ST. THOMAS' COLLEGE (AUTONOMOUS)
THRISSUR, KERALA – 680001

Affiliated to University of Calicut
Nationally reaccredited with 'A' Grade

CURRICULUM AND SYLLABUS
FOR
POSTGRADUATE PROGRAMME IN ELECTRONICS

UNDER CHOICE BASED CREDIT AND SEMESTER SYSTEM
(w.e.f. 2020 Admission onwards)

ST. THOMAS COLLEGE (AUTONOMOUS), THRISSUR

OUTCOME BASED EDUCATION

POST GRADUATE PROGRAM OUTCOMES

At the end of Post Graduate Program at St. Thomas College (Autonomous), a student would have:

PO1:	Attained profound **Expertise in Discipline**.
PO2:	Acquired **Ability to function in multidisciplinary Domains**.
PO3:	Attained ability to exercise **Research Intelligence** in investigations and Innovations.
PO4:	Learnt Ethical Principles and be committed to **Professional Ethics**.
PO5:	Incorporated **Self-directed and Life-long Learning**.
PO6:	Obtained Ability to maneuver in diverse contexts with **Global Perspective**.
PO7:	Attained **Maturity to respond to one's calling**.

INTRODUCTION

Emerging trends and stimulating developments in the field of science, increasing opportunities and demands at workplace have made it imperative that the Postgraduate science courses be redesigned to cater to the professional aspirations of the students. The present world is in need of professionals who are experts in the respective fields and hence restructuring of any science course should possess components as catalyst to achieve the goals. In response to these changes taking place in society, St. Thomas' college (autonomous) has embarked on a major restructuring exercise for its science courses, introducing M.Sc. programme in alternate pattern.

M.Sc. ELECTRONICS programme is one such course in science stream under Choice Based credit and Semester System of St. Thomas' college (autonomous) affiliated to University of Calicut. This restructured Postgraduate science course provides students with a broad exposure to the critical domains of sciences with adequate background of mathematical sciences. The tools and techniques of computer applications, industry automation, electronics and analytical techniques have a major role in the curriculum.

This programme equip students to create, select, and apply appropriate techniques, resources, modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations. We aim to provide in depth knowledge of the subject starting from its basic concepts to the state of art technologies in use today. Students are also provided extensive laboratory training on the course content basedonthecurrentrequirementsofindustriesandR&D.Thecourseisalsodesignedwitha view to catering to the present day requirements in industries, R&D field, higher studies and self-employment

Programme specific Outcomes:

PSO 1	**Understand techniques in Soft computing, Internet of things, digital system design, and Robotics**
PSO 2	**Apply the principles of digital signal processing using Matlab.**
PSO 3	**Understand the architecture and programming of different microcontrollers.**
PSO 4	**Analyze different communication networks and systems.**
PSO 5	**Understand the mathematical concepts and applications in the field of Numerical Methods, Linear programming, Probability and random variables, Linear Algebra**
PSO 6	**Understand and make aware of new concepts in the field of Electronics**

PROGRAMME STRUCTURE

I SEMESTER

Course	Course Code	Course Title	Internal (%)	External (%)	Credits
Core	ELS1C01	Applied Mathematics	25	75	4
Core	ELS1C02	Microcontroller Based System Design	25	75	4
Core	ELS1C03	Modern Digital and Optical Communication	25	75	4
Core	ELS1C04	Advanced Digital System Design	25	75	4
Practical	ELS1L01	Application Based Programming in Embedded C & Python	25	75	4
Audit	ELS1A01	Introduction to PYTHON Programming	25	75	4
Total Credits (excluding audit course)					20

II SEMESTER

Course	Course Code	Course Title	Internal (%)	External (%)	Credits
Core	ELS2C05	High Performance Communication Networks	25	75	4
Core	ELS2C06	Wireless Communication	25	75	4
Core	ELS2C07	Design of Embedded Systems	25	75	4
Core	ELS2C08	Advanced Microcontrollers	25	75	4
Practical	ELS2L02	Embedded Systems Lab	25	75	4
Audit	ELS2A02	Paper Writing and Seminar	25	75	4
Total Credits (excluding audit course)					20

III SEMESTER

Semester Course	Course Code	Course Title	Internal (%)	External (%)	Credits
Core	ELS3C09	Soft Computing and Optimization Techniques	25	75	4
Core	ELS3C10	Advanced Digital Signal Processing	25	75	4
Core	ELS3C11	Internet of Things	25	75	4
Elective	ELS3E01	Elective 1	25	75	4
Practical	ELS3L03	Communication and DSP Lab	25	75	4
Total Credits					20

List of Elective Courses for ELS3E01 (Choose any one)

ELS3E01A	RISC Processor Architecture & Programming
ELS3E01B	Industrial Instrumentation & Automation
ELS3E01C	VLSI Design and VHDL Programming
ELS3E01D	Satellite Communication

IV SEMESTER

Course	Course Code	Course Title	Internal (%)	External (%)	Credits
Core	ELS4C12	Robotics	25	75	4
Elective	ELS4E02	Elective 2	25	75	4
Elective	ELS4E03	Elective 3	25	75	4
Project	ELS4P01	Project	25	75	6
Viva Voce	ELS4V01	Viva Voce	25	75	2
Total credits					20
List of Elective Courses for ELS4E02 (choose any one)					
ELS4E02A	Cryptography and Network Security				
ELS4E02B	Digital Image Processing				
ELS4E02C	Design of Smart Systems				
ELS4E02D	Verilog Programming				
List of Elective Courses for ELS4E03 (choose any one)					
ELS4E03A	MEMS and NEMS				
ELS4E03B	Wireless Adhoc and Sensor Networks				
ELS4E03C	Neural networks and Applications				
ELS4E03D	Microwave Electronics				
Total credits					80

FIRST SEMESTER				
Course code	**ELS1C01:**			
Name of the course	**APPLIED MATHEMATICS**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
01	**CORE**	**4(4:0:0)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Understand numerical methods for solving algebraic and transcendental equations.	10	U	C	PSO5	PO2
CO2	Identify the numerical methods to solve simultaneous algebraic equation	10	U	C	PSO5	PO2
CO3	Illustrate numerical integration and differentiation methods.	15	Ap	F	PSO5	PO2
CO4	Develop linear programming problems.	10	Ap	F	PSO5	PO2
CO5	Interpret the basic feasible solution of transportation problems.	10	An	F	PSO5	PO2
CO6	Explain basic probability axioms and its different applications	20	Ap	C	PSO5	PO2
CO7	Understand the concept of vector space.	7	U	F	PSO5	PO2
CO8	Interpret linear transformations and eigen value problems.	8	U	C	PSO5	PO2

Numerical Methods (20 hrs)

Solution of algebraic and transcendental equations: Bisection method –Secant method – Newton Raphson method, Solution of simultaneous algebraic equations: Gauss elimination method – Gauss Jordan method –Gauss – Seidel method.

Numerical integration and differentiation (15 hrs)

Numerical Integration methods, Initial value problems: Euler's method, Modified Euler's methods, Runge-Kutta method. Trapezoidal rule, Simpson's rule.Improper Integrals and numerical differentiation.

Linear programming (20 hrs)

Formulation – Graphical solution-Simplex method -Transportation problems: balanced and unbalanced transportation problem-initial basic feasible solution: NW CR and VAM- optimality of transportation problem-Assignment models and solutions.

Probability and random variables (20 hrs)

Probability – Axioms of probability – Conditional probability – Bayes' theorem - Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distribution

Linear Algebra (15 hrs)

Vector spaces- finite dimensional vector space- bases- linear transformations- matrix representation of linear transformation- rank nullity theorem- Eigen values and eigen vectors and basic properties.

Text & Reference Books:

1. Hoffman.k and kunze.R, "Linear Algebra", Second edition, Printice Hall of India, 1991.

2. *Taha.H.A, "Operations Research an Introduction" 6th Edition, PHI, 1997.*

3. Chuchil.R.V, "Operational Mathematics, McGraw Hill, 1972.

4. *Richard A Johnson, Miller and Freund's Probability and Statistics for Engineers, 5th Edition, PHI*

5. S. Narayanan, T.K.ManickvachagamPillay and G.Ramanaiah, Advanced Mathematics for Engineering Students, Vol.II.S.Viswanathan Pvt. Ltd., 1986

6. Numerical Analysis, Santa Kumar.

7. Numerical Methods, Yengar& Jain.

8."Applied Numerical methods for Digital computation" ML James, GM Smith and JC Walford. Harper & Row

9."Introductory methods of Numerical analysis" Sastry SS, 5th Edition, PHI learning.

FIRST SEMESTER				
Course code	**ELS1C02:**			
Name of the course	**MICROCONTROLLER BASED SYSTEM DESIGN**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
02	**CORE**	**4(4:0:0)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Describe the basics of 8051 microcontroller	5	R	C	PSO3	PO1
CO2	Discuss about memory and I/O interfacing	5	U	C	PSO3	PO1
CO3	Ask about I/O programming	5	U	C	PSO3	PO1, PO5
CO4	Discuss about C programming	5	U	C	PSO3	PO1, PO5
CO5	Explain timer, interrupts and serial port in 8051 and its implementation	20	U	C	PSO3	PO1
CO6	Illustrate different interfacing using 8051	20	U	C	PSO3	PO1
CO7	Summarize Arduino and its programming.	15	U	C	PSO3	PO1, PO3
C08	Explain about python programming for Raspberry pi	15	U	C	PSO3	PO1, PO3

INTERFACING OVERVIEW (20 hrs)

Logic devices for Interfacing, Tristate devices, buffers-source and sinking currents-fan out, System design issues, encoders, decoders. Memory and I/O interfacing- chip select, memory map and addresses with examples, Absolute and linear select decoding, Input and output interfacing, Interfacing DIP switch and seven segment LED displays, 8051 pin out and its functions, I/O programming, C programming – logical operators-data conversion programs- Data serialization, Accessing code ROM space.

