KANDULA SRINIVASA REDDY MEMORIAL COLLEGE OF ENGINEERING
(AUTONOMOUS)

KADAPA-516003. AP

(Approved by AICTE, Affiliated to JNTUA, Ananthapuramu, Accredited by NAAC)

(An ISO 9001-2008 Certified Institution)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VALUE ADDED COURSE

ON

"INTELLIGENT CONTROL TECHNIQUES FOR POWER SYSTEM OPERATION AND CONTROL"

Resource Person :**Dr. T. MARIPRASATH, Associate Professor, Dept. of EEE,KSRMCE.**

Course Coordinator: Mr. G. HUSSIAN BASHA, Assistant Professor, Dept. of EEE,KSRMCE.

Duration: **09/03/2023 to 28/03/2023.**

K.S.R.M. COLLEGE OF ENGINEERING

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Kadapa,Andhra Pradesh, India– 516 003

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Lr./KSRMCE/EEE/2022-23/ Date:06-03-2023.

To
The Principal,
KSRMCE,
Kadapa.

Respected Sir,

Sub: Permission to Conduct Value added Course on "Intelligent control Techniques for Power System operation and Control" **09/03/2023 to 28/03/2023**–Req- Reg.

The Department of Electrical and Electronics Engineering is planning to offer a Value Added Course on "INTELLIGENT CONTROL TECHNIQUES FOR POWER SYSTEM OPERATION AND CONTROL" to B. Tech. students. The course will be conducted from **09/03/2023 to 28/03/2023**. In this regard, I kindly request you to grant permission to conduct Value Added Course.

Thanking you sir,

Forwarded to Principal Sir,

Yours faithfully,

G. Hussian Basha,
Assistant Professor,
EEE Dept.,
KSRMCE.

Permitted
V. S. S. Murty

K.S.R.M. COLLEGE OF ENGINEERING

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Cr./KSRMCE/EEE/2022-23/ Date:07/03/2023

Circular

The Department of Electrical and Electronics Engineering is offering a Value Added Course on "Intelligent control Techniques for Power System operation and Control" from **09/03/2023** to **28/03/2023** to B.Tech students. In this regard, interested students are requested to register their names for the Value Added Course with Course Coordinator.

For further information contact Course Coordinator.

Course Coordinator: Mr. G. Hussian Basha, Asst. Professor, Dept. of EEE.-KSRMCE.
Contact No: 9985246180.

HOD

Dept. of EEE

HEAD
Department of Electrical &
Electronics Engineering
K.S.R.M. College of Engineering
Kadapa -516003.

Cc to:

IQAC-KSRMCE

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Date:09.03.23.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

REGISTRATION FORM

Value Added Course

On

"Intelligent control Techniques for Power System operation and Control" From 09/03/2023 to 28/03/2023.

S. No	Full Name	Roll Number	Branch	Semester	Signature
1	Adimulam Gangadhar	209Y1A0202	EEE	VI	A.Gangadhar
2	Ambavaram Sanjana (W)	209Y1A0203	EEE	VI	A. Sanjana
3	Bandi Neeraja Reddy (W)	209Y1A0204	EEE	VI	B. Neeraja Reddy
4	Chemikala Rama Devi (W)	209Y1A0206	EEE	VI	Ch. Rama
5	Duggireddy Dharani (W)	209Y1A0209	EEE	VI	D. Dharani
6	Duggireddy Tejaswini (W)	209Y1A0210	EEE	VI	D. Tejaswini
7	Gaddam Harika (W)	209Y1A0211	EEE	VI	G. Harika.
8	Karnatakam Likhitha (W)	209Y1A0217	EEE	VI	K. Likhitha
9	Koramutla Mohan Krishna	209Y1A0219	EEE	VI	Krishna
10	Madireddy Gowri (W)	209Y1A0223	EEE	VI	M. Gowri
11	Mallem Charan Kumar	209Y1A0226	EEE	VI	Charan
12	Mallela Chandra Bharath Kumar Reddy	209Y1A0225	EEE	VI	Bharath
13	Mudda Maha Lakshmi (W)	209Y1A0227	EEE	VI	Mahen
14	Nareddy Sasi Rekha (W)	209Y1A0229	EEE	VI	Sasi Rekha
15	Pachipala Yogna (W)	209Y1A0231	EEE	VI	Yogna
16	Penugonda Ravi Shankar	209Y1A0233	EEE	VI	Ravi Shankar.
17	Pothuraju Sai Vignesh	209Y1A0235	EEE	VI	Sai Vignesh
18	Ramanaboina Madhu Krishna	209Y1A0236	EEE	VI	Madhu.
19	Sale Ramu	209Y1A0239	EEE	VI	Ramu.
20	Singarapu Shashikala (W)	209Y1A0247	EEE	VI	Shashikala
21	Talupula Pallavi (W)	209Y1A0249	EEE	VI	T. Pallavi

22	Veeramallu Vinay	209Y1A0251	EEE	VI	
23	Vema Jagadeesh	209Y1A0252	EEE	VI	
24	Yangammagari Somashekar Reddy	209Y1A0253	EEE	VI	
25	Arakata Vemula Venkata Yaswanth	219Y5A0202	EEE	VI	
26	Busagani Chandra Kumar	219Y5A0203	EEE	VI	
27	Mayakuntla Srinidhi (W)	219Y5A0204	EEE	VI	
28	Muddala Lakshmi Devi (W)	219Y5A0205	EEE	VI	
29	Nagipogu Prudviraj	219Y5A0206	EEE	VI	
30	Ramanaboina Thirumala	209Y1A0237	EEE	VI	
31	Saggam Sreekanth	209Y1A0238	EEE	VI	
32	Shaik Mahammad Javeed	209Y1A0243	EEE	VI	
33	Shaik Mohammed Sameera	209Y1A0244	EEE	VI	
34	Gadwala Lingamaiah	209Y1A0212	EEE	VI	
35	Gandla Venkata Sunil Kumar	209Y1A0213	EEE	VI	
36	Dasari Sai Pavan	209Y1A0207	EEE	VI	
37	Katika Mohammed Kaif Ali	209Y1A0218	EEE	VI	
38	Panchamarthi Dayananda	209Y1A0232	EEE	VI	
39	Shaik Alisha Sameera (W)	209Y1A0241	EEE	VI	
40	Singamsetty Sudharshan	209Y1A0246	EEE	VI	

Coordinator:

HOD of EEE

HEAD
Department of Electrical & Electronics Engineering
K.S.R.M. College of Engineering
Kadapa -516003.

Syllabus of Value Added Course

Course Name: Intelligent Control Techniques for Power System Operation and Control

Course Objectives:

1. To apply different problem-solving techniques in solving the Unit Commitment and Hydro-thermal coordination problems.
2. To solve issues related to reactive power requirements in power systems.
3. To explain various concepts related to optimal power flow and voltage control concepts.
4. Analyze the application of ICT for protection of power system equipment using ICT Techniques
5. To underline the concepts related to electricity markets.

Course Outcomes:

1. To understand the fundamentals of Intelligent Control Techniques and Fuzzy Sets
2. Demonstrate various neural networks and genetic algorithms
3. Review basic concepts related to formulation of optimal power flow and voltage control concepts.
4. Formulate the problems for solving the states estimation of power systems.
   Testing of various relays using ICT.

UNIT-I

Concept of artificial intelligence, Problem solving methods and searching techniques. Fuzzy sets, Operation on fuzzy sets, Fuzzy relations, Fuzzy measures, Fuzzy logic, Fuzzy controller.

UNIT-II

Fundamental concepts, Basic models, Learning rules, Single layer and multi-layer feed-forward and feedback networks, Supervised and unsupervised learning, Recurrent networks, Modular network, Self organizing maps, Function networks, Neural network controller, Basic principle, Evolution of genetic algorithm, Hybrid genetic algorithm. Hybrid Systems: Integrated neural-fuzzy system simulated evolution for neural network learning, Fast learning algorithms for training NN.

UNIT-III

ICT functions, ICT control of network for protection coordination, Common Format for Transient Data Exchange (COMTRADE). Protection in Distributed Generators (DGs), micro grids and smart grids. Power system protection testing: automatic testing, test methods, maintenance and field testing of relays.

UNIT-IV

Power system protection testing: automatic testing, test methods, maintenance and field testing of relays. ICT based fault detection identification and classification, Adaptive protection coordination.

UNIT-V

Testing of numerical over current relays, under/over frequency relays & differential relays.

