF Network	MLP
Uses Gaussian activation.	Uses Sigmoid/ReLU.
Single hidden layer.	Multiple layers.
Faster training.	Slower but more expressive.

Bloom Level: II

F. Multilayered Network Architecture

Answer:

- **Input Layer:** Raw data (e.g., image pixels).
- **Hidden Layers:** Feature extraction (ReLU activation).
- **Output Layer:** Prediction (Softmax for classification).

Universal Approximation Theorem: MLPs can model any continuous function.

Bloom Level: II

G. Temporal Feed-Forward Network

Answer:

Processes sequential data via:

- **Time-Delayed Inputs:** $x(t), x(t-1), \dots, x(t), x(t-1), \dots$ fed to a feedforward network.
- **Applications:** Stock price prediction, speech recognition.

Bloom Level: IV

H. PCA vs. ICA

Answer:

PCA (Orthogonal)	ICA (Independent)
Maximizes variance.	Maximizes statistical independence.
Gaussian data assumption.	Non-Gaussian sources.

Example: PCA for facial recognition, ICA for EEG signal separation.

Bloom Level: IV

Section B: Long Answer Questions (10 marks each)

2A. Recurrent Neural Networks (RNNs) with Backpropagation

Answer:

1. RNN Architecture:

- Hidden state $h_t = \sigma(W_h h_{t-1} + W_x x_t + b)$
- Output $y_t = \text{Softmax}(W_y h_t)$

2. Backpropagation Through Time (BPTT):

- Unroll the network over time steps.
- Compute gradients w.r.t. shared weights W_h, W_x, W_y .
- Example: Language modeling ("The cat sat" → predict "on").

3. Challenges:

- Vanishing gradients (solved by LSTM/GRU).

Bloom Level: IV

2B. Self-Organizing Maps (SOMs)

Answer:

1. Algorithm:

1. **Competition:** Find BMU $\arg \min_i \|x - w_i\|$
2. **Cooperation:** Update BMU and neighbors:
 $w_i = w_i + \eta \cdot h(i, \text{BMU}) \cdot (x - w_i)$

(Gaussian neighborhood function h).

2. Properties:

- Topology preservation (2D maps for high-dim data).
- Unsupervised clustering (e.g., customer segmentation).

Bloom Level: II

3A. Analyticity of Activation Functions

Answer:

1. Analytic Functions:

- Infinitely differentiable (e.g., Sigmoid $\sigma'(z) = \sigma(z)(1 - \sigma(z))$).
- **Importance:** Ensures smooth gradient flow in backpropagation.

2. Non-Analytic Example: ReLU (not differentiable at $z=0$).

Bloom Level: IV

3B. Neuro-Fuzzy-GA Integration

Answer:

1. Integration:

- **Neural Networks:** Learning from data.
- **Fuzzy Logic:** Handles uncertainty (e.g., "warm" vs. "hot").
- **Genetic Algorithms:** Optimizes parameters (e.g., membership functions).

2. Application:

- **Smart Thermostat:**
 - NN learns user preferences.
 - Fuzzy rules adjust temperature.
 - GA optimizes energy efficiency.

Bloom Level: IV

Internal Award List

PROGRAM

:

B.TECH-(COMPUTER SCIENCE)

MAX. MARKS

:

40.00

SEMESTER

:

SEVENTH SEMESTER

SESSION

:

2024-25

COURSE

:

Neural Network

COURSE CODE

:

ECS810

COLLEGE

:

FACULTY OF ENGINEERING

DATE

:

16-April-2025

SL. NO.	ENROLLMENT NO.	STUDENT'S NAME	ASSESSMENT BASES					TOTAL OBTAINED MARKS	
			CT1	CT2	CT3	ASN	ATT	IN FIGURE	IN WORDS
MARKS			10.00	10.00	10.00	10.00	10.00	40.00	FOURTY
1	TCA2109007	AKSHIT KUMAR	ABS	21.5		10	10		