805I BASED SYSTEM DESIGN (20 hrs)

Power on RESET with momentary switch, minimum connection for 89C51 based systems. Test program in assembly and C. 8051 timer and counter programming in Assembly and C. 8051 serial port programming-connection to RS 232-serial port programming in assembly and C. 8051 Interrupts -Programming timer and external hardware Interrupts-Interrupt priority – Interrupt programming in C

8051 INTERFACING (20 hrs)

LCD and Keyboard interfacing, ADC, DAC, sensor Interfacing and signal conditioning, 8051 interfacing to external memory, 8255 and RTC. RTC programming in C. Alarm, SQW and IRQ features of the DS12887chip. Motor control: Relay,PWM,DC and Stepper motors.

ARDUINO (15 hrs)

Arduino IDE- familiarization of Arduino boards- Arduino UNO- pin Descriptions- Technical specifications- Atmega328 -Communication- Embedded C Programming for Arduino and its applications such as interfacing with Key pad, displays,Sensors and motors .

RASPBERRY PI (15 hrs)

Getting Started with Raspberry Pi Zero, Raspberry Pi board- pin Descriptions- Technical specifications. Programming Raspberry Pi Zero- Python programming for Raspberry - Accessing the GPIO Pins on Raspberry Pi Zero- communication- Interfacing Applications.

Self study:8051 programming in Keil

Text books & References:

1. Microprocessor Architecture, Programming and Applications with8085/8080A: Gaonkar, Wiley Eastern.

2. Microprocessor Interfacing: Douglas Hall, McGraw Hill.

3. The 8051 Microcontroller and Embedded Systems, Muhammed Ali Mazidi and Janice Mazadi, 2000, Prentice Hall.

4. Arduino for dummies by John nussey

5.Arduino AppliedComprehensive Projects for Everyday Electronics, Neil Cameron

6. Beginning C for Arduino-Learn C program for the Arduino, Jack Purdum

7. Programming the Raspberry Pi, Second Edition: Amazon.

8. Getting Started with Raspberry Pi Zero. Richard Grimmett

FIRST SEMESTER				
Course code	**ELS1C03:**			
Name of the course	MODERN DIGITAL AND OPTICAL COMMUNICATION			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
03	**CORE**	**4(4:0:0)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Understand concept of Digital Network	20	U	C	PSO 4	PO1
CO2	Explain Protocol layers	20	U	C	PSO 4	PO6
CO3	Classify LAN hardware and Components	20	An	C	PSO 4	PO5
CO4	Explain concept of optical communication.	10	U	C	PSO 4	PO6
CO5	Explain BER	5	U	C	PSO 4	PO2
CO6	Summarize the nonlinear effects	10	U	C	PSO 4	PO6
CO7	Explain WDM system	5	U	C	PSO 4	PO1

NETWORK HARDWARE AND SOFTWARE (20 hrs)

LAN, MAN, WAN, Wireless and Internetworks, Protocol hierarchies, design issues for the layers, interfaces and services, connection oriented and connectionless services, OSI reference model, TCP/IP model, comparison.

PROTOCOL LAYERS AND THEIR FUNCTIONS(20 hrs)

Physical Layer, Data link Layer: Services provided to Network Layer, Medium Access Sub layer, Elementary ideas of framing Network and Transport layers.

LAN HARDWARE AND COMPONENTS (20 hrs)

Bound and Unbound media and its specifications, switches and Hubs, Bridges and Routers, Structured cabling and Passive components.

OPTICAL LINK DESIGN (15 hrs)

BER Calculation, quantum limit, power penalties, Optical Switches - Coupled mode analysis of directional couplers, Electro switches

NON-LINEAR EFFECTS IN FIBER OPTIC LINKS (15 hrs)

Concept of self phase modulation, group velocity dispersion and soliton based communication. Optical amplifiers- EDFA, Raman Amplifier and WDM systems.

Text & Reference Books

1. *J.Keiser, Fiber Optic communication, McGraw Hill, 2nd Ed 1992*
2. J.E. Midwinter, Optical Fibers for Transmission, John Wiley 1979
3. H.Dutlon, Understanding Optical Communications, Prentice Hall
4. R.P.Lathi, Modern Digital and analog communication systems

5. Proakis JJ, Digital Communications, McGraw Hill

6. A.S. Tanenbaum, "Computer Networks: PHI

FIRST SEMESTER				
Course code	**ELS1C04**			
Name of the course	**ADVANCED DIGITAL SYSTEM DESIGN**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
04	**CORE**	**4(4:0:0)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Establish a digital logic and apply it to solve real life problems.	10	Ap	C	PSO1	PO1,PO3
CO2	Design and implement combinational and sequential logic circuits.	10	C	P	PSO1	PO1,PO3
CO3	Understand digital system design using PLD.	15	U	C	PSO1	PO1,PO3
CO4	Focus different threshold logic functions.	20	An	C	PSO1	PO1
CO5	Explain the FPGA architecture	10	U	C	PSO1	PO1
CO6	Illustrate device technologies, system representation and abstraction levels	15	Ap	F	PSO1	PO1
CO7	Evaluate various Xilinx series	10	An	C	PSO1	PO1,PO3

ADVANCED TOPICS IN BOOLEAN ALGEBRA (20 hrs)

Shannon's expansion theorem, Consensus theorem, Octal designation, Gate expander, Reed Muller expansion, Synthesis of multiple output combinational logic circuits by product map method, design of static hazard free and dynamic hazard free logic circuits.

THRESHOLD LOGIC (20 hrs)

Linear Separability, Unateness, Physical implementation, Dual comparability, Reduced functions, Various theorems in threshold logic, Synthesis of single gate and multigate threshold network. Elementary symmetric functions, partially symmetric and totally symmetric functions, McCluskey decomposition method, Unity ratio symmetric ratio functions, Synthesis of Symmetric function by contact networks.

SEQUENTIAL LOGIC CIRCUITS (20 hrs)

Mealy machine, Moore machine, Trivial/Reversible/Isomorphic sequential machines, State diagrams, State table minimization, Incompletely specified sequential machines, State assignments, Design of synchronous sequential logic circuits working in the fundamental mode and pulse mode, Essential hazards, Unger's theorem.

PROGRAMMABLE LOGIC DEVICES (15 hrs)

Basic concepts, Programming technologies, Programmable Logic Element (PLE) , Programmable Logic Array (PLA), Programmable Array Logic (PAL), Structure of standard PLD's, Complex PLD's (CPLD), System design using PLD's – Design of combinational and sequential circuits using PLD's,

Programming PAL device using PALASM, design of state machine using Algorithmic State Machines (ASM) chart as a design tool.

FIELD PROGRAMMABLE GATE ARRAYS (15 hrs)

Introduction to Field Programmable Gate Arrays – Types of FPGA, Xilinx XC3000 series, Logic Cell array (LCA), Configurable Logic Blocks (CLB), Input/Output Block (IOB)- Programmable Interconnect Point (PIP), Introduction to Actel ACT2 family and Xilinx XC4000 families, Design examples.

Text & Reference Books:

1. William .I. Fletcher, "An Engineering Approach to Digital Design", Prentice Hall of India, 1996.

2. James E.Palmer, David E.Perlman, "Introduction to Digital Systems", Tata McGRaw Hill, 1996.

3. *Stephen Brown &ZvonkoVranesic, Fundamentals of Digital Logic with VHDL design*

4. NN Biswas, "Logic Design Theory", Prentice Hall of India, 1993.

5. S. Devadas, A.Ghosh and K.Keutzer, "Logic Synthesis", McGraw Hill, 1994.

FIRST SEMESTER				
Course code	**ELS1L01**			
Name of the course	**APPLICATION BASED PROGRAMMING IN EMBEDDED C &PYTHON**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
1	**CORE-LAB**	**4(0:0:4)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Understand the basics of Embedded C and Python Programming	35	U	C	PSO3	PO1
CO2	Apply the use of various interfacing devices using Arduino and Raspberry pi boards	55	Ap	P	PSO3	PO1

Embedded C and its Applications for Arduino (At least 8 experiments)

1.interfacing LED and Switches

2.Seven Segment display interfacing

3.Matrix Keypad interfacing

4.LCD interfacing

5.ADC interfacing

6.Timer

7.RTC interfacing

8.Sensor Interfacing – Temperature, Humidity, LDR, IR, Hall effect, Sound, Distance, Accelerometer, Gyroscope etc.(at least 4 sensor interfacing experiments)

9.Interfacing – DC motor, Servo or Stepper Motor.

10.Communication Interfacing – TSOP, GPS, Node MCU, GSM etc. (at least 2 experiments)

Python Programming and its Application for Raspberry Pi (At least 8 experiments)

1.Introduction to python programming

2.Interfacing LED and Switches

3.Seven segment Display interfacing

4.Matrix Keypad interfacing

5.LCD interfacing

6.Sensor Interfacing – Temperature, Humidity, LDR, IR, Hall effect, Sound, Distance, Accelerometer, Gyroscope etc. (at least 4 sensor interfacing experiments).

7.DC motor interfacing.

8.Webcam interfacing

9.Wifi interfacing

ELS1A01 – INTRODUCTION TO PYTHON PROGRAMMING

(ABILITY ENHANCEMENT AUDIT COURSE)

(Credits –4)

Course Evaluation & Course Credit

The Ability Enhancement Audit Course has 4 credits which will not be counted for evaluating the overall SGPA & CGPA. The College/Department shall conduct examination of 2 Hrs duration with a minimum of 20 weightagebefore the conclusion of first semester classes and have to intimate /upload the results of the same to the University on the stipulated date during the III Semester. Students have to obtain only minimum pass requirements in this Audit Course.

Course Delivery Mode

This course is an Ability Enhancement Audit Course. The course content is not delivered in the classrooms. Instead, the students have enroll themselves for the online course offered at NPTEL. The online course is available at https://nptel.ac.in/courses/106106145. Students can either view the video module online or can download the video lessons and transcripts to view or read them offline.

SYLLABUS

ELS1A01: INTRODUCTION TO PYTHON PROGRAMMING

(Credits - 4)

MODULE I (15Hrs)

Introduction to programming, algorithms and data structures viagcd, Downloading and installing Python, gcd in Python: variables, operations, control ow - assignments, condition-als, loops, functions. Python: types, expressions, strings, lists, tuples | Python memory model: names, mutable and immutable values | List operations: slices etc - Binary search | Inductive function definitions: numerical and structural induction | Elementary inductive sorting: selection and insertion sort | In-place sorting.