Text Books/Reference Books:

1. Lin, C., Lee, G., Neural Fuzzy Systems, Prentice Hall International Inc. (2000).
2. Rajashekran, S. and VijaylaksmiPai, G.A., Neural Networks, Fuzzy Logic and GeneticAlgorithmSysthesis and Applications, Prentice–Hall of India Private Limited (2004).
3. Taylor, C.W., Power System Stability, McGraw–Hill (2007).
4. Kosko, B., Neural Networks and Fuzzy Systems: a Dynamical systems Approach to Machine Intelligence, Prentice–Hall of India Private Limited (1992).
5. Zurda, J.M., C++ Neural Networks and Fuzzy Logics, BPS Publication (2001).

SCHEDULE

Department of Electrical and Engineering

Value Added Course

On

"Intelligent Control Techniques for Power System Operation and Control" From 09/03/2023 to 28/03/2023.

Date	Timing	Resource Person	Topic to be covered
09.03.2023	4 PM to 6 PM	Dr. T. Mariprasath	Introduction to the ICT for PSOC
10.03.2023	4 PM to 6 PM	Dr. T. Mariprasath	Concept of artificial intelligence
11. 03.2023	4 PM to 6 PM	Dr. T. Mariprasath	Problem solving methods and searching techniques
13. 03.2023	4 PM to 6 PM	Dr. T. Mariprasath	Fuzzy sets, Operation on fuzzy sets, Fuzzy relations, Fuzzy measures, Fuzzy logic, Fuzzy controller
14. 03.2023	4 PM to 6 PM	Dr. T. Mariprasath	Fundamental concepts, Basic models, Learning rules, Single layer and multi-layer feed-forward and feedback networks, Supervised and unsupervised learning, Recurrent networks
15. 03.2023	4 PM to 6 PM	Dr. T. Mariprasath	Function networks, Neural network controller, Basic principle, Evolution of genetic algorithm, Hybrid genetic algorithm
16. 03.2023	4 PM to 6 PM	Dr. T. Mariprasath	Hybrid Systems: Integrated neural-fuzzy system simulated evolution for neural network learning, Fast learning algorithms for training NN.
17. 03.2023	4 PM to 6 PM	Dr. T. Mariprasath	Introduction to ICT functions, ICT control of network for protection coordination
18. 03.2023	4 PM to 6 PM	Dr. T. Mariprasath	Common Format for Transient Data Exchange (COMTRADE).
20. 03.2023	4 PM to 6 PM	Dr. T. Mariprasath	Protection in Distributed Generators (DGs), micro grids and smart grids.
21. 03.2023	4 PM to 6 PM	Dr. T. Mariprasath	Power system protection testing: automatic testing, test methods,

			maintenance and field testing of relays
22. 03.2023	4 PM to 6 PM	Dr. T. Mariprasath	Power system protection testing: automatic testing, test methods, maintenance and field testing of relays
24. 03.2023	4 PM to 6 PM	Dr. T. Mariprasath	ICT based fault detection identification and classification, Adaptive protection coordination.
25. 03.2023	4 PM to 6 PM	Dr. T. Mariprasath	Testing of numerical over current relays.
26. 03.2023	4 PM to 6 PM	Dr. T. Mariprasath	under/over frequency relays & differential relays
27. 03.2023	4 PM to 6 PM	Dr. T. Mariprasath	Revision & Discussion
28.03.2023	4 PM to 6 PM	Dr. T. Mariprasath	Revision & Discussion

Resource Person(s)

Coordinator(s)

HOD

HEAD
Department of Electrical & Electronics Engineering
K.S.R.M. College of Engineering
Kadapa -516003.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Attendance sheet of Certification Course on "Intelligent control Techniques for Power System operation and Control"

From 09/03/2023 to 28/03/2023.

Sl. No.	Name of the Person	Roll No.	09/08/23	10/08/23	11/08/23	13/08/23	14/08/23	15/08/23	16/08/23	17/08/23	18/08/23	20/08/23	21/08/23	22/08/23	23/08/23	24/08/23	25/08/23	2/08/23	28/08/23
1	Adimulam Gangadhar	209Y1A0202																	
2	Ambavaram Sanjana (W)	209Y1A0203																	
3	Bandi Neeraja Reddy (W)	209Y1A0204																	
4	Chemikala Rama Devi (W)	209Y1A0206																	
5	Duggireddy Dharani (W)	209Y1A0209																	
6	Duggireddy Tejaswini (W)	209Y1A0210																	
7	Gaddam Harika (W)	209Y1A0211																	

8	Karnatakam Likhitha (W)	209Y1A0217																		
9	Koramutla Mohan Krishna	209Y1A0219																		
10	Madireddy Gowri (W)	209Y1A0223																		
11	Mallem Charan Kumar	209Y1A0226																		
12	Mallela Chandra Bharath Kumar Reddy	209Y1A0225																		
13	Mudda Maha Lakshmi (W)	209Y1A0227																		
14	Nareddy Sasi Rekha (W)	209Y1A0229																		
15	Pachipala Yogna (W)	209Y1A0231																		
16	Penugonda Ravi Shankar	209Y1A0233																		
17	Pothuraju Sai Vignesh	209Y1A0235																		
18	Ramanaboina Madhu Krishna	209Y1A0236																		
19	Sale Ramu	209Y1A0239																		
20	Singarapu Shashikala (W)	209Y1A0247																		
21	Talupula Pallavi (W)	209Y1A0249																		

22	Veeramallu Vinay	209Y1A0251																		
23	Vema Jagadeesh	209Y1A0252																		
24	Yangammagari Somashekar Reddy	209Y1A0253																		
25	Arakata Vemula Venkata Yaswanth	219Y5A0202																		
26	Busagani Chandra Kumar	219Y5A0203																		
27	Mayakuntla Srinidhi (W)	219Y5A0204																		
28	Muddala Lakshmi Devi (W)	219Y5A0205																		
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30	Ramanaboina Thirumala	209Y1A0237																		
31	Saggam Sreekanth	209Y1A0238																		
32	Shaik Mahammad Javeed	209Y1A0243																		
33	Shaik Mohammed Sameer	209Y1A0244																		
34	Gadwala Lingamaiah	209Y1A0212																		

35	Gandla Venkata Sunil	209Y1A0213																		
36	Dasari Sai Pavan	209Y1A0207																		
37	Katika Mohammed Kaif Ali	209Y1A0218																		
38	Panchamarthi Dayananda	209Y1A0232																		
39	Shaik Alisha Sameera (W)	209Y1A0241																		
40	Singamsetty Sudharshan	209Y1A0246																		

Coordinator(s)

HoD

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Department of Electrical & Electronics Engineering

Value added Course on "Intelligent control Techniques for Power System Operation and Control"

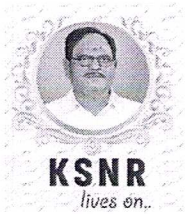
DATES : 09-03-2023 TO 28-03-2023.

VENUE : SJ 114

Coordinator
Mr. G. Hussian Basha
Assistant Professor
EEE Department

Resource Persons
Dr. T.Mariprasath, Assoc..,Professor
EEE Department

Dr. M.S. Priyadharshni	Dr.V.S.S.Murthy	Prof A.Mohan	Dr.K.Chandra Obul Reddy	Smt.K.Rajeswari	Sri K.Madan Mohan Reddy	Sri K.Raja Mohan Reddy
HOD	Principal	Director	Managing Director	Correspondent	Vice-Chairman	Chairman



Report of
Value Added Course on "Intelligent control Techniques for Power System operation and Control"
From 09/03/2023 to 28/03/2023

Target Group	**:**	**B.Tech Students**
Details of Participants	**:**	**40 Students**
Co-coordinator(s)	**:**	**Mr. G. Hussian Basha**
Resource Person(s)	**:**	**Dr. T. Mariprasath**
Organizing Department	**:**	**Electrical and Electronics Engineering**
Venue	**:**	**SJ 114, EEE Department**

Description:

The Department of Electrical and Electronics Engineering conducted a Value Added Course on "Intelligent control Techniques for Power System operation and Control" from 09/03/2023 to 28/03/2023. The course Resource Persons is Dr. T. Mariprasath, Assoc., Professor Department EEE, KSRMCE.

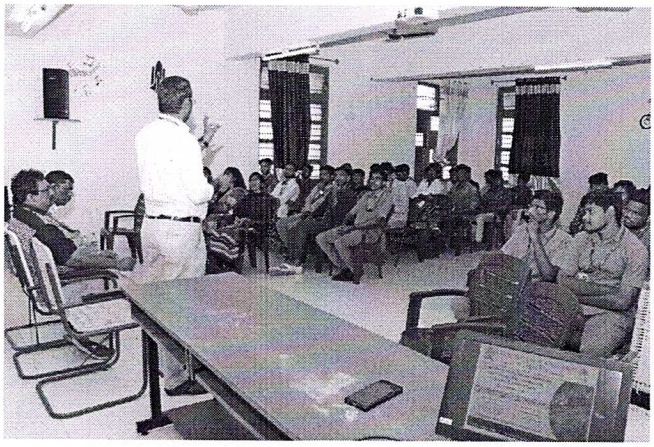
Over the last few years, many problems in the design, management and operation of modern power systems have attracted the attention of researchers – these systems are highly nonlinear, multivariable, and time-varying. These problems may arise from the growth of electrical networks and the high penetration of renewable energy sources in electrical systems.

