Department of Electronics and Communication Engineering

JUIT Waknaghat

A meeting of Board of Studies of the Department of Electronics and Communication Engineering was held on 17.08.2019 at 09:30 AM in the Board Room.

The following members were present

1.	Prof. M.J. Nigam	Chairman
2.	Prof. Samir Dev Gupta	Dean A & R
3.	Dr. Balwinder Singh	External Member
4.	Dr. Rajiv Kumar	Member
5.	Dr. Shruti Jain	Member Secretary
6.	Dr. Meenakshi Sood	Member
7.	Dr. Neeru Sharma	Member
8.	Dr. Shweta Pandit	Member
9.	Dr. Vikas Baghel	Member
10.	Dr. Naveen Jaglan	Co-opted Member
11.	Dr. Nafis uddin Khan	ECE Department
12.	Prof. P. B. Barman	HOD, PMS Department
13.	Dr. Anil Kant	Representative BT & BI Department
14.	Ms. Triambica Gautam	Representative HSS Department

Leave of absence

Leave of absence was granted to the following members by the Chairman Board of Studies:

1. Prof. C.C.Tripathi (External Member)
2. Prof. Debasis Ghosh (External Member)

The Chairman welcomed all the members who were present for the meeting. The meeting thereafter deliberated on agenda items as had been approved by the Chairman.

Item No. 1 : **Confirmation of minutes of Last Meeting of the Board of Studies held on 23.03.2019.**

As per the suggestion of Prof. D. Ghosh in the last BoS meeting, Automatic Control System has been added in 160 course curriculum in 3rd semester.

Also, change in course titles, syllabi of laboratory courses and addition of professional & open electives has been incorporated in the new scheme.

Rest approved

Item No. 2: **To consider the approval of B-Tech ECE Proficiency in Embedded Systems, Communication Technology, Machine Learning, Signal Processing, Digital Image Processing , and Microwave and RF Design**

The new titles of B-Tech Proficiency Program in ECE were approved in lieu of Item No 6 of BoS held on 23-03-2019.

Changes have been approved.

Item No. 3 : To consider the approval of course titles for B-Tech Proficiency Program in ECE.

All the course titles in every proficiency field have been approved.

Item No. 4 : **To consider the approval of course titles for B-Tech Minor Program in ECE.**

As per the suggestion of Dr. Meenakshi Sood, Biomedical Signal Processing course has been replaced to any Elective course run by the department.

Rest as recommended was approved.

Item No. 5 : **To revise the elective course of "Network Theory".**

As recommended was approved

Item No 6: To approve the Course Outcomes (COs) - Program Outcomes (POs) - Program Specific Outcomes (PSOs) attainments for 2018-19 (Odd Semester 2018 and Even Semester 2019).

As recommended was approved

Item No.7: To approve the newly floated Ph.D. course and its syllabus.

Dr. Balwinder Singh has suggested some changes in the syllabus. As per the suggestions changes has been incorporated and provided in **Appendix A**.

Item No 8: To approve the MOOCs to be introduced during the Academic Session 2019-20 for all batches of ECE.

Board has suggested giving only one MOOC of Computer Vision instead of two. So Introduction of Computer Vision has been deleted.

Rest all courses were approved.

Item No. 9: Any other item with the permission of the Chair.

Open Elective floated for 6th semester of 3 credits (3-0-0) for 2017 batch will be considered as Professional elective. The list of electives and their syllabi is provided in **Appendix B**

The meeting concluded at 10:30AM with a vote of thanks by **Prof. M. J. Nigam**, Chairman Board of Studies.