2	TCA2109009	AMAN BARANWAL	ABS	26.5		10	10		
3	TCA2109016	ARPIT JAIN	ABS	ABS		8	9		
4	TCA2109017	ARUN JAIN	26	25.5		10	10		
5	TCA2109019	ASHMIT KUMAR SAXENA	ABS	24		9	9		
6	TCA2109023	DEEPANSHU	21	22		8	9		
7	TCA2109027	DIVYANSH POOTHIYA	20	ABS		8	9		
8	TCA2109031	HARSH AGARWAL	21	22		9	10		
9	TCA2109032	HARSH VISHNOI	21	22.5		9	10		
10	TCA2109033	HARSH YADAV	ABS	18		8	9		
11	TCA2109035	HIMANSHU KUMAR	ABS	20.5		9	8		
12	TCA2109036	HIMANSHU VERMA	24	25		10	10		
13	TCA2109038	KHUSHI SAXENA	18.5	19.5		8	9		
14	TCA2109047	PALASH JAIN	19	ABS		9	9		
15	TCA2109055	ROHIT KUMAR	24.5	22.5		10	10		
16	TCA2109056	SAMEEP AGARWAL	26.5	26.5		10	10		
17	TCA2109057	SAMYAK JAIN	22	ABS		9	9		
18	TCA2109058	SANKET CHOUDHARY	ABS	ABS		8	9		
19	TCA2109063	SHOBHIT RAJPUT	ABS	15		8	9		
20	TCA2109065	SNEHA CHOUDHRY	19.5	24.5		9	9		
21	TCA2109066	SUJAL KUMAR	ABS	ABS		8	9		
22	TCA2109069	VIDIT VASHISTH	23	ABS		9	9		
23	TCA2109071	WAJID ALI	ABS	ABS		8	9		

24	TCA2109078	LAKSHY JAIN	23.5	23.5		10	10		
25	TCA2109079	MOHD AMAAN	25.5	ABS		10	10		
26	TCA2109081	GAYUR HUSSAIN	23.5	ABS		10	10		
27	TCA2109082	ADARSH JAIN	22	ABS		9	9		
28	TCA2159025	MOHD AZEEM	21.5	24		9	9		
29	TCAM2211033	WAJID ALI	23	23		10	10		
30	TCA2211002	AMAN KUMAR	ABS	ABS		8	9		
31	TCA2211004	ANURAG TRIPATHI	18.5	21.5		9	9		
32	TCA2211012	HARSHIT KAUSHIK	19.5	ABS		9	9		
33	TCA2211027	SANDEEP SINGH	18	ABS		8	9		
34	TCA2211028	SANDESH KUMAR SHAILLY	ABS	ABS		8	9		
35	TCA2211030	SONU KUMAR	19.5	ABS		8	9		
36	TCA2211032	TESU GAUR	ABS	24.5		10	10		
37	TCA2211034	SUMIT SINGH	19	ABS		9	9		

PROGRAM : B.TECH-COMPUTER SCIENCE
(LATERAL)

SEMESTER : SEVENTH SEMESTER

COURSE : Neural Network

MAX. MARKS : 40.00

SESSION : 2024-25

COURSE CODE : ECS810

SL. NO.	ENROLLMENT NO.	STUDENT'S NAME	ASSESSMENT BASES					TOTAL OBTAINED MARKS	
			CT1	CT2	CT3	ASN	ATT	IN FIGURE	IN WORDS
MARKS			10.00	10.00	10.00	10.00	10.00	40.00	FOURTY
1									
2									
3									
4									
5									

Identification of Slow Learners after CT1

1	TCA2109016	ARPIT JAIN	ABS
2	TCA2109047	PALASH JAIN	19
3	TCA2109066	SUJAL KUMAR	ABS
4	TCA2109071	WAJID ALI	ABS
5	TCA2211002	AMAN KUMAR	ABS
6	TCA2211028	SANDESH KUMAR SHAILLY	ABS

Identification of Slow Learners after CT2

1.	TCA2109016	ARPIT JAIN	ABS
2.	TCA2109047	PALASH JAIN	ABS
3.	TCA2109066	SUJAL KUMAR	ABS

4.	TCA2109071	WAJID ALI	ABS
5.	TCA2211002	AMAN KUMAR	ABS
6.	TCA2211028	SANDESH KUMAR SHAILLY	ABS

Special classes with attendance sheet of slow learners with ATR after CT-I

- Topics have been identified for slow learners after CT-1 as given below
 - Production System
 - Heuristic Search Techniques
- After special/remedial classes circular, classes had been taken as per below attendance sheet