Recent power systems require more complex control methods to be autonomous, intelligent, and reliable. The application of advanced, modern, and intelligent control systems is considered the primary aspect of enhancing the system's reliability and efficiency. Moreover, more attention should be paid to developing and analyzing the advanced control methods utilized in modern electrical systems, considering theoretical and practical challenging control problems

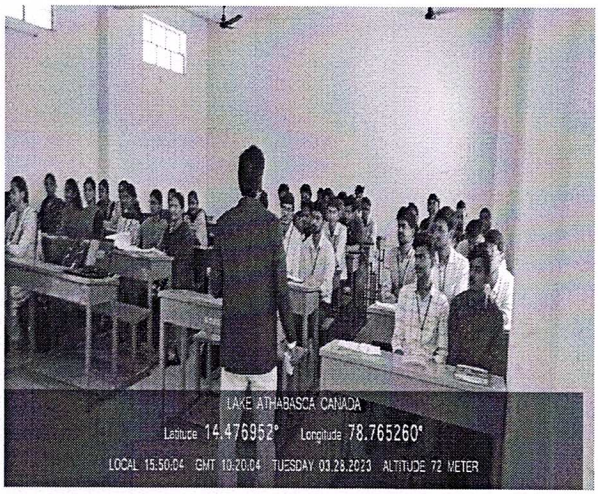
Photos

The pictures taken during the course are given below:

Resource Person Dr. T. Mariprasath, Asso., Prof in EEE, giving Keynote Address.



Coordinator Mr.G. Hussian Basha, Asst., Prof., in EEE, addressing the Gathering.



Participants Keenly Listening the Lecture

Certificates Distribution by the HoD Dr.M.S. Priyadharshni

Coordinator(s)

HoD

Seal HEAD
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Certificate of Completion

This is to certify that P. YOGNA bearing Roll N 20941A0231 has Sucessfully Completed the Value Added Course o "Intelligent Control Techniques for Power System Operation an Control " organized by the Department of EEE, K.S.R.M College o Engineering, Kadapa. From 09/03/2023 to 28/03/2023.

Coordinator

HOD EEE

PRINCIPAL

K.S.R.M. COLLEGE OF ENGINEERING

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KSN

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Certificate of Completion

This is to certify that T. PALLAVI bearing Roll N 209141A0249 has Sucessfully Completed the Value Added Course o "Intelligent Control Techniques for Power System Operation an Control " organized by the Department of EEE, K.S.R.M College Engineering, Kadapa. From 09/03/2023 to 28/03/2023.

Coordinator

HOD EEE

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KSN

Certificate of Completion

This is to certify that G. HARIKA bearing Roll N 20941AD211 has Sucessfully Completed the Value Added Course o "Intelligent Control Techniques for Power System Operation an Control " organized by the Department of EEE, K.S.R.M College Engineering, Kadapa. From 09/03/2023 to 28/03/2023.

Coordinator

HOD EEE

PRINCIPAL

Feedback form on Value Added Course "Intelligent control Techniques for Power System operation and Control" 09/03/2023 to 28/03/2023.

* Indicates required question

1. Email *

2. Roll Number *

3. Name of the Student *

4. The objectives of the Value Added Course were met (Objective) *

   Mark only one oval.

   - Excellent
   - Good
   - Satisfactory
   - Poor

5. The content of the course was organized and easy to follow (Delivery) *

Mark only one oval.

- ◯ Excellent
- ◯ Good
- ◯ Satisfactory
- ◯ Poor

6. The Resource Persons were well prepared and able to answer any question(Interaction) *

Mark only one oval.

- ◯ Excellent
- ◯ Good
- ◯ Satisfactory
- ◯ Poor

7. The exercises/role play were helpful and relevant (Syllabus Coverage) *

Mark only one oval.

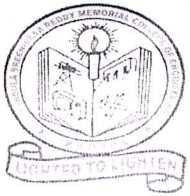
- ◯ Excellent
- ◯ Good
- ◯ Satisfactory
- ◯ Poor

8. The Value Added Course satisfy my expectation as a value added Programme * (Course Satisfaction)

Mark only one oval.

- Excellent
- Good
- Satisfactory
- Poor

9. Any Information *



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Value added Course on "Intelligent control Techniques for Power System operation and Control" 09/03/2023 to 28/03/2023

S No.	Email Address	Roll Number	Name of the Student	The obje	The conter	The Res	The ex	The V	Any Information
1	209y1a0202@ksrmce.ac.	209y1a0202	A Gangadhar	Good	Good	Satisfacto	Good	Excelle	Nothing
2	219y5a0203@ksrmce.ac.	219y5a0203	BUSAGANI CHANDRA KUI	Good	Excellent	Excellent	Good	Good	Nothing
3	209y1a0247@ksrmce.ac.	209y1a0247	S. Shashikala	Good	Good	Good	Good	Good	Nill
4	209y1a0241@ksrmce.ac.	209Y1A0241	Shaik Alisha Sameera	Good	Good	Good	Good	Good	No
5	219y5a0204@ksrmce.ac.	219y5a0204	M.srnidhi	Good	Good	Good	Good	Good	Ntg
6	209y1a0251@ksrmce.ac.	209y1a0251	V.vinay	Good	Excellent	Good	Good	Excelle	Nothing
7	219y5a0202@ksrmce.ac.	219y5a0202	ARAKATA VEMULA VENKA	Good	Good	Good	Good	Good	Nothing
8	209y1a0219@ksrmce.ac.	209y1a0219	Mohan Krishna	Good	Excellent	Excellent	Excelle	Good	No
9	209y1a0209@ksrmce.ac.	209y1A0209	D.Dharani	Excellent	Good	Good	Good	Good	Nothing
10	209y1a0232@ksrmce.ac.	209y1a0232	P.Dayananda	Good	Good	Good	Good	Good	No
11	209y1a0239@ksrmce.ac.	209Y1A0239	S.Ramu	Good	Satisfactory	Good	Good	Good	Nothing
12	209y1a0212@ksrmce.ac.	209y1a0212	G.lingamaiah	Excellent	Excellent	Satisfacto	Good	Good	No
13	209y1a0207@ksrmce.ac.	209y1a0207	D Sai Pavan	Good	Good	Good	Good	Good	All going good
14	209y1a0238@ksrmce.ac.	209y1a0238	Saggam Sreekanth	Excellent	Good	Good	Good	Good	No
15	209y1a0249@ksrmce.ac.	209y1a0249	T.pallavi	Satisfacto	Good	Good	Excelle	Good	No
16	209y1a0226@ksrmce.ac.	209y1a0222	M.Charan Kumar	Good	Good	Good	Good	Good	Ntg
17	209y1a0233@ksrmce.ac.	209Y1A0233	P.RAVI SHANKAR	Excellent	Good	Excellent	Good	Good	-
18	209y1a0237@ksrmce.ac.	209y1a0237	R.Thirumala	Good	Good	Good	Good	Good	Nothing
19	209y1a0217@ksrmce.ac.	209y1a0217	K.Likhitha	Good	Good	Excellent	Good	Excelle	Nothing
20	209y1a0213@ksrmce.ac.	209y1a0213	GANDLA VENKATA SUNIL	Excellent	Good	Excellent	Excelle	Good	5/5 Rating
21	209y1a0229@ksrmce.ac.	209y1a0229	N.Sasi Rekha	Good	Good	Good	Good	Good	No
22	209y1a0253@ksrmce.ac.	209y1a0253	Y somashekar reddy	Good	Good	Good	Good	Good	Nothing
23	219y5a0206@ksrmce.ac.	219y5a0206	NAGIPOGU PRUDVI RAJ	Excellent	Good	Good	Excelle	Good	Nothing
24	209y1a0223@ksrmce.ac.	209y1a0223	M.Gowri	Good	Good	Good	Excelle	Good	Nill
25	209y1a0210@ksrmce.ac.	209Y1A0210	D.Tejaswini	Good	Good	Good	Good	Good	Nothing
26	209y1a0231@ksrmce.ac.	209y1a0231	P . Yogna	Good	Good	Excellent	Good	Good	No
27	209y1a0203@ksrmce.ac.	209y1a0203	A.Sanjana	Good	Good	Good	Good	Good	-