Minutes of BoS held on 17.08.2019

Absent
(Prof. D.Ghosh)

Absent
(Prof. C.C. Tripathi)

17/8/19
(Dr. Balwinder Singh)

(Prof. M. J. Nigam)

(Prof. Samir DevGupta) 17/08/2019

17/08/2019
(Dr. Rajiv Kumar)

17/8/19
(Dr. Shruti Jain)

17/8/19
(Dr. Neeru Sharma)

17.8.19
(Dr. Meenakshi Sood)

17/8/19
(Dr. Shweta Pandit)

(Dr. Vikas Baghel)

Absent
(HOD, CSE/ IT Department)

(HOD, BT / BI Department)

17/8/19
(HOD, PMS Department)

17/8/2019
(HOD, Mathematics Department)

Absent

Triambica Gautam
17/8/19.
(HOD, HSS Department)

Absent
(HOD, Civil Engineering Department)

RECONFIGURABLE COMPUTING

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

Pre-requisite: None

Course Objectives : Students will gain fundamental knowledge and understanding of principles and practice in reconfigurable architecture and computing through class lectures and discussions, and reading assignments.

Course Outcomes :

S.No.	Course Outcomes	Level of Attainment
CO-1	Understand the concept of reconfigurable computing and FPGA architectures.	Familiarity
CO-2	Understand and explore the various FPGA computing platforms in terms of design tools.	Familiarity
CO-3	The student will be able to formulate the specialized arithmetic circuits and powerful techniques like pipelining and unfolding	Assessment
CO-4	Analyze the coarse-grained and fine grain configurability for performance enhancement using multi-FPGA systems.	Assessment
CO-5	To be able to create new designs and analyze advanced techniques such as fault tolerance and partial reconfiguration.	Usage
CO-6	Design, analyze and apply reconfigurable computing in various applications for optimization.	Usage

Course Contents :

S. No.	Contents	Lecture Required
1.	**Introduction:** Test Process and Test Economics, Functional vs Structural Testing Defects, Errors, Faults and Fault Modelling (mainly stuck at fault modelling), Fault Equivalence, Fault Dominance, Fault Collapsing and Checkpoint Theorem.	**8**

2.	**FPGA Architectures and Algorithms of reconfigurable computing :** General overview of computing models, Basic RC concepts, Performance, power, size, and other metrics, RC devices and architecture – fine grained and coarse grained, integration into traditional systems, FPGA computing platforms, Design tools and languages: HDLs, Synthesis, PAR, HLL and HLS, RC application development, domains and case studies, Special topics in RC: Middleware, Fault tolerance, Partial reconfiguration, device characterization.	**8**
3.	**Implementing Applications with FPGAs :** Strengths and Weaknesses of FPGAs, Time to Market, Development Time, Power Consumption, Debug and Verification, FPGAs and Microprocessors, Application Characteristics and Performance, Computational Characteristics and Performance, I/O and Performance, General Implementation Strategies for FPGA-based Systems, Configure-once, Runtime Reconfiguration, Summary of Implementation Issues, Implementing Arithmetic in FPGAs, Fixed-point Number Representation and Arithmetic, Floating-point Arithmetic, Block Floating Point, Constant Folding and Data-oriented Specialization	**9**
4.	**Defect and Fault Tolerance :** Defects and Faults, Defect Tolerance, Substitutable Resources, Yield, Defect Tolerance through Sparing, Defect Tolerance with Matching, Transient Fault Tolerance, Feedforward Correction, Rollback Error Recovery, Lifetime Defects, Detection, Repair, Configuration Upsets,	**8**
5.	**Reconfigurable Computing and Nanoscale Architecture** Trends in Lithographic Scaling, Bottom-up Technology, Nanowires, Nanowire Assembly, Crosspoints, Challenges, Nanowire Circuits, Wired-OR Diode Logic Array , Restoration, Statistical Assembly, nanoPLA Architecture, Basic Logic Block, Interconnect Architecture, Memories, Defect Tolerance, Design Mapping, Density Benefits, Nanoscale Design Alternatives, Imprint Lithography, Interfacing	**9**
	Total	**42**

Suggested Text Book (s) :

1. Scott Hauck and Andre DeHon, Reconfigurable Computing: The Theory and Practice of FPGA-*Based Computation*, Morgan Kaufmann (Elsevier), 2008
2. M. Gokhale and P. Graham, Reconfigurable Computing: Accelerating Computation with Field Programmable Gate Arrays, Springer, 2005
3. C. Bobda, Introduction to Reconfigurable Computing: Architectures, Algorithms and Applications, Springer,2007