Attendance Sheet

Classes for Slow Learners After First CT			Date/Month			
S.NO.	Enrollment No.	Name	13/03	17/03	18/03	20/03
1	TCA2109016	ARPIT JAIN	0	1	1	0
2	TCA2109047	PALASH JAIN	1	1	1	1
3	TCA2109066	SUJAL KUMAR	1	0	0	1
4	TCA2109071	WAJID ALI	0	1	1	1
5	TCA2211002	AMAN KUMAR	0	0	1	0
6	TCA2211028	SANDESH KUMAR SHAILLY	0	1	1	0

Classes for Slow Learners After First CT			Date/Month			
S.NO.	Enrollment No.	Name	14/04	15/04	17/04	21/04
1	TCA2109016	ARPIT JAIN	1	1	1	1
2	TCA2109047	PALASH JAIN	1	1	1	1
3	TCA2109066	SUJAL KUMAR	1	1	0	1
4	TCA2109071	WAJID ALI	1	1	1	0

5	TCA2211002	AMAN KUMAR	1	1	1	1
6	TCA2211028	SANDESH KUMAR SHAILLY	1	1	1	0

Special classes with attendance sheet of slow learners with ATR after CT-II

- Topics have been identified for slow learners after CT-2 as given below
 - Propositional Logic
 - Slot and Filler
 - Semantic Net
- After special/remedial classes circular, classes had been taken as per below attendance sheet

Special classes with attendance sheet of slow learners with ATR after CT-III

- Topics have been identified for slow learners after CT-3 as given below
 - Basic Programming in Prolog
 - List and Arrays in Prolog
- After special/remedial classes circular, classes had been taken as per below attendance sheet



Faculty of Engineering

Assignment -1

Program Name: B. Tech. (CSE)

Year :4th	Semester: 8th		Academic Session: 2024-25
Course Code: ECS810	Course Name: Neural Network		

		Max. Marks: 20
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*Bloom Level {1-Remembering, 2-Understanding, 3-Applying, 4-Analyzing, 5-Evaluating, 6-Creating}

Attempt all questions.

	Note: Attempt all question	MM	Unit	BTL	CO
Q1.	What is the difference between neuro-computing and neuroscience?	1	1	2	1
Q2.	Explain the basic structure of a biological neuron.	1	1	2	1
Q3.	What is knowledge representation in neural networks?	1	1	4	1
Q4.	Define error correction learning with an example.	1	1	3	1
Q5.	How does competitive learning work in neural networks?	1	1	4	1
Q6.	Compare and contrast supervised and unsupervised learning with real-world examples.	3	1	4	1
Q7.	Describe the different adaptation mechanisms in neural networks.	3	1	5	1
Q8.	Explain how the human brain processes information and its comparison with artificial neural networks.	3	1	4	1
Q9.	Discuss the historical development of neural networks and their impact on modern AI.	3	1	4	1
Q10.	Explain the different learning processes in neural networks and discuss their significance in artificial intelligence applications.	3	1	5	1



Faculty of Engineering

Assignment -2

Program Name: B. Tech. (CSE)

Year :4th	Semester: 8th	Academic Session: 2024-25
Course Code: ECS810	Course Name: Neural Network	
		Max. Marks: 20

*Bloom Level {1-Remembering, 2-Understanding, 3-Applying, 4-Analyzing, 5-Evaluating, 6-Creating}

Attempt all questions.

		MM	Unit	BTL	CO
Q1.	What is an artificial neuron, and how does it differ from a biological neuron?	1	2	2	2
Q2.	Define an activation function and list three commonly used activation functions in neural networks.	1	2	3	2
Q3.	What is the role of an aggregation function in an artificial neuron?	1	2	2	2
Q4.	Explain why single-layer perceptrons cannot solve non-linearly separable problems.	1	2	3	2
Q5.	What is the significance of the least mean square (LMS) algorithm in neural networks?	1	2	2	2
Q6.	Describe the architecture of a multilayer perceptron (MLP) and explain how it improves upon a single-layer perceptron.	3	2	4	2
Q7.	Explain the gradient descent rule in neural networks. What are its advantages and limitations?	3	2	4	2

Q8.	How do different activation functions impact the learning process in neural networks? Compare sigmoid, ReLU, and tanh activation functions.	3	2	5	2
Q9.	What is the least mean square algorithm? Explain its mathematical formulation and application in training neural networks.	3	2	5	2
Q10.	Discuss the concept of non-linearly separable problems in neural networks. How do multilayer perceptrons help in solving such problems?	3	2	5	2



Faculty of Engineering

Assignment -3

Program Name: B. Tech. (CSE)

Year :4 th	Semester: 8 th		Academic Session: 2024-25
Course Code: ECS810	Course Name: Neural Network		
		Max. Marks: 20	

*Bloom Level {1-Remembering, 2-Understanding, 3-Applying, 4-Analyzing, 5-Evaluating, 6-Creating}

Attempt all questions.