28	209y1a0246@ksrmce.ac.	209y1a0246	S. Sudharshan	Good	Good	Good	Good	Good	No
29	209y1a0244@ksrmce.ac.	209Y1A0244	Shaik Mohammed sameer	Good	Good	Good	Good	Good	No
30	219y5a0205@ksrmce.ac.	219y5a0205	M.lakshmi devi	Good	Good	Good	Good	Good	No
31	209y1a0206@ksrmce.ac.	209y1a0206	C Ramadevi	Good	Excellent	Good	Excelle	Good	-
32	209y1a0211@ksrmce.ac.	209Y1A0211	G Harika	Good	Good	Good	Good	Good	Nothing
33	209y1a0243@ksrmce.ac.	209Y1A0243	SHAIK MAHAMMAD JAVEE	Excellent	Excellent	Excellent	Excelle	Excelle	NIL
34	209y1a0218@ksrmce.ac.	209y1a0218	K mohammed kaif ali	Good	Good	Good	Good	Good	No
35	209y1a0252@ksrmce.ac.	209y1a0252	VEMA JAGADEESH	Good	Good	Excellent	Good	Good	Nothing
36	209y1a0204@ksrmce.ac.	209y1a0204	B Neeraja Reddy	Good	Good	Good	Satisfa	Good	Nothing
37	209y1a0205@ksrmce.ac.	209y1a0205	Beri Yaswanth	Excellent	Good	Satisfact	Excelle	Good	Nothing
38	209y1a0225@ksrmce.ac.	209y1a0225	MALLELA CHANDRA BHAF	Good	Good	Good	Good	Good	Na
39	209y1a0235@ksrmce.ac.	209Y1A0235	POTHURAJU SAI VIGNESH	Good	Good	Good	Good	Good	None
40	209y1a0227@ksrmce.ac.	209y1A0227	M Mahalakshmi	Good	Excellent	Good	Excelle	Good	-

Coordinator

HoD of EEE

HEAD
Department of Electrical &
Electronics Engineering
K.S.R.M. College of Engineering
Kadapa -516003.

K.S.R.M. COLLEGE OF ENGINEERING (AUTONOMOUS), KADAPA-516003
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
VALUE ADDED COURSE ON

"INTELLIGENT CONTROL TECHNIQUES FOR POWER SYSTEM OPERATION AND CONTROL"

FROM 09/03/2023 TO 28/03/2023
AWARD LIST

S.No	Roll Number	Name of the Student	Marks Obtained
1	209Y1A0202	Adimulam Gangadhar	18
2	209Y1A0203	Ambavaram Sanjana (W)	18
3	209Y1A0204	Bandi Neeraja Reddy (W)	17
4	209Y1A0206	Chemikala Rama Devi (W)	19
5	209Y1A0209	Duggireddy Dharani (W)	17
6	209Y1A0210	Duggireddy Tejaswini (W)	18
7	209Y1A0211	Gaddam Harika (W)	16
8	209Y1A0217	Karnatakam Likhitha (W)	15
9	209Y1A0219	Koramutla Mohan Krishna	16
10	209Y1A0223	Madireddy Gowri (W)	17
11	209Y1A0226	Mallem Charan Kumar	17
12	209Y1A0225	Mallela Chandra Bharath Kumar Reddy	16
13	209Y1A0227	Mudda Maha Lakshmi (W)	19
14	209Y1A0229	Nareddy Sasi Rekha (W)	18
15	209Y1A0231	Pachipala Yogna (W)	18
16	209Y1A0233	Penugonda Ravi Shankar	16
17	209Y1A0235	Pothuraju Sai Vignesh	17
18	209Y1A0236	Ramanaboina Madhu Krishna	18
19	209Y1A0239	Sale Ramu	18
20	209Y1A0247	Singarapu Shashikala (W)	19
21	209Y1A0249	Talupula Pallavi (W)	17
22	209Y1A0251	Veeramallu Vinay	18
23	209Y1A0252	Vema Jagadeesh	16
24	209Y1A0253	Yangammagari Somashekar Reddy	15
25	219Y5A0202	Arakata Vemula Venkata Yaswanth	17
26	219Y5A0203	Busagani Chandra Kumar	16
27	219Y5A0204	Mayakuntla Srinidhi (W)	16
28	219Y5A0205	Muddala Lakshmi Devi (W)	18
29	219Y5A0206	Nagipogu Prudviraj	17
30	209Y1A0237	Ramanaboina Thirumala	16
31	209Y1A0238	Saggam Sreekanth	17
32	209Y1A0243	Shaik Mahammad Javeed	18
33	209Y1A0244	Shaik Mohammed Sameer	19
34	209Y1A0212	Gadwala Lingamaiah	17
35	209Y1A0213	Gandla Venkata Sunil	16
36	209Y1A0207	Dasari Sai Pavan	17
37	209Y1A0218	Katika Mohammed Kaif Ali	15
38	209Y1A0232	Panchamarthi Dayananda	18

39	209Y1A0241	Shaik Alisha Sameera (W)	19
40	209Y1A0246	Singamsetty Sudharshan	18

Coordinator(s)

HoD EEE

K.S.R.M. COLLEGE OF ENGINEERING (19)

(UGC-AUTONOMOUS)

Kadapa, Andhra Pradesh, India– 516 005

Approved by AICTE, New Delhi & Affiliated to JNTUA, Ananthapuramu.

An ISO 14001:2004 & 9001: 2015 Certified Institution

Valued added Course on "**Intelligent Control Techniques for Power System Operation and Control**"

Name of the Student: C. Ramadevi Date: 28/03/2023

Roll No.. 209Y1A0206 Signature of Faculty:

1	Who invented perceptron neural networks?		[B]
	a) McCullocch-pitts	b) Widrow	
	c) Minsky & papert	d) Rosenblatt	
2.	. What is adaline in neural networks?		[A]
	a) adaptive linear element	b) automatic linear element	
	c) adaptive line element	d) none of the mentioned	
3.	who invented the adaline neural model?		[D]
	a) Rosenblatt	b) Hopfield	
	c) Werbos	d) Widrow	
4.	what is the another name of weight update rule in adaline model based on its functionality?		[C]
	a) LMS error learning law	b) gradient descent algorithm	
	c) both LMS error & gradient descent learning law	d) none of the mentioned	
5.	What is the form of Fuzzy logic?		[C]
	a) Two-valued logic	b) Crisp set logic	
	c) Many-valued logic	d) Binary set logic	
6.	3. The truth values of traditional set theory is _____ and that of fuzzy set is _____		[A]
	a) Either 0 or 1, between 0 & 1	b) Between 0 & 1, either 0 or 1	
	c) Between 0 & 1, between 0 & 1	d) Either 0 or 1, either 0 or 1	
7.	The room temperature is hot. Here the hot (use of linguistic variable is used) can be represented by _____		[B]
	a) Fuzzy Set	b) Crisp Set	
	c) Fuzzy & Crisp Set	d) None of the mentioned	
8.	The values of the set membership is represented by _____		[B]
	a) Discrete Set	b) Degree of truth	
	c) Probabilities	d) Both Degree of truth & Probabilities	
9.	Fuzzy Set theory defines fuzzy operators. Choose the fuzzy operators from the following.		[D]
	a) AND	b) OR	
	c) NOT	d) All of the mentioned	
10.	There are also other operators, more linguistic in nature, called _____ that can be applied to fuzzy set theory.		[A]
	a) Hedges	b) Lingual Variable	

	c) Fuzz Variable	d) None of the mentioned	
11.	Fuzzy logic is usually represented as _____		[B]
	a) IF-THEN-ELSE rules	b) IF-THEN rules	
	c) Both IF-THEN-ELSE rules & IF-THEN rules	d) None of the mentioned	
12.	_____ is/are the way/s to represent uncertainty.		[D]
	a) Fuzzy Logic	b) Probability	
	c) Entropy	d) All of the mentioned	
13.	_____ are algorithms that learn from their more complex environments (hence eco) to generalize, approximate and simplify solution logic.		[C]
	a) Fuzzy Relational DB	b) Ecorithms	
	c) Fuzzy Set	d) None of the mentioned	
14.	Which of the following is/are type of fuzzy interference method		[D]
	a) mamdani	b) sugeno	
	c) rivest	d) only a and b	
15.	Backpropagation can be defined as _____		[C]
	a)It is another name given to the curvy function in the perceptron.	b)It is the transmission of errors back through the network to adjust the inputs.	
	c)It is the transmission of error back through the network to allow weights to be adjusted so that the network can learn.	d)None of the above	
16.	Which of the following exhibits non-linear functions to any desired degree of accuracy?		[C]
	a)Neuro-fuzzy	b)Neuro-genetic	
	c)Fuzzy-genetic	d)None of the above	
17.	A perceptron adds up all the weighted inputs it receives, and if it exceeds a certain value, it outputs a 1, otherwise it just outputs a 0.		[A]
	a) True	b) False	
	c) Sometimes – it can also output intermediate values as well	d) Can't say	
18.	What is the name of the function in the following statement "A perceptron adds up all the weighted inputs it receives, and if it exceeds a certain value, it outputs a 1, otherwise it just outputs a 0"?		[B]
	a) Step function	b) Heaviside function	
	c) Logistic function	d) Perceptron function	
19.	What is true regarding backpropagation rule?		[D]
	a) it is also called generalized delta rule	b) error in output is propagated backwards only to determine weight updates	
	c) there is no feedback of signal at nay stage	d) all of the mentioned	
20.	What are general limitations of back propagation rule?		[D]
	a) local minima problem	b) slow convergence	
	c) scaling	d) all of the mentioned	

K.S.R.M. COLLEGE OF ENGINEERING

18

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Kadapa, Andhra Pradesh, India– 516 005

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An ISO 14001:2004 & 9001: 2015 Certified Institution

Valued added Course on "**Intelligent Control Techniques for Power System Operation and Control**"

Name of the Student: M. Lakshmi Devi Date: 28.03.2023.