MODULE II (15Hrs)

Basic algorithmic analysis: input size, asymptotic, complexity, O() notation | Arrays vs lists | Merge sort | Quicksort | Stable sorting. Dictionaries | More on Python functions: optional arguments, default values | Passing functions as arguments | Higher order functions on lists: map, lter, list comprehension

MODULE III (15Hrs)

Exception handling | Basic input/output | Handling les | String processing. Backtracking: N Queens, recording all solutions | Scope in Python: local, global, nonlocal names | Nested functions | Data structures: stack, queue | Heaps.

MODULE IV(10Hrs)

Abstract data types | Classes and objects in Python | "Linked" lists: find, insert, delete | Binary search trees: find, insert, delete | Height-balanced binary search trees.

MODULE V (15Hrs)

Efficient evaluation of recursive definitions: memorization | Dynamic programming: examples | Other programming languages: C and manual memory management | Other programming paradigms: functional programming.

Reference sites:

1. https://nptel.ac.in/courses/106106145
2. https://www.edx.org/learn/python

Text books & reference:

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist‘‘, 2nd edition, Updated for Python 3, Shroff/O‘Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr, “An Introduction to Python“ Revised and updated for Python 3.2, Network Theory Ltd., 2011.

SECOND SEMESTER				
Course code	**ELS2C05**			
Name of the course	**HIGH PERFORMANCE COMMUNICATIONNETWORKS**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
05	**CORE**	**4(4:0:0)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Understand concept of basics of networks.	20	U	C	PSO 4	PO6
CO2	Memorize OSI and IP models	5	R	C	PSO 4	PO4
CO3	Compare different packet switched networks	20	U	F	PSO 4	PO5
CO4	Explain internet and TCP/IP network	10	U	C	PSO 4	PO4
CO5	Understand network design	05	U	C	PSO 4	PO7
CO6	Explain optical network	10	U	C	PSO 4	PO7
CO7	Observe WDM System	05	R	C	PSO 4	PO2
CO8	Understand switching design	10	U	P	PSO 4	PO3

BASICS OF NETWORKS (20 hrs)

Introduction to wired and wireless networks, networking principles, and digitalization: service integration, network services and layered architecture, traffic characterization and QOS, network services: network elements and network mechanisms.

PACKET SWITCHED NETWORKS (25 hrs)

OSI and IP models: Ethernet (IEEE 802.3); token ring (IEEE 802.5), FDDI, DQDB, frame relay: SDMS: internet working with SDMS.

INTERNET AND TCP/IP NETWORKS (20 hrs)

Main features – addressing, signalling and routing: ATM header structure – adaptation layer, management and control; BISDN; Internetworking with ATM, wireless channel, Link level design, channel access; Network design and wireless networks.

OPTICAL NETWORKS AND SWITCHING (25 hrs)

Optical links – WDM systems, cross connects, optical LANs, Optical paths and networks; TDS and SDS; modular switch designs – packet switching, distributes, shared input and output buffers.

Text & Reference Books

1. *Jean Warland and PravinVaraiya, "HighPerformance Communication Networks", 2nd Ed, Harcourt*
and Morgan Kauffman, London, 2000.
2. Leon Garcia, Widjaja, "Communication Networks", Tata McGraw-Hill, New Delhi, 2000
3. SumitKasera, PankajSethi," ATM Networks", Tata McGraw-Hill, New Delhi, 2000.
4. Behrouz A Forouzan, "Data Communication and Networking", TataMcGraw-Hill, New Delhi, 2000.

SECOND SEMESTER				
Course code	**ELS2C06**			
Name of the course	WIRELESS COMMUNICATION			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
06	**CORE**	**4(4:0:0)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Describe about mobile communication techniques and different connecting networks.	15	R	C	PSO4	PO1
CO2	Infer the design fundamentals of cellular systems and technical challenges.	20	U	C	PSO4	PO1
CO3	Understand different propagation models	7	U	C	PSO4	PO1
CO4	Discuss about multiple access techniques	8	U	C	PSO4	PO1
CO5	Describe the principles and applications of modern wireless systems.	20	U	C	PSO4	PO1
CO6	Ask about analog and digital modulation techniques	7	U	C	PSO4	PO1

CO7	Describe about the performance of various modulation techniques	6	U	C	PSO4	PO1
CO8	Describe speech coding and channel coding	7	U	C	PSO4	PO1

INTRODUCTION TO MOBILE COMMUNICATIONS (15 hrs)

Evolution of mobile radio communication, paging systems, cordless telephone systems, wireless in local loop, WLAN, Bluetooth and personal area networks, overview of WIMAX Technologies.

CELLULAR CONCEPT AND SYSTEM DESIGN FUNDAMENTALS (20 hrs)

Cellular concept, Channel assignment and handoff, Interface and system capacity: cells splitting, sectoring and microcells, cellular systems design fundamentals, frequency reuse, channel assignment strategies, handoff strategies, interference and system capacity, improving coverage and capacity.

WIRELESS PROPAGATION (15 hrs)

Wireless propagation mechanism, free space propagation model, ground reflection model, knife edge diffraction model, path loss prediction in hilly terrain, introduction to fading diversity techniques, introduction to MIMO systems, multiple access techniques FDMA ,TDMA spread spectrum, CDMA, OFDM

MODERN WIRELESS COMMUNICATION SYSTEMS (20 hrs)

Comparison of 1G,2G,3G,4G,5G ,GSM system architecture, Radio link aspects, General packet radio service (GPRS), Digital enhanced cordless telecommunication(DECT), Enhanced data rate for global evolution(EDGE)

MODULATION AND SIGNAL PROCESSING (20hrs)

Analog and digital modulation techniques, Performance of various modulation techniques- Spectral efficiency, error rate, power Amplification, Equalizing Rake receiver concepts, Diversity and space time processing, speech coding and channel coding

Text & Reference Books

1. K.Feher, Wireless digital communications, PHI, New Delhi, 1995

2. T.S.Rappaport, Wireless Digital Communications: Principles and Prentice Hall, NJ, 1996.

3. W.C.Y.Lee, Mobile Communications Engineering: Theory And Applications, Second Edition, McGraw Hill, New York, 1998.

4. Schiller, Mobile Communications: Pearson Education Asia Ltd, 2000

5. Simon Haykin, Michael Mohar, Modern wireless communication, Pearson education, 2008

SECOND SEMESTER				
Course code	**ELS2C07**			
Name of the course	DESIGN OF EMBEDDED SYSTEMS			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
07	**CORE**	**4(4:0:0)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Remember ideas about embedded design life cycle	20	U	C	PSO 3	PO 2
CO2	Understand about hardware trends	10	U	C	PSO 3	PO 2
CO3	Identify partitioning decision	10	U	P	PSO 3	PO 2
CO4	Understand toolset and testing methods	15	U	P	PSO 3	PO 2
CO5	Summarize basic concepts of RTOS	8	U	C	PSO 3	PO 2
CO6	Compare different commercial RTOS features	12	Ap	P	PSO 3	PO 2
CO7	Infer embedded product development life cycle	7	U	P	PSO 3	PO 2
CO8	Illustrate different case studies of embedded applications	8	Ap	P	PSO 3	PO 2

DESIGN LIFE CYCLE AND SELECTIONPROCESS (20hrs)

Introduction, Product specification, Hardware software Partitioning, Iteration and implementation, detailed Design, Hardware software integration and Product testing and release. The selection process- packaging the silicon- Adequate performance- RTOS availability- Tool chain availability- Other issues in the selection process.

PARTITIONING DECISION (20hrs)

Hardware/software Duality, Hardware trends, ASIC Revolution, ASIC and Revision costs. The development environment- execution environment, memory organization- system start up. Special software techniques- Manipulating the hardware- speed and code density- Interrupt and ISRs- watchdog timer- flash memory- design methodology.

BASIC TOOLSET AND TESTING (15hrs)

Host based debugging- remote debuggers and Kernels, ROM emulator, Logic analyzer, Bulletproof Run control. Testing- Choosing test cases- Testing embedded software- Performance testing

RTOS BASED EMBEDDED SYSTEM DESIGN (20 hrs)

Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication shared memory, message passing, Interprocess Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance-comparison of commercial RTOS features - RTOS Lite, Full RTOS, VxWorks, μC/OS-II, RT Linux.

EMBEDDED SYSTEM APPLICATION DEVELOPMENT (15 hrs)

Objectives, different Phases &Modelling of the Embedded product Development Life Cycle (EDLC), Case studies on Digital camera- Smart card- Adaptive Cruise control in a Car - Mobile Phone software for key inputs.

Text books & References:

1. *Embedded system Design:* A unified Hardware/ software introduction, Frank Vahid and Tony Givargis, Wiley2001.

2. *Embedded system- Architecture, programming, Design:* Rajkamal, TataMcGrawHill 2003

3. *Fundamentals of Embedded software*- Daniel W Lewis, Prentice Hallof India, 2004

4. Embedded systems design- Arnold berger, CMP books

SECOND SEMESTER				
Course code	**ELS2C08**			
Name of the course	**ADVANCED MICROCONTROLLERS**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
08	**CORE**	**4(4:0:0)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Express the basic features of PIC Microcontrollers	5	U	C	PSO3	PO1
CO2	Understand PIC microcontroller with its registers ,RAM and ROM	20	U	C	PSO3	PO1
CO3	Understand the concepts of PIC programming using Assembly & Embedded C	20	Ap	P	PSO3	PO1
CO4	Explain the concepts of peripherals in PIC microcontroller	20	Ap	P	PSO3	PO1
CO5	Interpret different interfacing techniques using PIC microcontroller	20	An	P	PSO3	PO1
CO6	Interpret the basics of ARM microprocessor	3	U	C	PSO3	PO1
CO7	Explain the Registers-Pipeline- Interrupts in ARM microprocessor	2	U	C	PSO3	PO1

PIC MICROCONTROLLERS-HISTORY AND FEATURES (15 hrs)

Microcontrollers and embedded processors- Overview of PIC 18 family- Introduction to Embedded C – Development tools in embedded system lab.