		MM	Unit	BTL	CO
Q1.	What is a multilayered network architecture in neural networks?	1	3	2	3
Q2.	Define the backpropagation algorithm and its primary objective.	1	3	2	3
Q3.	How do heuristics help in improving the backpropagation algorithm?	1	3	3	3
Q4.	What are Radial Basis Function (RBF) networks, and how do they differ from perceptrons?	1	3	2	3

Q5.	Mention one key difference between RBF networks and multilayer perceptrons (MLPs).	1	3	1	3
Q6.	Explain the backpropagation algorithm in detail, including the steps involved in weight updates.	3	3	5	3
Q7.	What are the major challenges in the backpropagation algorithm, and how can they be addressed using heuristics?	3	3	4	3
Q8.	Describe the approximation properties of Radial Basis Function(RBF) networks and their significance in function approximation.	3	3	5	3
Q9.	Compare Radial Basis Function (RBF) networks with Multilayer Perceptrons (MLPs) in terms of architecture, learning methods, and applications.	3	3	5	3
Q10.	Discuss how a multilayered network architecture improves learning and generalization compared to a single-layer network.	3	3	4	3



Faculty of Engineering

Assignment -4

Program Name: B. Tech. (CSE)

Year : 4 th	Semester: 8 th	Academic Session: 2024-25
Course Code: ECS810	Course Name: Neural Network	
		Max. Marks: 20

*Bloom Level {1-Remembering, 2-Understanding, 3-Appling, 4-Analyzing, 5-Evaluating, 6-Creating}

Attempt all questions.

		MM	Unit	BTL	CO
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Q1.	What is a Recurrent Neural Network (RNN), and how does it differ from a feedforward network?	1	4	2	4
Q2.	Define a temporal feedforward network and its key applications.	1	4	2	4
Q3.	What is the role of backpropagation in implementing recurrent networks?	1	4	2	4
Q4.	What are Self-Organizing Maps (SOMs), and how do they function?	1	4	2	4
Q5.	List two important properties of feature maps in Self-Organizing Maps (SOMs).	1	4	1	4
Q6.	Explain the Self-Organizing Map (SOM) algorithm with its steps and working principles.	3	4	2	4
Q7.	Describe the process of implementing a Recurrent Neural Network (RNN) using backpropagation through time.	3	4	3	4
Q8.	What are the key properties of feature maps, and how do they help in unsupervised learning?	3	4	4	4
Q9.	Compare Principal Component Analysis (PCA) and Independent Component Analysis in terms of their objectives and applications.	3	4	5	4
Q10.	Discuss the role of computer simulation in training and evaluating Self-Organizing Maps (SOMs).	3	4	5	4



Faculty of Engineering

Assignment -5

Program Name: B. Tech. (CSE)

Year : 4th	Semester: 8th	Academic Session: 2024-25
Course Code: ECS810	Course Name: Neural Network	
		Max. Marks: 20

*Bloom Level {1-Remembering, 2-Understanding, 3-Applying, 4-Analyzing, 5-Evaluating, 6-Creating}

Attempt all questions.

		MM	Unit	BTL	CO
Q1.	What does analyticity of an activation function mean in the context of neural networks?	1	5	2	5

Q2.	How is complexity analysis performed for neural network models?	1	5	2	5
Q3.	What are the key components of soft computing?	1	5	1	5
Q4.	Define the role of fuzzy logic in neuro-fuzzy systems.	1	5	2	5
Q5.	What is the significance of genetic algorithms in optimizing neural networks?	1	5	2	5
Q6.	Explain the importance of analyticity in activation functions and provide examples of analytic and non-analytic activation functions.	3	5	4	5
Q7.	Discuss the methods used for complexity analysis of neural network models, including time and space complexity.	3	5	4	5
Q8.	Describe the concept of Neuro-Fuzzy integration and its applications in machine learning.	3	5	4	5
Q9.	Explain how genetic algorithms are used for optimizing neural networks, and compare them with gradient-based optimization techniques.	3	5	6	5
Q10.	Discuss the relationship between soft computing techniques (Neural Networks, Fuzzy Logic, and Genetic Algorithms) and how they can be integrated to solve complex problems.	3	5	5	5