Roll No.. 21945A0205 Signature of Faculty:

1	Who invented perceptron neural networks?		[D]
	a) McCullocch-pitts	b) Widrow	
	c) Minsky & papert	d) Rosenblatt	
2.	. What is adaline in neural networks?		[A]
	a) adaptive linear element	b) automatic linear element	
	c) adaptive line element	d) none of the mentioned	
3.	who invented the adaline neural model?		[D]
	a) Rosenblatt	b) Hopfield	
	c) Werbos	d) Widrow	
4.	what is the another name of weight update rule in adaline model based on its functionality?		[C]
	a) LMS error learning law	b) gradient descent algorithm	
	c) both LMS error & gradient descent learning law	d) none of the mentioned	
5.	What is the form of Fuzzy logic?		[A]
	a) Two-valued logic	b) Crisp set logic	
	c) Many-valued logic	d) Binary set logic	
6.	3. The truth values of traditional set theory is _____ and that of fuzzy set is _____		[A]
	a) Either 0 or 1, between 0 & 1	b) Between 0 & 1, either 0 or 1	
	c) Between 0 & 1, between 0 & 1	d) Either 0 or 1, either 0 or 1	
7.	The room temperature is hot. Here the hot (use of linguistic variable is used) can be represented by _____		[A]
	a) Fuzzy Set	b) Crisp Set	
	c) Fuzzy & Crisp Set	d) None of the mentioned	
8.	The values of the set membership is represented by _____		[B]
	a) Discrete Set	b) Degree of truth	
	c) Probabilities	d) Both Degree of truth & Probabilities	
9.	Fuzzy Set theory defines fuzzy operators. Choose the fuzzy operators from the following.		[B]
	a) AND	b) OR	
	c) NOT	d) All of the mentioned	
10.	There are also other operators, more linguistic in nature, called _____ that can be applied to fuzzy set theory.		[A]
	a) Hedges	b) Lingual Variable	

	c) Fuzz Variable	d) None of the mentioned	
11.	Fuzzy logic is usually represented as _____		[B]
	a) IF-THEN-ELSE rules	b) IF-THEN rules	
	c) Both IF-THEN-ELSE rules & IF-THEN rules	d) None of the mentioned	
12.	_____ is/are the way/s to represent uncertainty.		[D]
	a) Fuzzy Logic	b) Probability	
	c) Entropy	d) All of the mentioned	
13.	_____ are algorithms that learn from their more complex environments (hence eco) to generalize, approximate and simplify solution logic.		[B]
	a) Fuzzy Relational DB	b) Ecorithms	
	c) Fuzzy Set	d) None of the mentioned	
14.	Which of the following is/are type of fuzzy interference method		[D]
	a) mamdani	b) sugeno	
	c) rivest	d) only a and b	
15.	Backpropagation can be defined as _____		[C]
	a)It is another name given to the curvy function in the perceptron.	b)It is the transmission of errors back through the network to adjust the inputs.	
	c)It is the transmission of error back through the network to allow weights to be adjusted so that the network can learn.	d)None of the above	
16.	Which of the following exhibits non-linear functions to any desired degree of accuracy?		[C]
	a)Neuro-fuzzy	b)Neuro-genetic	
	c)Fuzzy-genetic	d)None of the above	
17.	A perceptron adds up all the weighted inputs it receives, and if it exceeds a certain value, it outputs a 1, otherwise it just outputs a 0.		[A]
	a) True	b) False	
	c) Sometimes – it can also output intermediate values as well	d) Can't say	
18.	What is the name of the function in the following statement "A perceptron adds up all the weighted inputs it receives, and if it exceeds a certain value, it outputs a 1, otherwise it just outputs a 0"?		[B]
	a) Step function	b) Heaviside function	
	c) Logistic function	d) Perceptron function	
19.	What is true regarding backpropagation rule?		[A]
	a) it is also called generalized delta rule	b) error in output is propagated backwards only to determine weight updates	
	c) there is no feedback of signal at nay stage	d) all of the mentioned	
20.	What are general limitations of back propagation rule?		[D]
	a) local minima problem	b) slow convergence	
	c) scaling	d) all of the mentioned	

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18

Valued added Course on "**Intelligent Control Techniques for Power System Operation and Control**"

Name of the Student: A. Gangadhar

Date: 28/03/2023

Roll No..2094/A0202

Signature of Faculty:

1	Who invented perceptron neural networks?		[D]
	a) McCullocch-pitts	b) Widrow	
	c) Minsky & papert	d) Rosenblatt	
2.	. What is adaline in neural networks?		[A]
	a) adaptive linear element	b) automatic linear element	
	c) adaptive line element	d) none of the mentioned	
3.	who invented the adaline neural model?		[D]
	a) Rosenblatt	b) Hopfield	
	c) Werbos	d) Widrow	
4.	what is the another name of weight update rule in adaline model based on its functionality?		[C]
	a) LMS error learning law	b) gradient descent algorithm	
	c) both LMS error & gradient descent learning law	d) none of the mentioned	
5.	What is the form of Fuzzy logic?		[A]
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6.	3. The truth values of traditional set theory is _____ and that of fuzzy set is _____		[A]
	a) Either 0 or 1, between 0 & 1	b) Between 0 & 1, either 0 or 1	
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7.	The room temperature is hot. Here the hot (use of linguistic variable is used) can be represented by _____		[A]
	a) Fuzzy Set	b) Crisp Set	
	c) Fuzzy & Crisp Set	d) None of the mentioned	
8.	The values of the set membership is represented by _____		[B]
	a) Discrete Set	b) Degree of truth	
	c) Probabilities	d) Both Degree of truth & Probabilities	
9.	Fuzzy Set theory defines fuzzy operators. Choose the fuzzy operators from the following.		[D]
	a) AND	b) OR	
	c) NOT	d) All of the mentioned	
10.	There are also other operators, more linguistic in nature, called _____ that can be applied to fuzzy set theory.		[A]
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11.	Fuzzy logic is usually represented as _____		[B]
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12.	_____ is/are the way/s to represent uncertainty.		[D]
	a) Fuzzy Logic	b) Probability	
	c) Entropy	d) All of the mentioned	
13.	_____ are algorithms that learn from their more complex environments (hence eco) to generalize, approximate and simplify solution logic.		[B]
	a) Fuzzy Relational DB	b) Ecorithms	
	c) Fuzzy Set	d) None of the mentioned	
14.	Which of the following is/are type of fuzzy interference method		[D]
	a) mamdani	b) sugeno	
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15.	Backpropagation can be defined as _____		[C]
	a)It is another name given to the curvy function in the perceptron.	b)It is the transmission of errors back through the network to adjust the inputs.	
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	a) it is also called generalized delta rule	b) error in output is propagated backwards only to determine weight updates	
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15

Valued added Course on "**Intelligent Control Techniques for Power System Operation and Control**"

Name of the Student: K. MOHAMMED KAIF ALI Date: 28/03/2023

Roll No.. 20941A0218 Signature of Faculty:

1	Who invented perceptron neural networks?		[D]
	a) McCullocch-pitts	b) Widrow	
	c) Minsky & papert	d) Rosenblatt	
2.	. What is adaline in neural networks?		[A]
	a) adaptive linear element	b) automatic linear element	
	c) adaptive line element	d) none of the mentioned	
3.	who invented the adaline neural model?		[D]
	a) Rosenblatt	b) Hopfield	
	c) Werbos	d) Widrow	
4.	what is the another name of weight update rule in adaline model based on its functionality?		[A]
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	c) both LMS error & gradient descent learning law	d) none of the mentioned	
5.	What is the form of Fuzzy logic?		[A]
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	c) Between 0 & 1, between 0 & 1	d) Either 0 or 1, either 0 or 1	
7.	The room temperature is hot. Here the hot (use of linguistic variable is used) can be represented by _____		[B]
	a) Fuzzy Set	b) Crisp Set	
	c) Fuzzy & Crisp Set	d) None of the mentioned	
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	a) Fuzzy Logic	b) Probability	
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19.	What is true regarding backpropagation rule?		[D]
	a) it is also called generalized delta rule	b) error in output is propagated backwards only to determine weight updates	
	c) there is no feedback of signal at nay stage	d) all of the mentioned	
20.	What are general limitations of back propagation rule?		[D]
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	c) scaling	d) all of the mentioned	