Suggested Reference Book(s):

1. D. Pellerin and S. Thibault, Practical FPGA Programming in C, Prentice-Hall, 2005
2. W. Wolf, FPGA-based System Design, Prentice-Hall, 2004
3. R. Cofer and B. Harding, Rapid System Prototyping with FPGAs: Accelerating the

Design Process, Newnes, 2005

4. C. Maxfield, The Design Warrior's Guide to FPGAs, Newnes, 2004
5. F. Vahid and R. Lysecky. VHDL for Digital Design, Wiley, 2007
6. P. Lysaght and W. Rosenstiel (eds.), New Algorithms, Architectures and Applications for Reconfigurable Computing, Springer, 2005

Other useful resource(s):

Link to topics related to course:

Electrical and Computer Engineering Department, Oakland University, http://www.secs.oakland.edu/~llamocca/Fall2015_ece495.html

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, SOLAN

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

PROFESSIONAL ELECTIVES FOR 6th Semester

2017-18

List of Professional Elective for 6th Semester ECE, 2017 batch

S.No.	Professional Electives
1	Applied Artificial Intelligence (with same code)
2	Control Systems (with same code)
3	Microwave Components and Devices (with same code)
4	Neural Networks
5	Embedded Systems

Syllabi of Professional Elective for 6th Semester ECE, 2017 batch

Applied Artificial Intelligence

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

Pre-requisite: None

Course Objectives:

1. Study of design of expert systems which exhibit intelligent behavior.
2. Study of design and development of products using Artificial Intelligence.
3. Participate in the design of systems that act intelligently and learn from experience.
4. To study State of the Art algorithms with engineering applications.

Course Outcomes:

S. No.	Course Outcomes	Level of Attainment
CO-1	Basic methods and algorithms from area of artificial intelligence	Familiarity
CO-2	Identify problems where artificial intelligence techniques are applicable.	Assessment
CO-3	Analysis of problem solving, knowledge and reasoning	Assessment
CO-4	Study of application domains.	Usage

Course Contents:

Unit	Contents	Lectures required
1	**Introduction to Artificial Intelligence (AI):** Overview of AI, Philosophy of AI, AI Foundation and History, Applications of AI in modern world.	**8**
2	**Intelligent Agents:** Agents and Environments, The structure of Agents, Agent Programs, Simple reflex Agents, Model based reflex Agents, Goal based Agents, Utility based Agents, Learning Agents.	**8**
3	**Problem Solving, Knowledge and Reasoning:** Problem solving Agents, Formulating Problems, Searching for Solutions, Uninformed Search Strategies, Knowledge based agents, Knowledge Representation, Uncertain Knowledge and Reasoning	**7**
4	**Machine Learning**: Machine learning concepts, K-nearest neighbors and training-testingLogistic regression, Decision trees, Neural networks, Clustering, Association rules	**7**
5	**Reinforcement Learning:** Learning from Observations, Knowledge in Learning, Statistical Learning, Reinforcement Learning, Perceptional Analysis, Communication as Action	**6**

6	**Applications of AI Techniques:** Semantic Interpretation, Probabilistic Language Processing, Robotic Hardware and Software Architectures, Probabilistic Inference, Planning and Search, Localization, Tracking and Control.	**6**
Total lectures		**42**

Suggested Text Book(s):

1. Stuart J. Russel and Peter Norvig: Artificial Intelligence: A Modern Approach, Third Edition, Pearson Education Limited, 2014.
2. E. Rich and K. Knight: Artificial Intelligence and Applications, Third Edition, Tata McGraw Hill, 2012.

Suggested Reference Book(s):

1. P. Kulkarni and P. Joshi: Artificial Intelligence, Second Edition, PHI Learning Private Limited, 2015.
2. P. H. Winston: Artificial Intelligence and Applications, Third Edition, PHI Learning Private Limited, 2017.