PIC MICROCONTROLLER (20 hrs)

PIC Architecture- Registers - WREG register- File register- Using instruction with default access bank- status register, data format and directives, program counter -Addressing modes- RAM and ROM allocation.

PERIPHERALS (15 hrs)

Timers, Interrupts, I/O ports, I2C bus, CCP modules, Flash and EPROMS.

PIC PROGRAMMING (20 hrs)

Instruction set,-Arithmetic, logical, branching- time delay loop- CALL Programming in assembly and Embedded C- Interfacing- LCD, ADC and DAC- PIC timer - serial port programming- interrupt programming- CCP programming.

INTRODUCTION TO ARM (20 hrs)

Advanced RISC Machine- ARM architecture- architectural Inheritance- Core and architectures- Registers- Pipeline- Interrupts- ARM organization. Introduction to ARM programming using embedded C.

Text books& References:

1.) *Muhammad Ali Mazidi-Rolin-D-Muckinlay, Danny Caussey. "*PICMICROCONTROLLER AND EMBEDDED SYSTEM USING ASSEMBLY ANDC FOR PIC 18"

2.) *Dorgan Ibrahim.* "ADVANCED PIC MICROCONTROLLER PROJECTS INC*"*

3.) *John B Beatman. "*DESIGN WITH PIC MICROCONTROLLERS" prentice Hall.

4.) *Steve Furber. "*ARM SYSTEM ON CHIP ARCHITECTURE".Addisonwisley 2nd edition.

5.) *Andrew N.Sloss Dominic Sysmes Chris Wright* "ARM SYSTEM DEVELOPMENT GUIDE"*, Morgan Kaufmann Publishers, Reprinted 2010.*

SECOD SEMESTER				
Course code	**ELS2L02**			
Name of the course	**EMBEDDED SYSTEMS LAB**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
2	**CORE-LAB**	**4(0:0:4)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Understand the basics of Embedded C using keil and MPLAB Software's	35	U	C	PSO3	PO1
CO2	Apply the use of various interfacing devices using PIC microcontroller and ARM microprocessor	55	Ap	P	PSO3	PO1

I)PIC16F87X BASED PROGRAMS (At least 12 experiments)

1) Arithmetic and Logical programs
2) Square wave generation using ports
3) Key & LED interfacing
4) Seven segment LED display Interfacing
5) LCD display interfacing
6) ADC Interface
7) Sensor interfacing
8) DAC Interface
9) DC motor interface
10) Stepper motor control

11) Serial communication using RS232C

12) Temperature monitoring and control

13) DAC interface

14) Traffic Light controller

15) Water level controller

16) RTOS Multitasking

II) ARM LPC 2148 BASED PROGRAMS (At least 4 experiments)

1) Square wave generation using ports

2) Key & LED interfacing

3) ADC Interface

4) DAC Interface

5) DC motor interface

6) Stepper motor control

ELS2A02: PAPER WRITING AND SEMINAR

(Credits – 4)

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The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography (at least 15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the author's contributions and critically analysing each paper.
6. Preparing a working outline
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation

The student should give a seminar on his/her work, during the semester, and submit a technical report. Technical report should be prepared in IEEE conference style format.

Course Delivery Mode

Students should be given choice to opt for the supervisor according to his/her area of interest. The Department council will finally decide and distribute the students among the faculty members by accommodating the choice and interest of the students, as far as possible. The faculty in charge must give proper directions and guidance to the students in carrying out the literature review effectively and systematically.

Course Evaluation & Course Credit

The Professional Competency Audit Course has 4 credits which will not be counted for evaluating the overall SGPA & CGPA. The Department shall conduct the final evaluation of the course based on the following criteria and have to intimate /upload the results of the same to the University on the stipulated date during the III Semester.

Components	**Weightage**
Publication of the Review Paper in a UGCListed, Peer Reviewed or other peerreviewed refereed Journals	20% (Maximum weightage must be given to UGC listed Journal and weightage be reduced in other cases)
Presentation in an International/ National/Regional Conference	20% (Maximum weightage must be given toInternational Conferences with Proceedinghaving ISBN and weightage be reduced inother cases
Quality of the Technical Report	40 %
Quality and Effectiveness of the Report presentation	20 %

Students have to obtain only minimum pass requirements in this Audit Course.

REFERENCES

1.Articles from ACM/IEEE/Elsevier/ science direct Journals/Conference proceedings and/or equivalent documents, standard textbooks and web based materials, approved by the supervisor.

THIRD SEMESTER				
Course code	**ELS3C09**			
Name of the course	**SOFT COMPUTING AND OPTIMIZATION TECHNIQUES**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
09	**CORE**	**4(4:0:0)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Identify the applications of neural networks	2	U	C	PSO 1	PO 1
CO2	Understand the principles of neural networks	13	U	C	PSO 1	PO 1
CO3	Infer the concept of fuzzy logic	15	U	C	PSO 1	PO 1
CO4	Illustrate neuro-fuzzy modelling	13	U	C	PSO 1	PO 1
CO5	Intrpret different case studies of neuro-fuzzy models	7	Ap	F	PSO 1	PO 1, PO 3
CO6	Understand the concept of optimization techniques	4	U	C	PSO 1	PO 1
CO7	Understand different conventional optimization techniques	16	U	C	PSO 1	PO 1
CO8	Understand various evolutionary optimization techniques	20	U	C	PSO 1	PO 1

NEURAL NETWORKS (15 hrs)

Machine Learning using Neural Network, Learning algorithms, Supervised Learning Neural Networks – Feed Forward Networks, Radial Basis Function, Unsupervised Learning Neural Networks – Self Organizing map , Adaptive Resonance Architectures, Hopfield network.

FUZZY LOGIC (15 hrs)

Fuzzy Sets – Operations on Fuzzy Sets – Fuzzy Relations – Membership Functions-Fuzzy Rules and Fuzzy Reasoning – Fuzzy Inference Systems – Fuzzy Expert Systems – Fuzzy Decision Making

NEURO-FUZZY MODELING (20 hrs)

Adaptive Neuro-Fuzzy Inference Systems – Coactive Neuro-Fuzzy Modelling – Classification and Regression Trees – Data Clustering Algorithms – Rule base Structure Identification – Neuro-Fuzzy Control – Case Studies.

CONVENTIONAL OPTIMIZATION TECHNIQUES (20 hrs)

Introduction to optimization techniques, Statement of an optimization problem, classification, Unconstrained optimization-gradient search method-Gradient of a function, steepest gradient conjugate gradient, Newton's Method, Marquardt Method, Constrained optimization –sequential linear programming, Interior penalty function method, external penalty function method.

EVOLUTIONARY OPTIMIZATION TECHNIQUES (20 hrs)

Genetic algorithm - working principle, Basic operators and Terminologies, Building block hypothesis, Travelling Salesman Problem, Particle swam optimization, Ant colony optimization.

Text books &References:

1. David E. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addisonwesley, 2009.

2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic-Theory and Applications, Prentice Hall, 1995.

3. James A. Freeman and David M. Skapura, Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Edn., 2003.

4. Jyh-Shing Roger Jang, Chuen-Tsai Sun, EijiMizutani, Neuro-Fuzzy and Soft Computing, Prentice- Hall of India, 2003.

5. Mitchell Melanie, An Introduction to Genetic Algorithm, Prentice Hall, 1998.

6. Simon Haykins, Neural Networks: A Comprehensive Foundation, Prentice Hall International Inc, 1999.

7. Singiresu S. Rao, Engineering optimization Theory and practice, John Wiley & sons, Inc, Fourth

Edition, 2009

8. Timothy J.Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill, 1997.

9. VenkataRao, Vimal J. Savsani, Mechanical Design Optimization Using Advanced Optimization

Techniques, Springer 2012

THIRD SEMESTER				
Course code	**ELS3C10:**			
Name of the course	**ADVANCED DIGITAL SIGNAL PROCESSING**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
10	**CORE**	**4(4:0:0)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Comprehend the basics of DSP	15	U	C	PSO2	PO1
CO2	Explain the basics of Matlab Programming	15	U	P	PSO2	PO1
CO3	Summarize the different attributes of discrete random signal processing	20	U	C	PSO2	PO1
CO4	Analyze the estimation techniques to calculate power spectrum	20	Ap	C	PSO2	PO1
CO5	Explain the basics of multi rate digital signal processing	20	U	C	PSO2	PO1

INTRODUCTION TO DSP (15 hrs)

Signals and system: Operations - Convolution – Correlations, Sampling – Aliasing, Fourier series Fourier transforms- DFT –FFT, Z transforms, Concept of discrete time systems, Concept of filters, IIR and FIR filters

INTRODUCTION TO MATLAB (15 hrs)

Introduction to MATLAB – MATLAB Characteristics – MATLAB Preliminaries– Rules on Variable and Function Names – Special Characters – Basic Arithmetic Operators – Elementary math Intrinsic Functions –File Types.

DISCRETE RANDOM SIGNAL PROCESSING (20 hrs)

Discrete random processes, expectations, variance, co -variance, scalar product, energy of discrete signals- Parseval's theorem, Wiener Khintchine relation- power spectral density- periodogram –sample autocorrelation- sum decomposition theorem, spectral factorization theorem - discrete random signal processing by linear systems - simulation of white noise - low pass filtering of white noise.

SPECTRUM ESTIMATION (20 hrs)

Non-parametric methods-correlation method - co-variance estimator- performance analysis of estimators -unbiased, consistent estimators- windows- periodogram estimator- barlett spectrum estimation - welch estimation- model based approach - ar, ma, arma signal modelling- parameter estimation using Yule - walker method

MULTIRATE DIGITAL SIGNAL PROCESSING (20 hrs)

Mathematical description of change of sampling rate - interpolation and decimation - continuous time model - direct digital domain approach - decimation by an integer factor - interpolation by an integer factor – single and multistage realization - poly phase realization - application to sub band coding - wavelet transform and filter bank implementation of wavelet expansion of signals.