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Valued added Course on "**Intelligent Control Techniques for Power System Operation and Control**"

Name of the Student: 209X1A0237

Roll No.. R. Tirumala

Date: 28.03.2023

Signature of Faculty:

1	Who invented perceptron neural networks?		[D]
	a) McCullocch-pitts	b) Widrow	
	c) Minsky & papert	d) Rosenblatt	
2.	. What is adaline in neural networks?		[B]
	a) adaptive linear element	b) automatic linear element	
	c) adaptive line element	d) none of the mentioned	
3.	who invented the adaline neural model?		[D]
	a) Rosenblatt	b) Hopfield	
	c) Werbos	d) Widrow	
4.	what is the another name of weight update rule in adaline model based on its functionality?		[C]
	a) LMS error learning law	b) gradient descent algorithm	
	c) both LMS error & gradient descent learning law	d) none of the mentioned	
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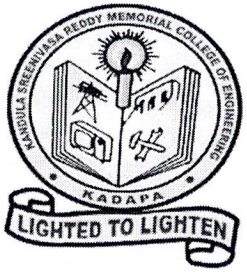
	a) Two-valued logic	b) Crisp set logic	
	c) Many-valued logic	d) Binary set logic	
6.	3. The truth values of traditional set theory is _____ and that of fuzzy set is _____		[B]
	a) Either 0 or 1, between 0 & 1	b) Between 0 & 1, either 0 or 1	
	c) Between 0 & 1, between 0 & 1	d) Either 0 or 1, either 0 or 1	
7.	The room temperature is hot. Here the hot (use of linguistic variable is used) can be represented by _____		[A]
	a) Fuzzy Set	b) Crisp Set	
	c) Fuzzy & Crisp Set	d) None of the mentioned	
8.	The values of the set membership is represented by _____		[B]
	a) Discrete Set	b) Degree of truth	
	c) Probabilities	d) Both Degree of truth & Probabilities	
9.	Fuzzy Set theory defines fuzzy operators. Choose the fuzzy operators from the following.		[D]
	a) AND	b) OR	
	c) NOT	d) All of the mentioned	
10.	There are also other operators, more linguistic in nature, called _____ that can be applied to fuzzy set theory.		[A]
	a) Hedges	b) Lingual Variable	

	c) Fuzz Variable	d) None of the mentioned	
11.	Fuzzy logic is usually represented as _____		[B]
	a) IF-THEN-ELSE rules	b) IF-THEN rules	
	c) Both IF-THEN-ELSE rules & IF-THEN rules	d) None of the mentioned	
12.	_____ is/are the way/s to represent uncertainty.		[A]
	a) Fuzzy Logic	b) Probability	
	c) Entropy	d) All of the mentioned	
13.	_____ are algorithms that learn from their more complex environments (hence eco) to generalize, approximate and simplify solution logic.		[C]
	a) Fuzzy Relational DB	b) Ecorithms	
	c) Fuzzy Set	d) None of the mentioned	
14.	Which of the following is/are type of fuzzy interference method		[D]
	a) mamdani	b) sugeno	
	c) rivest	d) only a and b	
15.	Backpropagation can be defined as _____		[C]
	a)It is another name given to the curvy function in the perceptron.	b)It is the transmission of errors back through the network to adjust the inputs.	
	c)It is the transmission of error back through the network to allow weights to be adjusted so that the network can learn.	d)None of the above	
16.	Which of the following exhibits non-linear functions to any desired degree of accuracy?		[C]
	a)Neuro-fuzzy	b)Neuro-genetic	
	c)Fuzzy-genetic	d)None of the above	
17.	A perceptron adds up all the weighted inputs it receives, and if it exceeds a certain value, it outputs a 1, otherwise it just outputs a 0.		[A]
	a) True	b) False	
	c) Sometimes – it can also output intermediate values as well	d) Can't say	
18.	What is the name of the function in the following statement "A perceptron adds up all the weighted inputs it receives, and if it exceeds a certain value, it outputs a 1, otherwise it just outputs a 0"?		[B]
	a) Step function	b) Heaviside function	
	c) Logistic function	d) Perceptron function	
19.	What is true regarding backpropagation rule?		[D]
	a) it is also called generalized delta rule	b) error in output is propagated backwards only to determine weight updates	
	c) there is no feedback of signal at nay stage	d) all of the mentioned	
20.	What are general limitations of back propagation rule?		[D]
	a) local minima problem	b) slow convergence	
	c) scaling	d) all of the mentioned	



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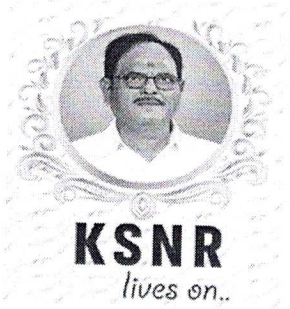


DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VALUE ADDED COURSE ON

"INTELLIGENT CONTROL TECHNIQUES FOR POWER SYSTEM OPERATION AND CONTROL"

Introduction to Intelligent Control & Fuzzy Logic

Learning Outcomes

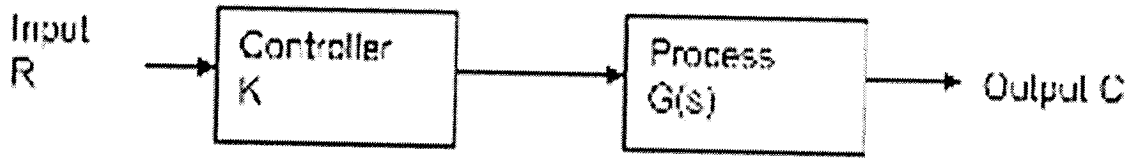
In this topic we shall look at the fundamentals of intelligent control and fuzzy logic. At the end of this topic you should be able to:

- Define intelligent control.
- Define fuzzy logic.
- Explain the structure and operation of fuzzy logic controllers/systems
- Create a fuzzy logic system in Matlab.
- Explain the application of fuzzy logic in mechatronic systems.

Introduction to Intelligent Control

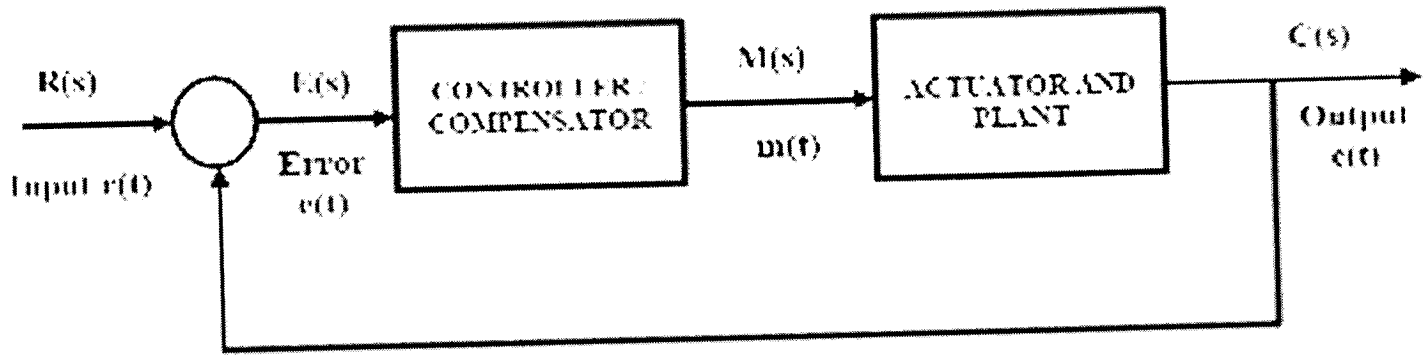
What is Normal (Classical) Control?