Other useful resource(s):

Link to topics related to course:

i. https://nptel.ac.in/courses/106105077/
ii. https://nptel.ac.in/courses/106105079/
iii. https://www.tutorialspoint.com/artificial_intelligence/

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1.	T-1	15	1 Hour.	Syllabus covered upto T-1
2.	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2) - 10 Attendance - 5

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

Course outcomes (Applied Artificial Intelligence)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	2	2	3	3	2	1	1	1	2	2	2	2	**1.91**
CO-2	3	3	3	3	3	2	1	1	3	2	1	3	**2.33**
CO-3	2	3	2	2	2	2	2	2	2	2	1	2	**2.00**
CO-4	3	3	3	3	2	1	1	1	2	3	2	3	**2.25**
Average	**2.50**	**2.75**	**2.75**	**2.75**	**2.25**	**1.50**	**1.25**	**1.25**	**2.25**	**2.25**	**1.50**	**2.50**	

Control Systems

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

Pre-requisite: None

Course Objectives:

1. To understand procedures for developing mathematical models of physical systems, and related analytical and numerical methods for predicting their behavior.
2. To understand stability of state space models and their controllability and observability in modern automation and control.

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	The ability to analyze any physical system using mathematical model.	Familiarity
CO-2	The ability to formulate reduced models for complex systems.	Familiarity

CO-3	The skill to analyze the response of any LTI system.	Assessment
CO-4	The ability to design any system with desired specifications both in time and frequency domain.	Assessment
CO-5	The ability to derive, interpret and solve problems using modern state space control methods for continuous time and discrete time systems.	Usage
CO-6	The skill to apply advance control schemes for various applications.	Usage

Course Contents:

Unit	Contents	Lectures required
1	**Introduction to Systems and Control:** Open loop and closed loop control systems, components of control system: sensors, actuators, controllers, process, modeling principles of physical systems: electrical, mechanical, thermal and pneumatic systems, effect of feedback on gain, stability, sensitivity and noise, characteristics of transfer function models: poles, zeros, stability and minimal realization, block diagram algebra, signal flow graphs, Mason's gain formula, conversion between block diagram and signal flow graph.	**6**
2	**Response Analysis:** Standard test input signals, transient and steady state response: first, second and higher order systems, system design specifications, error analysis: static and dynamic error coefficients, Effect of adding poles and zeroes, Correlation-ship between time and frequency domain specifications	**8**
3	**Stability Analysis:** Absolute stability, relative stability, routh-hurwitz, root locus, bode plot, polar plot and Nyquist plot techniques, gain margin and phase margin, constant magnitude loci: M-circles, constant phase Loci: N-circles, nichol's chart. system identification: inverse bode plots. Effect of adding zero to the forward path, effect of adding pole to the forward path.	**8**
4	**Compensator Design:** System design specifications, design of compensating networks (Lead, Lag, Lag-Lead) for specified control system performance using root locus and bode plot, concepts and applications of P, PD, PI and PID controllers..	**6**
5	**Linear State Variable Models:** Concept of state, state space modeling: SISO and MIMO systems, useful transformations in state space analysis and design, various forms: physical variable form, phase variable form, Jordan canonical form, solution of state equations, computation of state transition matrix: Laplace	**8**

	method, power series method and Cayley Hamilton method, derivation of transfer function from State variable model, decomposition of transfer function: direct decomposition, cascade decomposition, parallel decomposition, characteristics of linear state variable models, natural and forced responses, determination of controllability and observability of a control system using Kalman and Gilbert tests..	
6	**Advanced Control Schemes:** Control systems with multiple loops- cascade control, selective control systems: override control, split range control, feed-forward and ratio control, adaptive and inferential control systems.	**6**
Total lectures		**42**

Suggested Text Book(s):

1. Benjamin C. Kuo: Automatic Control Systems, 9th Ed., Prentice Hall of India, 2014.
2. Nagrath & Gopal: Control System Engineering, 6th Ed., New Age International Pvt Ltd, 2018.
3. Stephanopoulos, G.: Chemical Process Control, 1st Ed., Prentice Hall of India, 2008.