Text books &References:

1. Monson H. Hayes, Statistical Digital Signal Processing And Modeling, John Wiley And Sons, Inc.New York, 1996.

2. Hunt, Lipsman, Rosenberg, A Guide To Matlab, Cambridge

3. JohnG.Proakis, DimitrisG.Manolakis, Digital Signal Processing Prentice Hall Of India, 1995

4. SanjaySharma, SignalsAnd Systems, KatsonBooks,

5. SopoclesJ.Orfanidis, Optimum Signal Processing, McGraw Hill, 1990.

THIRD SEMESTER				
Course code	**ELS3C11**			
Name of the course	**Internet of Things**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
11	**CORE**	**4(4:0:0)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Interpret the vision and levels of IoT	15	Ap	C	PSO 1	PO 1
CO2	Explain IoT architecture and protocols	15	U	C	PSO 1	PO1
CO3	Implement data and knowledge management using different IoT protocols	15	Ap	C	PSO 1	PO1
CO4	Explain the security system with IoT	5	U	C	PSO 1	PO1
CO5	Develop the IoT with Raspberry Pi	10	Ap	P	PSO 1	PO2
CO6	Develop the IoT with Aurduino	10	Ap	P	PSO 1	PO2
CO7	Determine the revolution of internet in web services, cloud and sensor network.	10	Ap	C	PSO 1	PO5
CO8	Understand the web services for IoT	10	U	C	PSO 1	PO7

INTRODUCTION TO IoT (15 hrs)

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology

IoT ARCHITECTURE (15 hrs)

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture

IoT PROTOCOLS (20 hrs)

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP– Security

BUILDING IoT WITH RASPBERRY PI & ARDUINO (20 hrs)

Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.

CASE STUDIES AND REAL WORLD APPLICATIONS (20 hrs)

Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.

Text books &References:

1.ArshdeepBahga, Vijay Madisetti, “Internet of Things A hands-on approach”, Universities Press,2015

2.Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.

3.Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press, 2012

4.Jan Ho¨ ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis,Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age
of Intelligence", Elsevier, 2014.

5.Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012

SEMESTER				
Course code	**ELS3E01A:**			
Name of the course	**RISC PROCESSOR ARCHITECTURE & PROGRAMMING**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
1A	**ELECTIVE**	**4(4:0:0)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Understand AVR architecture	2	U	C	PSO6	PO1
CO2	Practise programming with AVR	15	Ap	P	PSO6	PO1,PO3
CO3	Understand ARM architecture and its instruction sets	8	U	C	PSO6	PO1
CO4	Identify the concept of ARM application development	20	U	C	PSO6	PO1
CO5	Illustrate the use of memory protection and management in RISC machine	20	U	C	PSO6	PO1
CO6	Interpret programming practices in ARM using ASM/C	25	Ap	P	PSO6	PO1,PO3

AVR MICROCONTROLLER ARCHITECTURE (20Hrs)

Architecture – memory organization – addressing modes – I/O Memory – EEPROM – I/O Ports – SRAM –Timer –UART – Interrupt Structure- Serial Communication with PC – ADC/DAC Interfacing

ARM ARCHITECTURE AND PROGRAMMING (15Hrs)

Arcon RISC Machine – Architectural Inheritance – Core & Architectures -- The ARM Programmer's model -Registers – Pipeline - Interrupts – ARM organization - ARM processor family – Co-processors.

Instruction set – Thumb instruction set – Instruction cycle timings

ARM APPLICATION DEVELOPMENT (20Hrs)

Introduction to RT implementation with ARM – –Exception Handling – Interrupts – Interrupt handling schemes- Firmware and boot loader – Free RTOS Embedded Operating Systems concepts –example on ARM core like ARM9 processor.

MEMORY PROTECTION AND MANAGEMENT (20Hrs)

Protected Regions-Initializing MPU, Cache and Write Buffer-MPU to MMU-Virtual Memory-Page Tables-TLB-Domain and Memory Access Permission-Fast Context Switch Extension.

DESIGN WITH ARM MICROCONTROLLERS (15Hrs)

Assembler Rules and Directives- Simple ASM/C programs- Hamming Code- Division-Negation-Simple Loops –Look up table- Block copy- subroutines-application.

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process: Discussions/Exercise/Practice on Workbench:*on* Programming practices on the KEIL Work Bench for Simple ASM/C / Input & output interfacing programs with ARM 7/ARM 9/Nuvoton Processors

Text books &References

1. Steve Furber, 'ARM system on chip architecture', Addison Wesley

2. Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield 'ARM System

3. Developer's Guide Designing and Optimizing System Software', Elsevier 2007.

4. Muhammad Ali Mazidi, SarmadNaimi, SepehrNaimi'AVR Microcontroller and Embedded Systems using Assembly and C", Pearson Education 2014.

5. ARM Architecture Reference Manual, LPC213x User Manual

6. www.Nuvoton .com/websites on Advanced ARM Cortex Processors

THIRD SEMESTER				
Course code	**ELS3E01B**			
Name of the course	**INDUSTRIAL INSTRUMENTATION & AUTOMATION**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
1B	**ELECTIVE**	**4(4:0:0)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Illustrate PC architecture and its interfacing with its peripherals	**20**	**U**	**C**	PSO6	**PO1**
CO2	Understand the use of sensors in industrial measurements	**15**	**U**	**C**	PSO6	**PO1,PO3**
CO3	Illustrate different PC based data acquisition modules in industrial measurements	**10**	**U**	**C**	PSO6	**PO1**
CO4	Familiarize different PC based data acquisition & control system	**10**	**U**	**C**	PSO6	**PO1**
CO5	Identify various components of intelligent instrumentation	**15**	**U**	**C**	PSO6	**PO1,PO3**
CO6	Identify the applications of Programmable logic Controllers	**20**	**U**	**C**	PSO6	**PO1**

IBM PC & INTERFACING(20 hrs)

PC architecture, mother board, memory, bus expansion system (ISA, EISA,PCI etc), external interface standards (like Rs 232, Rs485, Centronics, IEEE488 etc), operating systems, device drivers and system programming, plug and play cards. (to be covered, only to the extent to use PC as anapplication tool)

SELECTED INDUSTRIAL MEASUREMENTS(15 hrs)

Transducers/sensors for general industrial measurement of temperature, force & weight, torque, pressure, flow, level, displacement, thickness and velocity. Signal conditioning (Linearization of measured variables, amplification etc), various type of transmitters, interfacing, calibration etc.

PC BASED DATA ACQUISITION MODULES(20 hrs)

Analog I/O module, digital I/O modules, counter frequency modules, data conversion techniques, etc. controllers: implementation of on/off feedback& feed forward controllers, cascading & tuning of control loop etc, Actuators /final control elements. Software: tools for virtual instrumentation, soft logic, OLE, SCADA, DCS, HMI etc. PC based data acquisition & control system design

INTELLIGENT INSTRUMENTATION (15 hrs)

Design and implementation of fuzzy logic & neural networks based Controllers, smart sensors and transmitters, field programmers

PROGRAMMABLE LOGIC CONTROLLERS(20 hrs)

PLC system architecture, hardware (CPU module, analog I/O modules, Digital I/O modules, counter/frequency modules etc., programming languages (IEC- 1131 –3 based). Programmable logic controllers based system design

Text books &References:

1. Inside The PC: by: Peter Norton: PHI

2. Standards & Recommended Practices for Instrumentation & Control, Vol 1-3: Instrument Society of America

3. Soft logic: by Robert Carrow: McGraw Hill

4. Essentials of user interface design: by Allan Cooper: Comdex

5. Writing Windows Virtual Device Drivers: by David Thielen; Byran.Addison Wesley

6. Programmable Logic Controllers: by Thomas Hughes; Instrument Society of America

7. Instrument Engineers Hand Book, process measurement; by BelaG.Liptak; Instrument Society of America

THIRD SEMESTER				
Course code	**ELS3E01C**			
Name of the course	VLSI DESIGN AND VHDL PROGRAMMING			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
1C	**ELECTIVE**	**4(4:0:0)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Discuss sequential and combinational circuit design using HDL.	5	U	C	PSO6	PO1
CO2	Illustrate MOS transistor theory.	10	U	C	PSO6	PO1
CO3	Understand CMOS technology and its design rules.	15	U	C	PSO6	PO3
CO4	Describe the basics of HDL programming	20	U	C	PSO6	PO1
CO5	Explain combinational circuit design using verilog	20	Ap	P	PSO6	PO3
CO6	Explain sequential circuit design using verilog	20	Ap	P	PSO6	PO3

MOS TRANSISTOR THEORY (15 hrs)

NMOS and PMOS transistors-CMOS logic, MOS transistor theory introduction, Enhancement mode transistor action, ideal IV characteristics, DC transfer characteristics, threshold voltage-body effect second order effects, Small signal AC characteristics, simple MOS capacitance models, detailed MOS diffusion capacitance model

CMOS TECHNOLOGY AND DESIGN RULE (15 hrs)

CMOS fabrication and layout, CMOS technologies – P-well process, N-well process- twin tub process, stick diagrams and layout diagram- layout design rules, overview of IC fabrication steps.

HDL BASICS (20 hrs)

Concepts of HDL – Verilog & VHDL basic concepts, instructions, syntax of programming using VHDL & Verilog, overview of CAD.

COMBINATIONAL CIRCUIT DESIGN USING VERILOG (20 hrs)

Programming using Verilog – combinational circuits – design and coding Half adder, full adder, half subtractor, full subtractor, multiplexer, demultiplexer, encoder and decoder.

SEQUENTIAL CIRCUIT DESIGN USING VERILOG (20 hrs)

Basics of sequential circuits, state diagram, state table, Meely-Moore machines, design and coding using Verilog – flipflops (S-R, J-K, T and D), counters – up and down counters – shift registers – SISO, SIPO, PIPO, PISO.