- Open loop control system
  - Signal is sent to plant (mechatronic device) in order to make it move to a certain position
  - No feedback to tell if the target has been reached



- Closed-loop control system
  - Output of the plant is feedback to the input side

- Error between input and output is applied to a controller which then controls the plant



- The whole idea behind classical control is that the system to be controlled requires a model.
- The success of the system depends on the accuracy of this model and controller parameters (e.g. PID controller gains).
- The model and the parameters are rigid (i.e. fixed) E.g. first and second order systems and PID controller equation

First order system: $G(s) = \frac{1}{Ts + 1}$

Second order system: $G(s) = \frac{1}{s^2 + 2\zeta\omega_n s + \omega_n^2}$

$$G_c(s) = k_c\left[1 + \frac{1}{\tau_i s} + \tau_d s\right]$$

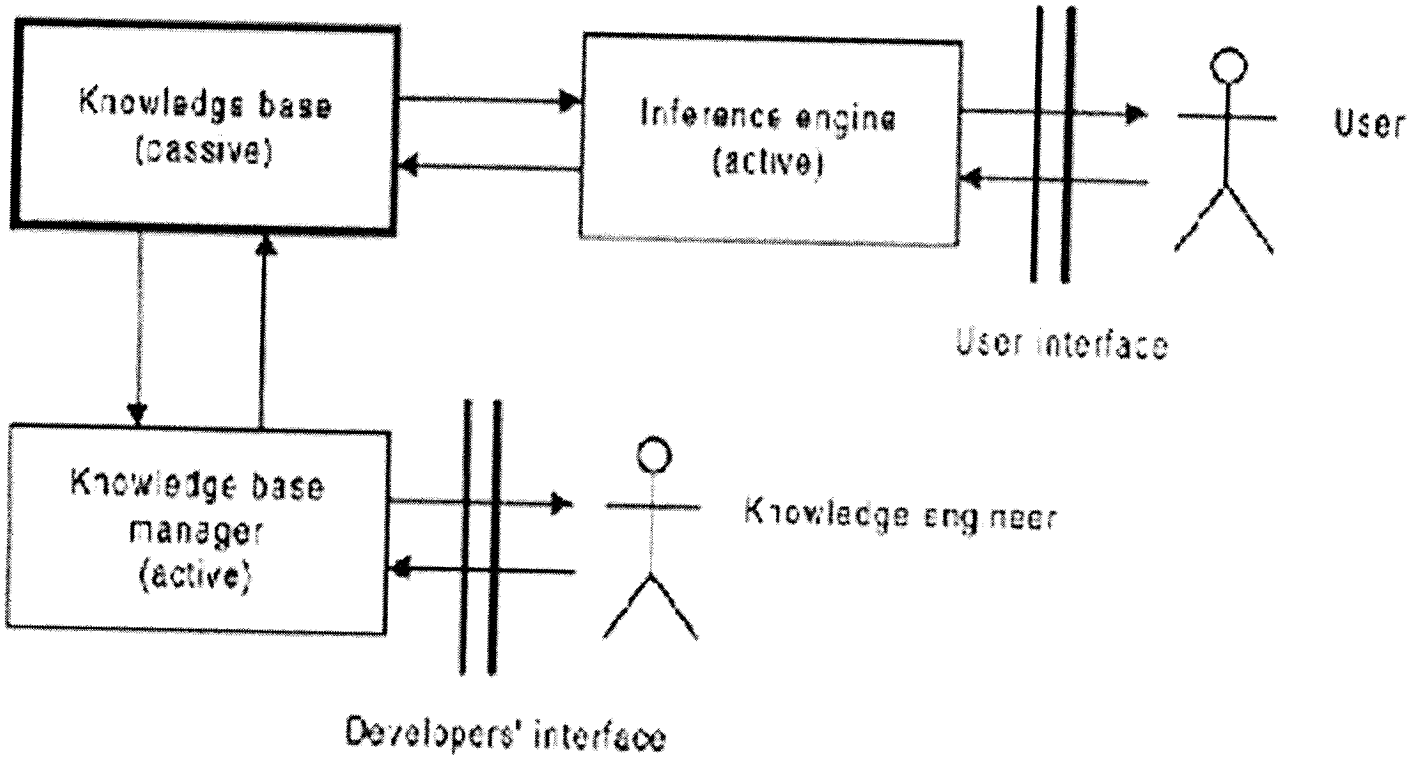
PID controller TF: P I D

What about Intelligent Control?

- The premise behind intelligent control is that the system to be controlled does not have to be rigidly modelled.

- This is unlike classical control and is the biggest distinction between the two approaches.
- Humans can perform complex tasks without knowing exactly how they do them (and without using a rigid model).
- Therefore, one may say that an intelligent method solves
  - A difficult (non-trivial, complex, usually large or complicated) problem
  - In a non-trivial human-like way
- Types of intelligent control include:
  - Fuzzy logic
  - Artificial neural networks
  - Genetic programming
  - Support vector machines
  - Reinforcement learning
- We shall consider Fuzzy logic and artificial neural networks

Components of Intelligent Systems



Structure of intelligent system

- Two categories of components
  - Software Elements
    - Knowledge Base – similar to a database, stores rules and relationships between data elements
    - Inference Engine – is the processing (program) element. Performs reasoning using knowledge base content and inputs
    - Knowledge base manager – resource and consistency management of the knowledge base and relationships between knowledge items
  - Users
    - Knowledge Engineer – design, implement, verify, validate the system
    - User – person or (process/plant/device) that connects to the inference engine

WHAT IS FUZZY LOGIC?

- **Fuzzy**

  Fuzzy – "not clear, distinct, or precise; blurred"

- **Fuzzy logic**

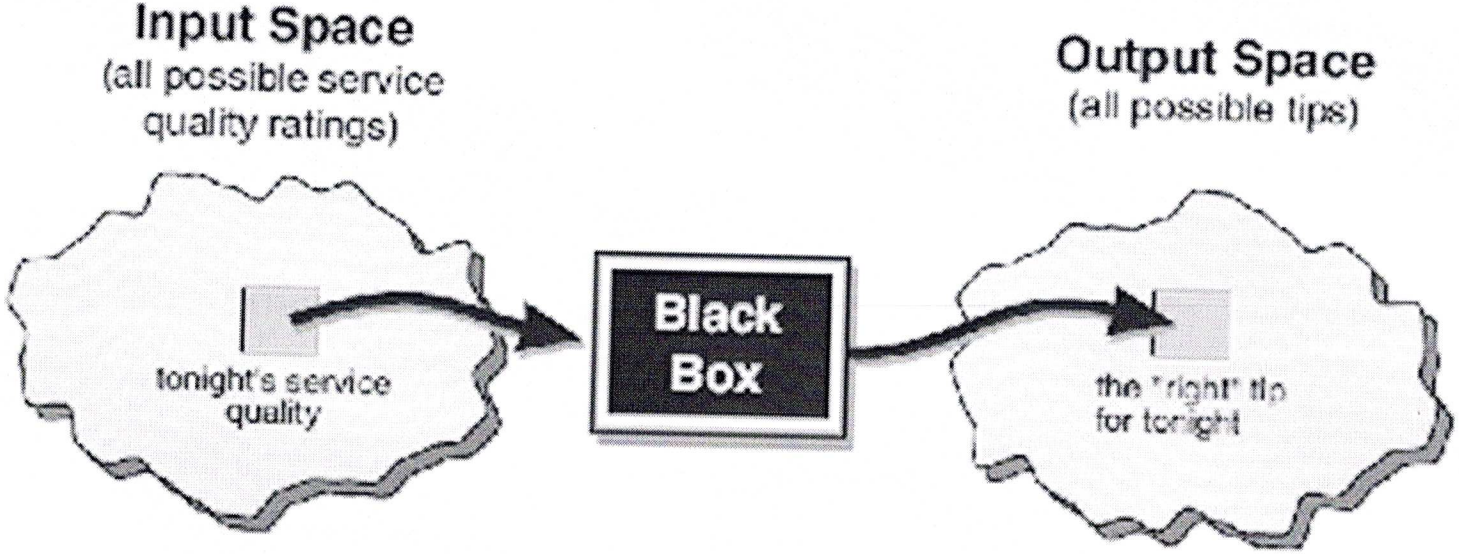
  A form of knowledge representation suitable for notions that cannot be defined precisely, but which depend upon their contexts.

Introduction to Fuzzy Logic

What is Fuzzy Logic?

- Fuzzy logic like most of the intelligent control methods attempts to model the way of reasoning that goes on in the human brain.
- It is based on the idea that human reasoning is approximate, non-quantitative, and non-binary. In many cases, there is no black and white answer, but shades of grey
- The simplest example is temperature. Usually when you as someone the temperature they respond with "cool", "warm", "hot", "very hot" as opposed to telling the exact temperature such as "28.5 degrees" or "33.1 degrees"

- Fuzzy logic is a convenient way to map input space to output space. E.g. How much to tip at a hotel? Input space is the quality of service and output space is the amount of tip.



An input-output map for the tipping problem:
"Given the quality of service, how much should I tip?"

Why use Fuzzy Logic?