Suggested Reference Book(s):

1. K. Ogata: Modern Control Engineering, 5th Ed., Prentice Hall India Learning Private Limited, 2010.
2. Norman S. Nise: Control Systems Engineering, 6th Ed., John Wiley & Sons Inc, 2010.
3. Richard C Dorf, Robert H Bishop: Modern Control Systems, 12th Ed., Pearson Edu Pearson, 2014.

Other useful resource(s):

1. Link to NPTEL course contents: Control systems
   https://onlinecourses.nptel.ac.in/noc18_ee41/preview

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2

3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (3) - 10 Quizzes (3) - 10 Attendance - 5

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

Course outcomes (Control Systems)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	2	2	2	2	1	2	1	1	1	1	2	**1.67**
CO-2	3	2	1	3	2	1	1	1	1	1	1	2	**1.58**
CO-3	3	2	1	3	2	1	1	1	1	1	1	2	**1.58**
CO-4	3	3	2	1	2	1	1	1	1	1	1	2	**1.58**
CO-5	3	3	3	1	2	1	1	1	2	1	1	2	**1.75**
CO-6	3	2	2	2	3	1	1	1	1	1	1	2	**1.67**
Average	**3.00**	**2.33**	**1.83**	**2.00**	**2.17**	**1.00**	**1.17**	**1.00**	**1.17**	**1.00**	**1.00**	**2.00**	

Microwave Components and Devices

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

Pre-requisite: None

Course Objectives:

1. To learn the basic operating principles of microwave components.
2. To have a strong foundations in microwave measurements.

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	To understand the basic knowledge of microwave sources.	Familiarity
CO-2	To have a complete knowledge about the wave guide components and their applications in microwave systems.	Assessment
CO-3	To understand and gain knowledge of different active devices and their working principles.	Familiarity
CO-4	To understand and gain thorough knowledge of microwave measurements.	Usage

Course Contents:

Unit	Contents	Lectures required
1	**Microwave Sources:** Microwave transmission lines, Klystron amplifier design and operation, reflex klystron and TWT amplifier and its gain calculations.	**10**
2	**Microwave waveguides:** Parallel plate wave guides, rectangular wave-guides, cylindrical wave-guides, resonators.	**10**
3	**Microwave components:** Directional coupler, E-plane Tee, H-plane Tee, Magic Tee, Microwave circulators, Microwave isolators, Microwave attenuators, microwave phase shifters, microwave impedance matching circuits.	**10**
4	**Microwave Devices:** Principles of microwave transistor, microwave FET, Gunn oscillators, IMPATT diode, TRAPATT Diode, BARITT diode, PIN diode, Tunnel diode.	**6**
5	**Network analysis and Microwave Measurements:** Power measurement, frequency measurement, impedance measurement and VSWR measurement. Scattering parameters and SFG models	**6**
Total lectures		**42**

Suggested Text Book(s):

1. Samuel Y.Liao, " Micro wave Devices and Circuits", 3rd edition, Pearson education,2003.
2. R.E.Collin, "Foundations for microwave Engineering", 2nd edition,Tata Mc Graw Hill,1992.

Suggested Reference Book(s):

1. Annapurna Das,Sisir.K.Das,"Microwave Engineering",Tata McGraw Hill, 2000.
2. Pozar, David M. "Microwave engineering" John Wiley & Sons,2009.