References & text books

1. Neil H.E Weste and kamranEshraghian, “Principles of CMOS VLSI design”, Pearson education Asia second edition, 2000
2. John.P.Uyemura, “introduction to VLSI circuits and systems”, john wiley& sons Inc 2002

3. Pucknell, “Basics VLSI design”, prentice hall India, publication 1999

4. Samir panikar, “Verilog HDL, A guide to digital design”

5. Peter J Ashenden, The Designer's Guide to VHDL, Harcourt Asia Private Limited & Morgan Kauffman, 1996.

SEMESTER				
Course code	**ELS3E01D**			
Name of the course	SATELLITE COMMUNICATION			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
1D	**ELECTIVE**	**4(4:0:0)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Understand the basics of orbital parameters in satellite communication	15	U	C	PSO6	PO1
CO2	Explain link calculation in satellite communication	10	Ap	C	PSO6	PO1,PO3
CO3	Determine various access techniques used in satellite communication	10	Ap	C	PSO6	PO1,PO3
CO4	Identify Earth station, high power transmitters and antennas used in satellite communication	20	U	F	PSO6	PO1,PO3
CO5	Classify the satellites and discuss its use	10	An	C	PSO6	PO1
CO6	Understand the design of earth station design of satellites	10	U	P	PSO6	PO1,PO3
CO7	Understand how analog & digital technologies used for satellite communication networks	15	U	C	PSO6	PO1,PO3

Orbital Parameters(15 hrs)

Orbital Parameters, Orbital perturbations, Geo-stationary orbits.Low Earth and Medium Earth orbits. Frequency selection, Frequency co-ordination and regulatory services, Sun transit outages, Limits of visibility, Altitude and Orientation control, spin stabilization techniques, Gimbal platform

Link Calculations (20 hrs)

Space craft Configuration, Payload and supporting subsystems, Satellite uplink- down link, link power budget, C/No, G/T, Noise temperature, system Noise, propagation factor, Rain and Ice effects, Polarization calculations.

Access Techniques (15 hrs)

Modulation and Multiplexing: Voice, Data, Video, Analog and Digital Transmission systems, Multiple access techniques: FDMA, TDMA, T1- T2carrier systems, SPADE, SS-TDMA, CDMA, Assignment methods.

Earth Station Parameters(20 hrs)

Earth Station location, Propagation effect of ground, High power transmitters – Klystron, Crossed field devices. Receivers: Low Noise frontend amplifiers, MIC devices, Antennas: Reflector antennas, Cassegrain feeds, Measurements on G/T and Eb/Na

Satellite Applications(20 hrs)

INTELSAT series, INSAT, VSAT, Remote sensing, Mobile Satellite service: GSM, GPS, INMARSAT, Satellite Navigation System, Direct to Home service (DTH), Special services – E-mail, Video conferencing and internet connectivity.

Text books &References:

1. Bruce R. Elbert, "The Satellite Communication Applications Handbook", Artech House Boston, 1997.

2. Wilbur L. Pritchard, HendriSuyderhood G. Robert A, Nelson, "Satellite Communication System Engineering", II Edition, Prentice Hall, New Jersey, 1993.

3. Dennis Rody, "Satellite Communication", Regents/Prentice Hall, Englewoodcliffs, New Jersey, 1989.

4. *Tri.T.Ha, "Digital Satellite Communication", 2nd Edition, McGraw Hill, New York, 1990.*

5. Feher K, Digital Communication Satellite / Earth Station Engineering ", Prentice Hall Inc.

THIRD SEMESTER				
Course code	**ELS3L03**			
Name of the course	**COMMUNICATION AND DSP LAB**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
3	**CORE-LAB**	**4(0:0:4)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Familiarization of MATLAB.	10	U	C	PSO2	PO1
CO2	Implement MATLAB based programs.	10	U	C	PSO2	PO1
CO3	Apply linear and circular convolution	10	Ap	C	PSO2	PO1
CO4	Evaluate DTFT, DFT	10	E	C	PSO2	PO1
CO5	Design of filters using MATLAB	10	An	C	PSO2	PO1
CO6	Construct AM and FM modulation and Demodulation techniques using Simulink	20	Ap	C	PSO4	PO1
CO7	Compute PAM, BFSK, MSK	10	E	C	PSO4	PO1
CO8	Familiarization of optical fiber and optical communication	10	U	C	PSO4	PO1

DSP LAB (at least 12 experiments)

1. Familiarization to MATLAB
2. Matrix Addition
3. Matrix Subtraction
4. Inverse ofthe Matrix
5. Linear Convolution
6. Circular Convolution
7. Discrete Time Signals and Systems
8. DTFT
9. DFT
10. Impulse Response
11. FFT Operation
12. IFFT Operation
13. Verification of Sampling Theorem
14. Design of FIR Filters
15. Design of IIR Filters
16. Z Transforms
17. Familiarization of DSP Trainer Kit from Texas Instrument TMS320 Series

COMMUNICATION LAB (at least 4 experiments)

1. Introduction to Simulink
2. AM- Modulation and Demodulation
3. FM - Modulation and Demodulation
4. Digital Modulation
   i. PAM
   ii. BFSK
   iii. MSK
5. Familiarization of Optical Fiber Trainer Kit & Fundamentals of Fiber Optic Communications

FOURTH SEMESTER				
Course code	**ELS4C12**			
Name of the course	**ROBOTICS**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
12	**CORE**	**4(4:0:0)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Understand the concept of Coordinate transformation.	5	U	C	**PSO 1**	**PO 1**
CO2	Understand the principles of robot kinematics, dynamics and Trajectory planning.	10	U	F	**PSO 1**	**PO 1, PO 5**
CO3	Identify robot hardware and its organization.	15	U	C	**PSO 1**	**PO 1**
CO4	Illustrate the principles and applications of AI in robotics.	10	U	C	**PSO 1**	**PO 1, PO 5**
CO5	Practice programming principles and languages for a robot control system.	10	Ap	F	**PSO 1**	**PO 1, PO 3, PO 5**
CO6	Identify the key principles of Robotic Vision Systems	20	U	C	**PSO 1**	**PO 1**
CO7	Understand various applications of industrial robotic systems.	14	U	C	**PSO 1**	**PO 1, PO 5**
CO8	Compare different types of robot configurations and their role in automation	6	U	F	**PSO 1**	**PO 1, PO 5**

Robot Organization(15 hrs)

Coordinate transformation, kinematics and inverse kinematics. Trajectory planning and remote manipulation

Robot Hardware(15 hrs)

Robot sensors, Proximity sensors, Range sensors, Visual sensors, Audity sensors, Robot manipulators, Manipulator dynamics, manipulator control, Wrists, End efforts, Robot grippers.

Robot and Artificial Intelligence(20 hrs)

Principles of AI.Basics of learning, Planning movement, Basics of knowledge representations, Robot programming languages.

Robotic Vision Systems (20 hrs)

Principles of edge detection, Determining optical flow and shape, image segmentation, Pattern recognition, model directed scene analysis.

Robot Control Application (20 hrs)

Overview of robot applications, Prosthetic devices .Robot in material handling, processing assembly and storage. Industrial applications of Robots, Mobile robots, Micro robots, Recent developments in Robotics.

Self-study Topics:

1. Comparative study of PUMA, SCARA, Articulated robots
2. Robot control methods like voice, infrared
3. Robots in industrial automation
4. Machine Learning and Artificial Intelligence, Machine Learning using Python

Text & Reference Books:

1. Koren. "Robotics for Engineers", McGraw Hill International Company, Tokyo, 1995.

2. Vokopravotic, "Introduction to Robotics", Springer, 1988.

3. Rathmill.K. "Robot Technology and Application", Sringer, 1985.

4. Charniak and McDarmott, "Introduction to Artificial Intelligence", McGraw Hill, 1986.

5. K.S.Fu. R.C.Gonzally, C.S.G.Lee, "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book Company, 1997.

6. Barry Leatham, Jones, "Elements of Industrial Robotics", Pittman Publishing, 1987

7. Mikell P Groover, Mitchell Weiss, Roger. N.Nagel, NocholasG.Odrey, "Industrial Robotic Technology Programming and Applications", McGraw Hill Book Company, 1986.

8. S.R Deb &Sankha Deb, "Robotics Technology and Flexible Automation", Tata McGraw-Hill Education.

FOURTH SEMESTER				
Course code	**ELS4E02A**			
Name of the course	**CRYPTOGRAPHY AND NETWORK SECURITY**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
2A	**ELECTIVE**	**4(4:0:0)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Understand the basics of Cryptography	6	U	C	PSO6	PO 1, PO 2, PO 3
CO2	Understand different encryption techniques	9	U	C	PSO6	PO 1, PO 2, PO 3
CO3	Summarize public key cryptosystems	20	U	C	PSO6	PO 1, PO 2, PO 3
CO4	Understand about message authentication and security	20	U	C	PSO6	PO 1, PO 2, PO 3
CO5	Determine about e-mail security	15	U	P	PSO6	PO 1, PO 2, PO 3
CO6	Understand about IP security and associated problems	20	U	P	PSO6	PO 1, PO 2, PO 3

INTRODUCTION TO CRYPTOGRAPHY (15 hrs)

Overview: Services, Mechanisms and attacks, OSI security architecture, Model for network security.

Classical Encryption Techniques: Symmetric cipher model, Substitution techniques, Transposition techniques, Rotor machine, Steganography, Problems.

Block Ciphers and DES (Data Encryption Standards): Simplified DES, Block cipher principles, DES,Strength of DES, Block cipher design principles, Block cipher modes of operation, Problems.

PUBLIC KEY CRYPTOSYSTEMS (20 hrs)

Public Key Cryptography and RSA: Principles of public key cryptosystems, RSA algorithm, Problems.

Other Public Key Crypto Systems and Key Management: Key management, Diffie- Hellman key exchange, Elliptic curve arithmetic, Elliptic curve cryptography, Problems.

AUTHENTICATION AND SECURITY (20 hrs)

Message Authentication and Hash Functions: Authentication requirements, Authentication functions,Message authentication codes, Hash functions, Security of hash functions and MAC's, Problems.

Digital Signature and Authentication Protocol: Digital signature, Authentication protocols, Digital signature standard.

EMAIL SECURITY (15 hrs)

Electronic Mail Security: Pretty good privacy, S/MIME, Data compression using ZIP, Radix-64 conversion, PGP random number generator.

IP SECURITY (20 hrs)

IP Security: Overview, IP security architecture, Authentication header, ESP (encapsulating securitypay load), Security associations, Key management, Problems.)