Advantages over 'conventional' or 'classical' control:

- Don't need a good mathematical model of process being controlled.
- Control system requires less information
- Can be quicker to implement
- Rules (more details later) can be tested individually

Other advantages include:

1. Conceptually easy to understand – mathematical concepts are simple
2. Flexible – easy to layer on more functionality to existing system

3. Fuzzy logic is tolerant of imprecise data

Applications in Mechatronics include:

1. Speed and position control in mechatronic systems (alternative to PID controllers)
2. Robot trajectory control and obstacle avoidance
3. Control of appliances such as washing machines

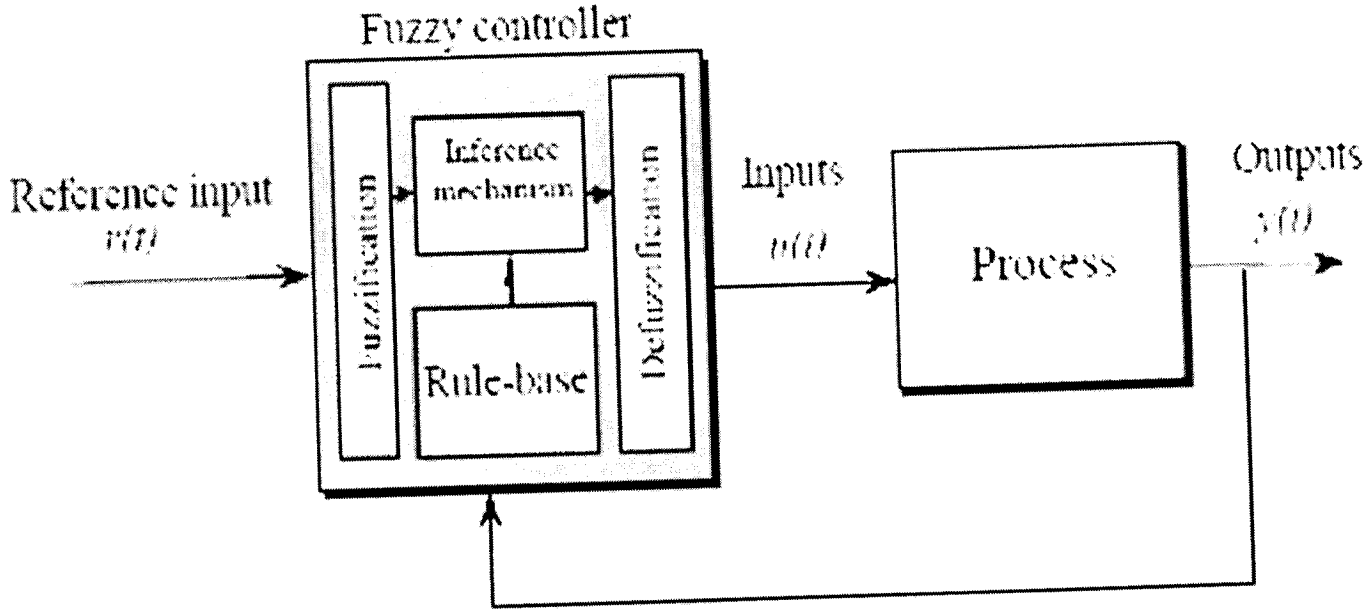
General Approach to Fuzzy Logic Control

The general approach to designing a fuzzy logic controller is made up 5 steps. These steps are

1. Define the Input and Output Variables
2. Define the subsets (Fuzzy sets) intervals

3. Choose the Membership Functions
4. Set the IF-THEN rules
5. Perform calculations (using Fuzzy Inference) and adjust rules

The block diagram of a fuzzy controller is shown below.

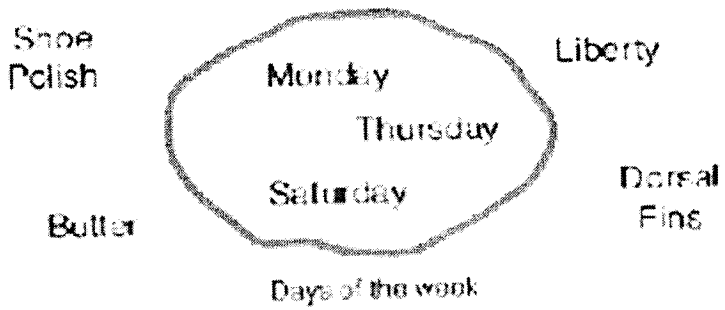


We shall look at Fuzzy sets, Membership Functions, IF-THEN rules, and Fuzzy Inference in the next section. Fuzzy Inference is the combination of Fuzzification, the Inference Mechansim and Defuzzification

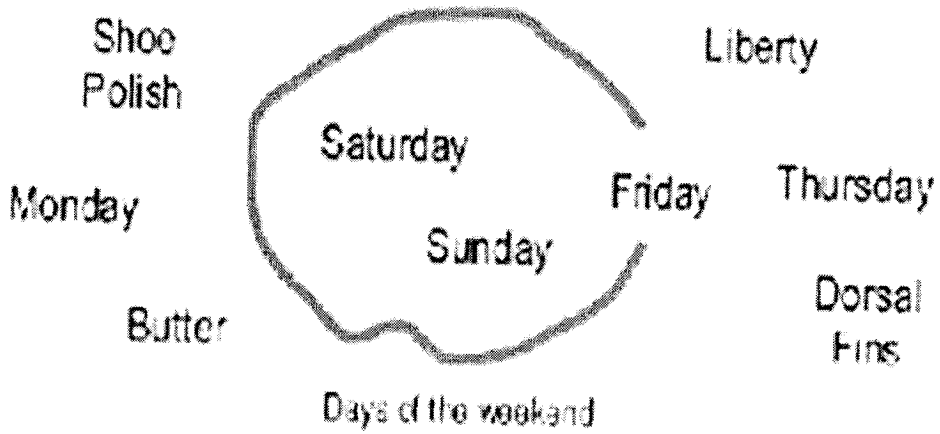
Components of Fuzzy Logic

Fuzzy Sets

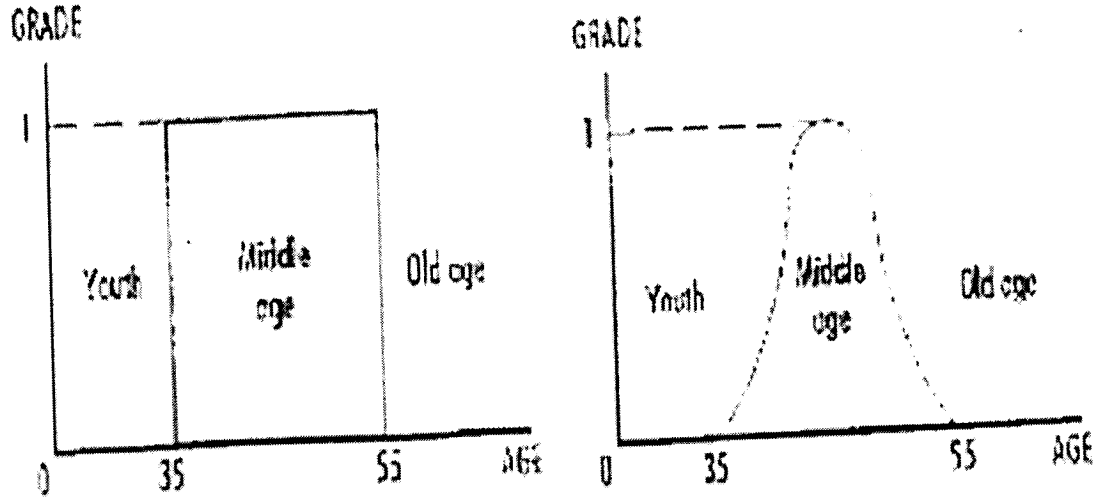
- Fuzzy logic relies on the notion of fuzzy sets
- A fuzzy set is a set without any crisp, clearly defined boundaries.
- It can contain elements with a partial degree of membership.
- Classical sets either wholly include an element or wholly exclude it. E.g. a set of the days of the week



- An example of a fuzzy set would the set of days that make up the weekend



- Another example is age. If we were to ask "what is middle age?, we would be inclined to classify middle age on grade so that we classify middle age as fuzzy, rather than a crisp set.



Crisp set **Fuzzy set**

The curve in the fuzzy set that defines middle age is a function that maps the input space (age) to the output space (middle agedness or grade). Specifically, this is known as a membership function.

Membership Functions

- A membership function (MF) is a curve that defines how each point in the input space is mapped to a membership value (or degree of membership) between 0 and 1.
- The input space is sometimes referred to as the universe of discourse.
- The output-axis is a number known as the membership value between 0 and 1.
- The curve is known as a membership function and is often given the designation of μ.

The only condition a membership function must satisfy is that it must vary between 0 and 1.