Other useful resource(s):

1. Link to NPTEL course contents: https://nptel.ac.in/courses/108101112/
2. Link to topics related to course: https://nptel.ac.in/courses/108101112/1 to 12

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2) - 10 Attendance - 5

Course Outcomes (COs) contribution to the Programme Outcomes(POs)

Course outcomes (Microwave Components and Devices)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	2	2	2	2	2	1	1	1	2	2	2	1	**1.7**
CO-2	2	3	3	3	3	1	1	1	2	2	2	1	**2.0**
CO-3	2	2	2	2	3	1	1	1	2	2	2	1	**1.8**
CO-4	2	3	3	3	2	1	1	1	2	3	2	1	**2.0**
Average	**2**	**2.5**	**2.5**	**2.5**	**2.5**	**1.0**	**1.0**	**1.0**	**2.0**	**2.25**	**2.0**	**1.0**	

NEURAL NETWORKS

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

Pre-requisite: None

Course Objectives:

1. To understand the fundamental theory and concepts of neural networks, neuro-modeling, several neural network paradigms and its applications
2. Expose the students to neural network applications and develop the skills for engineering design

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Comprehend the fundamental theory and concepts of neural networks	Familiarity
CO-2	Assess the power and usefulness of artificial neural networks and identify different neural network architectures, algorithms, applications and their limitations	Assessment
CO-3	Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications	Assessment
CO-4	Reveal different applications of these models to solve engineering and other problems as pattern matching, control, optimization, and other areas.	Usage

Course Contents:

Unit	Contents	Lectures required
1	INTRODUCTION TO NEURAL NETWORKS Artificial Neural Networks (ANN) and their biological roots and motivations. Comparison Between Artificial and Biological Neural Networks, Applications of Neural network. Network Architecture, Taxonomy of neural networks: feed forward and recurrent networks.	**6**

2	LEARNING PROCESS Types of learning, Error Correction learning, Memory based learning, Boltzmann learning, Credit Assignment Problem. Learning paradigms : supervised and unsupervised learning laws . Learning Laws : Hebb's rule, Delta rule, Widrow - Hoff (The Least-Mean-Square) learning rule, correlation learning rule, instar and outstar learning rules, Competitive learning, Learning Tasks.	**10**
3	SUPERVISED LEANING The Perceptron and its learning law, Classification of linearly separable patterns, Multi-Layer Perceptron, Supervised Learning, Back-Propagation Learning law. Feed forward networks, Recurrent Networks. RADIAL BASIS FUNCTION Neural Networks, Memory based learning, , Boltzmann learning. .	**12**
4	UNSUPERVISED LEANING: Winner takes-all Networks, Competitive Learning, Kohonen's Self organizing Maps Self-organizing Feature-Mapping Algorithm; Properties of SOM algorithms; Examples of Feature Maps; Applications and Adaptive Resonance Theory.	**8**
5	Introduction to Adaptive Resonance Theory and its applications	**3**
6	APPLICATIONS OF NN:ANNs as signal processing devices: Classification, Function approximation and pattern recognition problems. Solving Optimization Problems, Solving Traveling Salesman Problems. Application in Handwritten Character Recognition, Biomedical, Communication, and Healthcare.	**5**
Total lectures		**42**

Suggested Text Book(s):

3. Simon Haykin, "*ArtificialNeutral Networks"* Pearson, 2nd Edition, 2008
4. Yegna Narayanan, *"Artificial Neural Networks"* Prentice-Hall of India, 2010
5. S.N.Sivanandam, S.N Deepa, "*Principles of Soft Computing*" Wiley, 3rd Edition, 2019

Suggested Reference Book(s):

3. L. Fausett, "Fundamentals of Neural Networks: Architectures, Algorithms, and Applications",
Prentice-Hall, 1994

4. Jack M. Zurada, "Introduction to Artificial Neural Systems", PWS Publishing Co., Boston, 2002.

Other useful resource(s):

Link to NPTEL course contents

1. **http://nptel.ac.in/courses/117105084/**
2. **http://nptel.ac.in/courses/106105079/**

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2) - 10 Attendance - 5

Course Outcomes (COs) contribution to the Programme Outcomes(POs)

Course outcomes (Parallel and Distributed Algorithms)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	3	2	2	3	2	1	1	1	2	3	3	**1.92**
CO-2	3	3	3	3	3	2	1	1	1	2	2	3	**2.00**
CO-3	3	3	3	3	3	2	1	1	1	2	2	3	**2.08**
CO-4	3	3	3	3	3	3	3	2	3	3	3	3	**2.58**
Average	**3**	**2.25**	**2.75**	**2.75**	**3**	**1.75**	**1.5**	**1**	**1**	**2.25**	**2.25**	**2.25**	**2.15**

Embedded Systems

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

Pre-requisite: None

Course Objectives:

To learn about the embedded system application areas, design challenges, design and development methodology, tools used for embedded system design, embedded system integration and testing.