Attendance Sheet (Month-wise)

Attendance for the month of Feb 2024

		Day	11	14	17	18	20	24	25
		Month	Feb	Feb	Feb	Feb	Feb	Feb	Feb
Sl.	Enrollment No.	Student Name	1	1	1	1	1	1	0
1	TCA2109007	AKSHIT KUMAR	1	1	1	1	1	1	1
2	TCA2109009	AMAN BARANWAL	1	1	1	1	1	1	1
3	TCA2109016	ARPIT JAIN	1	1	1	1	1	0	1
4	TCA2109017	ARUN JAIN	1	1	1	1	1	1	1
5	TCA2109019	ASHMIT KUMAR SAXENA	1	1	1	0	1	1	1
6	TCA2109023	DEEPANSHU	1	1	1	1	1	1	1
7	TCA2109027	DIVYANSH POOTHIYA	1	1	1	1	1	1	1
8	TCA2109031	HARSH AGARWAL	1	1	1	1	1	1	1
9	TCA2109032	HARSH VISHNOI	1	1	1	1	1	1	1
10	TCA2109033	HARSH YADAV	1	1	1	1	1	1	1
11	TCA2109035	HIMANSHU KUMAR	1	0	1	1	1	1	1
12	TCA2109036	HIMANSHU VERMA	1	1	1	1	1	1	1
13	TCA2109038	KHUSHI SAXENA	1	1	1	1	1	1	1
14	TCA2109047	PALASH JAIN	1	1	1	1	1	1	1
15	TCA2109055	ROHIT KUMAR	1	1	1	1	1	1	1
16	TCA2109056	SAMEEP AGARWAL	1	1	1	1	1	0	1
17	TCA2109057	SAMYAK JAIN	1	1	1	1	1	1	1
18	TCA2109058	SANKET CHOUDHARY	1	1	1	0	1	1	1
19	TCA2109063	SHOBHIT RAJPUT	1	1	1	1	1	1	1
20	TCA2109065	SNEHA CHOUDHRY	1	1	1	1	1	1	1
21	TCA2109066	SUJAL KUMAR	1	1	1	1	1	1	1

22	TCA2109069	VIDIT VASHISTH	1	1	1	1	1	1	1
23	TCA2109071	WAJID ALI	1	1	1	1	1	1	1
24	TCA2109078	LAKSHY JAIN	1	1	1	1	1	1	1
25	TCA2109079	MOHD AMAAN	1	1	1	1	1	1	1
26	TCA2109081	GAYUR HUSSAIN	1	1	1	1	1	1	1
27	TCA2109082	ADARSH JAIN	1	1	1	1	1	1	1
28	TCA2159025	MOHD AZEEM	1	1	1	1	1	1	1
29	TCAM2211033	WAJID ALI	1	1	1	1	1	1	1
30	TCA2211002	AMAN KUMAR	1	1	1	1	1	1	1
31	TCA2211004	ANURAG TRIPATHI	1	1	1	1	1	1	1
32	TCA2211012	HARSHIT KAUSHIK	1	1	1	1	1	1	1
33	TCA2211027	SANDEEP SINGH	1	1	0	1	1	1	1
34	TCA2211028	SANDESH KUMAR SHAILLY	1	1	1	1	1	1	1
35	TCA2211030	SONU KUMAR	1	1	1	1	1	1	1
36	TCA2211032	TESU GAUR	1	1	1	1	1	1	1
37	TCA2211034	SUMIT SINGH	1	1	1	1	1	1	0

Attendance for the month of March 2024

		Day	3	10	11	13	17	18	20	24	25	27
		Month	March	March	March	March	March	March	March	Mar	Mar	Mar
Sl.	Enrollment No.	Student Name	1	1	1	0	1	1	0	1	1	1
1	TCA2109007	AKSHIT KUMAR	1	1	1	0	1	1	0	1	1	1
2	TCA2109009	AMAN BARANWAL	1	1	1	0	1	1	0	1	1	1
3	TCA2109016	ARPIT JAIN	1	1	1	0	1	1	0	1	1	1