Firewalls: Firewall design principles; Trusted systems, Problems.

Text books & References:

1. William Stallings, “Cryptography and Network Security”, 3rd Ed, Pearson Education (Asia)/ Prentice Hall of India, 2003.

2. C. Kaufman, R. Perlman, and M. Speciner, "Network Security: Private Communication in a Public World”, 2nd edition, Pearson Education (Asia) Pte.Ltd., 2002.

3. AtulKahate, “Cryptography and Network Security”, Tata McGraw-Hill, 2003.

4. Eric Maiwald, “Fundamentals of Network Security”, McGraw- Hill, 2003.

FOURTH SEMESTER				
Course code	**ELS4E02B:**			
Name of the course	DIGITAL IMAGE PROCESSING			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
2B	**ELECTIVE**	**4(4:0:0)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Distinguish fundamentals of image processing	15	U	C	PSO6	PO 1 ,PO 2
CO2	Compare different image transforming methods	15	U	F	PSO6	PO 1 ,PO 2
CO3	Infer image enhancement techniques in image processing	10	U	C	PSO6	PO 1 ,PO 2
CO4	Infer restoration methods in image processing	10	U	C	PSO6	PO 1 ,PO 2
CO5	Understand image segmentation techniques	20	U	F	PSO6	PO 1 ,PO 2
CO6	Understand image enhancement techniques	20	U	F	PSO6	PO 1 ,PO 2

DIGITAL IMAGE FUNDAMENTALS (15 hrs)

Elements of digital image processing systems, Vidicon and Digital Camera working principles, Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, Image sampling, Quantization, dither, Two-dimensional mathematical preliminaries.

IMAGE TRANSFORMS (15 hrs)

1D DFT, D transforms – DFT, DCT, Discrete Sine, Walsh, Hadamard, Slant, Haar, KLT, SVD, Wavelet transform.

IMAGE ENHANCEMENT AND RESTORATION (20 hrs)

Histogram modification, Noise distributions, Spatial averaging, Directional Smoothing, Median, Geometric mean, Harmonic mean, Contra harmonic and Yp mean filters. Image restoration – degradation model, Unconstrained and Constrained restoration, Inverse filtering removal of blur caused by uniform linear motion, Wiener filtering, Geometric transformations-spatial transformations, Gray-Level interpolation.

IMAGE SEGMENTATION (20 hrs)

Image segmentation – Edge detection, Edge linking and boundary detection, Region growing, Region splitting and merging.

IMAGE RECOGNITION (20 hrs)

Image Recognition – Patterns and pattern classes, Matching by minimum distance classifier, Matching by correlation. Neural networks-Back propagation network and training, Neural network to recognize shapes.

TEXT BOOKS AND REFERENCES:

1. Rafael C. Gonzalez, Richard E. Woods, 'Digital Image Processing', Pearson Education, Inc., Second Edition, 2004

2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins,‘ Digital Image Processing using MATLAB’, Pearson Education, Inc., 2004.

3. Anil K. Jain, ‘Fundamentals of Digital Image Processing’, Pearson Education, Inc., 2002.

4. D.E. Dudgeon and R.M. Mersereau, ‘Multidimensional Digital Signal Processing’, Prentice Hall Professional Technical Reference, 1990.

5. William K. Pratt, ‘Digital Image Processing’, John Wiley, New York, 2002.

6. Milan Sonka et al, ‘IMAGE PROCESSING, ANALYSIS AND MACHINE VISION’, Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.

FOURTH SEMESTER				
Course code	**ELS4E02C**			
Name of the course	DESIGN OF SMART SYSTEMS			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
2C	**ELECTIVE**	**4(4:0:0)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Understand the overview of smart system designs.	6	U	C	PSO6	PO 2
CO2	Understand different design requirements of embedded systems	9	U	C	PSO6	PO 2
CO3	Compare different applications of embedded systems	11	Ap	C	PSO6	PO 2
CO4	Understand the concept of home automation	15	U	C	PSO6	PO 2
CO5	Discuss the smart appliances and energy management	20	U	C	PSO6	PO 2
CO6	Summarize about embedded systems and robotics	20	U	C	PSO6	PO 2

SMART SYSTEM OVERVIEW (15 hrs)

Overview of smart system design and requirements- Hardware and software selection & co-design-Communications-smart sensors and actuators-Open-source resources for embedded system- android for embedded system- android for embedded system - Embedded system for Ecommerce- Embedded system for Smart card design and development –Recent trends.

MOBILE EMBEDDED SYSTEM (20 hrs)

Design requirements-Hardware platform- OS and Software development platform- Mobile Apps development- Applications: heart beat monitoring, blood pressure monitoring, mobile banking and appliances control.

HOME AUTOMATION (15 hrs)

Home Automation System Architecture-Essential Components- Linux and Raspberry Pi – design and real time implementation.

SMART APPLIANCES AND ENERGY MANAGEMENT (20 hrs)

Overview- functional requirements-Embedded and Integrated Platforms for Energy Management-Energy Measurement Techniques for Smart Metering-Smart Embedded Appliances Networks – Security Considerations.

EMBEDDED SYSTEMS AND ROBOTICS (20 hrs)

Robots and Controllers-components - Aerial Robotics -Mobile Robot Design- Three-Servo Ant Robot- Autonomous Hexacopter System.

Text books &References:

1. Thomas Bräunl, Embedded Robotics, Springer, 2003.

2. Grimm, Christoph, Neumann, Peter, Mahlknech and Stefan, Embedded Systems for Smart Appliances and Energy Management, Springer 2013.

3. Raj Kamal,*Embedded Systems* - Architecture. Programming and Design", McGraw- Hill, 2008

4. NilanjanDey, AmartyaMukherjee, Embedded Systems and Robotics with Open Source Tools, CRC press, 2016.

5. KarimYaghmour, Embedded Android, O'Reilly, 2013.

6. Steven Goodwin, Smart Home Automation with Linux and Raspberry Pi, Apress, 2013

FOURTH SEMESTER				
Course code	**ELS4E02D**			
Name of the course	VERILOG PROGRAMMING			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
2D	**ELCTIVE**	**4(4:0:0)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Understand basic CMOS circuits and its characteristics	15	U	C	PSO6	PO1
CO2	Understand the fundamentals of Verilog programming	15	U	C	PSO6	PO1
CO3	Understand the programming using verilog to implement basic combinational circuits	20	U	C	PSO6	PO7
CO4	Explain different sequential circuits designs	20	Ap	C	PSO6	PO6
CO5	Explain CMOS technology	6	U	C	PSO6	PO6
CO6	Explain various design and implementations of basic circuits using Verilog	14	U	C	PSO6	PO5

CMOS CIRCUITS (15 hrs)

Introduction to CMOS circuits, MOS transistors, operations, ideal I-V characteristics, non ideal I-V characteristics, DC transfer characteristics.

VERILOG BASICS (15 hrs)

Verilog background and basic concepts, instructions, syntax for programming and programming concepts.

COMBINATIONAL CIRCUITS (20 hrs)

Programming using verilog- combinational circuits, half adder, full adder, half substractor , multiplexer, demultiplexer, encoder and decoder

SEQUENTIAL CIRCUITS (20 hrs)

Sequential circuits using verilog – fliflops (SR, JK, T, D), up/down counter, shift registers- serial input serial output, serial input parallel output, parallel input parallel output.

DESIGN AND IMPLEMENTATION (20 hrs)

CMOS technologies, layout design rules, stick diagram, implementation of basic gates using CMOS transistors, hazards and types of hazards.

Text books & references:

1. Navabi.Z, VHDL Analysis and Modeling of Digital Systems, McGraw Hill 1993.
2. Mohammed Ismail and Terri Fiez, Analog VLSI Signal and Information Processing, McGraw Hill, 1994.
3. Peter J Ashenden, The Designer's Guide to VHDL, Harcourt Asia Private Limited & Morgan Kauffman, 1996

FOURTH SEMESTER				
Course code	**ELS4E03A**			
Name of the course	**MEMS AND NEMS**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
3A	**ELECTIVE**	**4(4:0:0)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Identify micro, nano scale systems and their applications	**15**	**U**	**C**	PSO6	**PO 1, PO 3**
CO2	Identify MEMS fabrication technologies	**20**	**U**	**C**	PSO6	**PO 1**
CO3	Interpret the working of various micro sensors.	**15**	**U**	**C**	PSO6	**PO 1, PO 5**
CO4	Interpret the basic approaches for designing various actuators.	**20**	**U**	**F**	PSO6	**PO 1, PO 5**
CO5	Understand the principles of Nano systems	**10**	**U**	**C**	PSO6	**PO 1, PO 2**
CO6	Identify the uses of Quantum mechanics	**10**	**U**	**C**	PSO6	**PO 1, PO 2**

OVERVIEW (15 hrs)

New trends in Engineering and Science: Micro and Nano scale systems, Introduction to Design of MEMS and NEMS, MEMS and NEMS – Applications, Devices and structures. Materials for MEMS: Silicon, silicon compounds, polymers, metals.

MEMS FABRICATION TECHNOLOGIES(20 hrs)

Micro system fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation. Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect- Ratio (LIGA and LIGA-like) Technology; Packaging: Microsystems packaging, Essential packaging technologies, Selection of packaging materials.

MICRO SENSORS (15 hrs)

MEMS Sensors: Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Micro sensors. Case study: Piezo-resistive pressure sensor.

MICRO ACTUATORS (20 hrs)

Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators), Micromechanical Motors and pumps. Case study: Comb drive actuators.

NANOSYSTEMS AND QUANTUM MECHANICS (20 hrs)

Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Schrodinger Equation and Wave function Theory, Density Functional Theory, Nanostructures and Molecular Dynamics, Electromagnetic Fields and their quantization, Molecular Wires and Molecular Circuits.

Self-study Topics:

1. Micro/Nano systems for photonics.
2. Computer-aided design, fabrication, analysis and characterization of nano-structured materials, micro- and nano-scale devices.