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Understand various components of embedded system, design challenges and design metrics	Familiarity
CO-2	Learn about embedded system programming through 8051 microcontroller, programming and I/O interfacing	Usage
CO-3	Comprehend RISC architecture, programming of ARM and PIC microcontrollers	Usage
CO-4	Know about embedded system design and development methodology, tools and languages used for embedded system design	Usage
CO-5	Learn about integration and testing of embedded systems	Assessment

Course Contents:

Unit	Contents	Lectures required
1.	Introduction: Embedded systems overview, Classification, Application areas, Design challenges – real-time execution, physical size, power consumption, multirate operation. Design metrics – time-to-market, unit cost, performance.	4
2.	Typical Embedded System: Core of the embedded system, Sensors and actuators, Communication interface, Embedded firmware	6
3.	8051 Microcontroller: 8051 Architecture, timers and interrupts, Special function registers, Program/ data memory, addressing modes. instruction set, interrupts,	8
4.	ARM Processor Fundamentals and Architectures, ARM Instruction Set, PIC Microcontroller and its Architecture.	10
5.	Design and Development of Embedded product: Analog Electronic Components, Digital Electronic Components, Electronic design automation tools, Embedded firmware design approaches, Embedded firmware development languages	8
6.	Integration and testing of embedded hardware and firmware, Embedded system development environment, Product enclosure design and development, Embedded product development life cycle, Trends in embedded industry	6
Total		42

Suggested Text Book(s):

1. Frank Vahid and Tony Givargis, "Embedded system design: A unified Hardware/Software introduction,"3rd Ed., Wiley 2014
2. Shibu K. V, "Introduction to Embedded Systems," 2nd Ed., McGraw Hill 2017

Suggested Reference Book(s):

1. Steve Furber, "ARM System-on-Chip Architecture," 2nd Ed., Pearson 2012
2. Tim Wilmshurst, "Designing Embedded Systems with PIC Microcontrollers: Principles and Applications," 2nd Ed., Newnes 2009
3. Steven F Barrett and Daniel J Pack, "Embedded Systems Design and Applications with the 68HC12 and HCS12," 1st Ed., Pearson 2012
4. Kenneth Ayala, "The 8051 microcontroller," 3rd Ed., Thomson, 2005

Other useful resource(s):

NPTEL ONLINE COURSES

1. Embedded Systems: https://nptel.ac.in/courses/108105057/ (Prof. A. Routray, Prof. Rajib Mall, Prof. Amit Patra, IIT Kharagpur)
2. Embedded Systems: https://nptel.ac.in/courses/108102045/ (Prof. Santanu Chaudhary, IIT Delhi)
3. Embedded Systems Design: https://nptel.ac.in/courses/106105159/ (Prof. Anupam Basu ,IIT Kharagpur)

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2) - 10 Attendance - 5

Course Outcomes (COs) contribution to the Programme Outcomes(POs)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	Average
CO1	2	X	2	1	2	X	X	X	X	X	3	1	**0.92**
CO2	3	3	3	2	3	2	X	X	2	3	X	3	**2.00**
CO3	3	2	3	2	3	2	X	X	1	2	X	2	**1.67**
CO4	3	2	3	2	3	2	X	X	1	X	X	2	**1.50**
CO5	3	2	3	2	3	2	X	X	X	X	X	2	**1.42**
CO6	3	2	3	2	2	3	X	X	2	2	1	1	**1.75**
Average	**2.83**	**1.83**	**2.83**	**1.83**	**2.67**	**1.83**	**0.00**	**0.00**	**1.00**	**1.17**	**0.67**	**1.83**	