4	TCA2109017	ARUN JAIN	1	1	1	0	1	1	0	1	1	1
5	TCA2109019	ASHMIT KUMAR SAXENA	1	1	1	0	1	1	0	1	1	1
6	TCA2109023	DEEPANSHU	1	1	1	0	1	1	0	1	1	1
7	TCA2109027	DIVYANSH POOTHIYA	1	1	1	0	1	1	0	1	1	1
8	TCA2109031	HARSH AGARWAL	1	1	1	1	1	1	0	1	1	1
9	TCA2109032	HARSH VISHNOI	1	1	1	1	1	1	0	1	1	0
10	TCA2109033	HARSH YADAV	1	1	1	1	0	1	0	1	0	0
11	TCA2109035	HIMANSHU KUMAR	1	1	1	1	1	1	0	1	1	1
12	TCA2109036	HIMANSHU VERMA	1	1	1	1	1	1	1	1	1	1
13	TCA2109038	KHUSHI SAXENA	1	1	1	1	1	1	1	1	0	0
14	TCA2109047	PALASH JAIN	1	1	1	1	1	1	1	1	0	1
15	TCA2109055	ROHIT KUMAR	1	1	1	1	1	1	1	1	1	1
16	TCA2109056	SAMEEP AGARWAL	1	1	1	1	1	1	1	1	1	1
17	TCA2109057	SAMYAK JAIN	1	1	1	1	0	1	1	0	0	1
18	TCA2109058	SANKET CHOUDHARY	1	1	1	1	1	1	1	1	1	1
19	TCA2109063	SHOBHIT RAJPUT	1	1	1	1	1	1	1	1	1	1
20	TCA2109065	SNEHA CHOUDHRY	1	1	1	1	0	0	1	1	1	0
21	TCA2109066	SUJAL KUMAR	1	1	1	1	1	1	1	0	1	1
22	TCA2109069	VIDIT VASHISTH	1	1	1	0	1	1	1	1	1	1
23	TCA2109071	WAJID ALI	1	1	1	0	1	1	1	1	1	1
24	TCA2109078	LAKSHY JAIN	1	1	1	0	1	1	1	1	0	1
25	TCA2109079	MOHD AMAAN	1	1	1	0	1	1	1	1	1	1
26	TCA2109081	GAYUR HUSSAIN	1	1	1	0	1	1	0	1	1	1
27	TCA2109082	ADARSH JAIN	1	1	1	0	1	1	0	1	1	1
28	TCA2159025	MOHD AZEEM	1	1	1	0	1	1	0	1	1	0
29	TCAM2211033	WAJID ALI	1	1	1	0	0	1	0	1	1	1

30	TCA2211002	AMAN KUMAR	1	1	1	0	1	1	0	1	1	1
31	TCA2211004	ANURAG TRIPATHI	1	1	1	0	1	1	0	1	1	1
32	TCA2211012	HARSHIT KAUSHIK	1	1	1	0	1	1	0	1	1	1
33	TCA2211027	SANDEEP SINGH	1	1	1	0	1	1	0	1	0	1
34	TCA2211028	SANDESH KUMAR SHAILLY	1	1	1	0	0	1	0	1	1	1
35	TCA2211030	SONU KUMAR	1	1	1	0	1	1	0	1	0	1
36	TCA2211032	TESU GAUR	1	1	1	0	1	1	0	1	1	1
37	TCA2211034	SUMIT SINGH	1	1	1	0	1	1	0	1	1	1

Attendance for the month of April 2024

		Day	1	7	14	15	17	21	22	29
		Month	April	April	April	April	April	April	April	April
Sl.	Enrollment No.	Student Name								
1	TCA2109007	AKSHIT KUMAR	1	1	1	1	0	0	1	1
2	TCA2109009	AMAN BARANWAL	1	1	1	1	0	1	1	1
3	TCA2109016	ARPIT JAIN	1	1	1	1	1	1	1	0
4	TCA2109017	ARUN JAIN	1	1	1	1	1	1	1	1
5	TCA2109019	ASHMIT KUMAR SAXENA	1	1	1	1	1	1	0	1
6	TCA2109023	DEEPANSHU	1	1	1	1	1	0	1	1
7	TCA2109027	DIVYANSH POOTHIYA	1	1	1	1	0	1	1	1
8	TCA2109031	HARSH AGARWAL	1	1	1	1	1	0	1	1
9	TCA2109032	HARSH VISHNOI	0	1	0	1	1	0	1	0
10	TCA2109033	HARSH YADAV	1	1	1	1	0	1	0	1
11	TCA2109035	HIMANSHU KUMAR	1	1	1	1	1	1	1	1
12	TCA2109036	HIMANSHU VERMA	1	1	1	1	1	1	1	0
13	TCA2109038	KHUSHI SAXENA	1	1	1	1	0	0	1	1

14	TCA2109047	PALASH JAIN	1	1	1	1	1	1	1	0
15	TCA2109055	ROHIT KUMAR	0	1	1	1	1	0	0	1
16	TCA2109056	SAMEEP AGARWAL	0	0	1	1	0	1	1	1
17	TCA2109057	SAMYAK JAIN	1	1	1	1	0	1	0	1
18	TCA2109058	SANKET CHOUDHARY	1	1	0	1	1	0	1	1
19	TCA2109063	SHOBHIT RAJPUT	1	1	1	1	0	1	0	1
20	TCA2109065	SNEHA CHOUDHRY	1	0	0	1	1	0	1	1
21	TCA2109066	SUJAL KUMAR	0	1	1	1	0	1	1	1
22	TCA2109069	VIDIT VASHISTH	0	1	1	1	1	0	1	1
23	TCA2109071	WAJID ALI	1	1	1	1	1	0	0	1
24	TCA2109078	LAKSHY JAIN	0	1	1	1	1	1	0	1
25	TCA2109079	MOHD AMAAN	1	1	1	1	1	1	1	1
26	TCA2109081	GAYUR HUSSAIN	1	1	1	1	1	1	0	1
27	TCA2109082	ADARSH JAIN	1	0	1	1	1	1	1	1
28	TCA2159025	MOHD AZEEM	1	1	1	1	1	1	0	1
29	TCAM2211033	WAJID ALI	1	1	1	0	1	0	1	1
30	TCA2211002	AMAN KUMAR	1	0	1	1	1	1	1	1
31	TCA2211004	ANURAG TRIPATHI	1	1	1	1	0	1	1	1
32	TCA2211012	HARSHIT KAUSHIK	1	1	1	1	1	0	1	1
33	TCA2211027	SANDEEP SINGH	0	1	1	1	1	1	1	1
34	TCA2211028	SANDESH KUMAR SHAILLY	1	1	1	1	1	0	1	1
35	TCA2211030	SONU KUMAR	1	1	1	1	1	1	1	1
36	TCA2211032	TESU GAUR	1	1	0	1	1	1	0	1
37	TCA2211034	SUMIT SINGH	1	1	1	1	0	1	1	1

24	TCA2109078	LAKSHY JAIN	1	1									
25	TCA2109079	MOHD AMAAN	0	1									
26	TCA2109081	GAYUR HUSSAIN	1	1									
27	TCA2109082	ADARSH JAIN	1	1									
28	TCA2159025	MOHD AZEEM	1	1									
29	TCAM2211033	WAJID ALI	1	1									
30	TCA2211002	AMAN KUMAR	0	1									
31	TCA2211004	ANURAG TRIPATHI	1	0									
32	TCA2211012	HARSHIT KAUSHIK	1	1									
33	TCA2211027	SANDEEP SINGH	1	1									
34	TCA2211028	SANDESH KUMAR SHAILLY	1	1									
35	TCA2211030	SONU KUMAR	0	1									
36	TCA2211032	TESU GAUR	1	1									
37	TCA2211034	SUMIT SINGH	1	1									



FACULTY OF ENGINEERING
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Year: 4th

Sem: 8th

Branch: CSE

Neural Networks ECS 810

A.Y.: 2024-25 ODD SEM

COURSE FILE CLOSURE REPORT

Course file consists of the following details:

- Vision & Mission of Institute
- Vision & Mission of Department
- Program Educational Objectives (PEOs)
- Program Outcomes (POs)
- Program Specific Outcomes (PSOs)
- Institute Academic Calendar

- Course Evaluation Scheme
- Course Outcomes
- CO-PO-PSO Mapping
- Lecture Plan & Course Coverage
- Time Table-Faculty
- Time Table- Sections
- List of Assignments/Quizzes
- Class Test Paper (CT1, CT2, and CT3)
- Class Test Marks (CT1, CT2, and CT3)
- Class Test Solution
- Assignments/Quizzes Solution
- List of Slow Learner Students of Class test and action taken
- List of Fast Learner Students of Class test and action taken
- Previous Year Question Papers
- **End Semester Exam Analysis**
- Direct and Indirect CO Attainment- CTs & End Sem

Subject Teacher Name

Verified by IQAC

HOD