Text books & References:

1. Chang Liu, "Foundations of MEMS", Pearson education India limited, 2006.

2. Marc Madou, "Fundamentals of Microfabrication", CRC press 1997

3. Stephen D. Senturia," Micro system Design", Kluwer Academic Publishers, 2001

4. Sergey Edward Lyshevski, "MEMS and NEMS: Systems, Devices, and Structures" CRC Press, 2002.

5. Tai Ran Hsu,"MEMS and Microsystems Design and Manufacture", Tata McGraw Hill, 2002.

FOURTH SEMESTER				
Course code	ELS4E03B:			
Name of the course	WIRELESS ADHOC AND SENSOR NETWORKS			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
3B	**ELECTIVE**	**4(4:0:0)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Understand various MAC protocols developed for Ad Hoc networks.	**7**	**U**	**F**	PSO6	**PO 1, PO 2**
CO2	Identify different TCP protocols developed for Ad Hoc networks.	**8**	**U**	**F**	PSO6	**PO 1, PO 2**
CO3	Understand routing protocols for Ad Hoc wireless networks.	**15**	**U**	**F**	PSO6	**PO 1, PO 3**
CO4	Illustrate the concepts of network architecture and MAC layer protocol for Wireless Sensor Networks.	**20**	**U**	**C**	PSO6	**PO 1, PO 5**
CO5	Identify different protocols and issues in Sensor management	**20**	**U**	**C**	PSO6	**PO 1, PO 3, PO 5**
CO6	Identify and address the security threats in Ad Hoc and sensor networks.	**20**	**U**	**C**	PSO6	**PO 1, PO 3**

MAC & TCP IN AD HOC NETWORKS (15 hrs)

Fundamentals of WLANs – IEEE 802.11 Architecture - Self configuration and Auto configuration-Issues in Ad-Hoc Wireless Networks – MAC Protocols for Ad-Hoc Wireless Networks – Contention Based Protocols - TCP over Ad-Hoc networks-TCP protocol overview - TCP and MANETs – Solutions for TCP over Ad-Hoc Networks.

ROUTING IN AD HOC NETWORKS (15 hrs)

Routing in Ad-Hoc Networks- Introduction-Topology based versus Position based Approaches-Proactive, Reactive, Hybrid Routing Approach-Principles and issues – Location services - DREAM – Quorums based location service – Grid – Forwarding strategies – Greedy packet forwarding – Restricted directional flooding- Hierarchical Routing- Issues and Challenges in providing QoS.

MAC, ROUTING & QOS IN WIRELESS SENSOR NETWORKS(20 hrs)

Introduction – Architecture - Single node architecture – Sensor network design considerations – Energy Efficient Design principles for WSNs – Protocols for WSN – Physical Layer : Transceiver Design considerations – MAC Layer Protocols – IEEE 802.15.4 Zigbee – Link Layer and Error Control issues - Routing Protocols – Mobile Nodes and Mobile Robots - Data Centric & Contention Based Networking – Transport Protocols & QOS – Congestion Control issues – Application Layer support.

SENSOR MANAGEMENT (20 hrs)

Sensor Management - Topology Control Protocols and Sensing Mode Selection Protocols - Time synchronization - Localization and positioning – Operating systems and Sensor Network programming – Sensor Network Simulators.

SECURITY IN AD HOC AND SENSOR NETWORKS(20 hrs)

Security in Ad-Hoc and Sensor networks – Key Distribution and Management – Software based Anti-tamper techniques – water marking techniques – Defense against routing attacks - Secure Adhoc routing protocols – Broadcast authentication WSN protocols – TESLA – Biba – Sensor Network Security Protocols – SPINS.

Text books & References:

1. *Adrian Perrig, J. D. Tygar, "Secure Broadcast Communication: In Wired and Wireless Networks", Springer, 2006.*

2. Carlos De MoraisCordeiro, Dharma PrakashAgrawal "Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition), World Scientific Publishing, 2011

3. C.Siva Ram Murthy and B.S.Manoj, "Ad Hoc Wireless Networks – Architectures and Protocols", Pearson Education, 2004.

4. C.K.Toh, "Ad Hoc Mobile Wireless Networks", Pearson Education, 2002.

5. ErdalÇayırcı,ChunmingRong, "Security in Wireless Ad Hoc and Sensor Networks", John Wiley and Sons, 2009.

6. Holger Karl, Andreas willig, Protocols and Architectures for Wireless Sensor Networks, John Wiley & Sons, Inc .2005.

7. Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, "Ad Hoc Mobile Wireless Networks", Auerbach Publications, 2008.

8. WaltenegusDargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks Theory and Practice", John Wiley and Sons, 2010.

FOURTH SEMESTER				
Course code	**ELS4E03C**			
Name of the course	**NEURAL NETWORKS & APPLICATIONS**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
3C	**ELECTIVE**	**4(4:0:0)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Understand the fundamentals of artificial neural networks.	**15**	**U**	**C**	PSO6	**PO 1**
CO2	Illustrate neural network using back propagation algorithm and its applications.	**10**	**U**	**C**	PSO6	**PO 1, PO 5**
CO3	Understand the fundamentals of Bi-directional Associative memory.	**10**	**U**	**C**	PSO6	**PO 1, PO 5**
CO4	Illustrate the principles of Simulated Annealing and Counter Propagation Network	**15**	**U**	**C**	PSO6	**PO 1, PO 5**
CO5	Illustrate Self organization map and Adaptive Resonance Theory	**20**	**U**	**C**	PSO6	**PO 1,PO 3, PO 5**
CO6	Understand the Architecture of Neocognitron	**20**	**U**	**C**	PSO6	**PO 1,PO 3, PO 5**

Introduction to Artificial Neural Networks (15 hrs)

Neuro - physiology – General Processing Element – ADALINE – LMS learning rule – MADALINE – MR2 training algorithm

BPM and BAM (20 hrs)

Back Propagation Network – updating of output and hidden layer weights- application of BPN – associativeMemory – Bi-directional Associative memory- Hopfield memory – travelling sales man problem

Simulated Annealing and CPN (15 hrs)

Annealing, Boltzmann machine – learning – application – counter Propagation network – architecture – training – Applications

SOM and ART (20 hrs)

Self organization map - learning algorithm – feature map classifier – applications – architecture of Adaptive Resonance Theory – pattern matching in ART network

Neocognitron(20 hrs)

Architecture of Neocognitron – Data processing and performance of architecture of spacio – temporal networks for speech recognition.

Text & Reference Books

1. *J.A. Freeman and B.M. Skapura, "Neural Networks, Algorithms Applications and Programming Techniques", Addison – Wesley, 1990.*

2. LaureneFausett, "Fundamentals of Neural Networks:Architecture, Algorithms and Applications", Prentice Hall, 1994

FOURTH SEMESTER				
Course code	**ELS4E03D**			
Name of the course	MICROWAVE ELECTRONICS			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total Weightage**
3D	**ELECTIVE**	**4(4:0:0)**	**5**	**30**

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PSO	PO
CO1	Understand the principles of microwave communication	**6**	**U**	**C**	PSO6	**PO1**
CO2	Analyse the working of various microwave components and their parameters	**14**	**An**	**F**	PSO6	**PO1,PO3**
CO3	Interpret different Microwave transmission lines	**20**	**Ap**	**F**	PSO6	**PO1, PO5**
CO4	Understand the principles of RF components	**15**	**U**	**C**	PSO6	**PO1,PO3**
CO5	Illustrate the working of RF Microwave Antennas	**20**	**U**	**C**	PSO6	**PO1,PO3**
CO6	Understand the testing of microwave components and circuits with standard microwave bench and vector network analyzer	**20**	**U**	**P**	PSO6	**PO1,PO3,PO5**

Introduction to microwave (15 hrs)

Microwave region and band designation, Advantages, Application. Wave guides-TE, TM, TEM mode field patterns, Guide wavelength, Group velocity, Phase velocity. Microwave components-waveguides, solution of wave equations in rectangular waveguides, structural dispersion, Wave guide Tees – E plane Tee - H plane Tee, E plane Tee, EH plane Tee, Magic Tee, Scattering parameters

Transmission line (20 hrs)

Transmission Line Analysis Importance, Examples of transmission line-Two wire line, Coaxial line. Transmission line parameters, Transmission line equation, Lossless line, Distortion less line, Input impedance, Standing wave ratio, power, Shorted line, Open circuit line, Matched line, Smith chart , analysis of dual transmission lines, introduction to metamaterials

RF Components (15 hrs)

Active RF Components Schottky contact, RF diodes, Schottky diode, PIN diode, Varactor diode, IMPATT diode, Tunnel diode, TRAPATT,BARRITT and Gunn diode, RF transistor (Book 3-Chapter 8)

Antennas (20 hrs)

Introduction, Types of antenna-Wire antenna, Aperture antenna, Microstrip, Array, Reflector, Lens antenna. Antenna parameters-Radiation power density, Radiation intensity, Directivity, Radiation pattern, Bandwidth, Gain, Input impedance, Efficiency, Near field to far field transformations.

Microwave Measurements (20 hrs)

Microwave benches, Frequency measurements, Power measurements, Attenuation measurements, Phase shift measurements, VSWR measurements, Impedance measurements, introduction to vector network analyzers and measurements.

Self-study Topics:

1. Microwave tubes
2. Microwave Integrated Circuit (MIC) devices

Text & Reference Books

1."Microwave and Radar Engineering" M Kulkarni, 1st edition, Umesh Publications

2."Principles of Electromagnetics" Matthew N.O Sadiku, 4th edition, Oxford University Press

3."Microwave Devices and Circuits" Samuel Y Liao, 3rd edition, Prentice-Hall, Inc

4."Antenna Theory Analysis and Design" Constantine A Balanis, 2nd edition, John Wiley and Sons

5. Liao, Samuel Y. *Microwave devices and circuits*. Pearson Education India, 1989.

6."RF Circuit Design-Theory and Applications" Reinhold Ludwig & Powel Bretchko, 1st edition, Pearson Education Ltd.

7."Microwave Engineering" David M Pozar, 2 nd edition, John Wiley and Sons, Inc

MODEL QUESTION PAPERS

ST.THOMAS' COLLEGE (AUTONOMOUS), THRISSUR.
FIRST SEMESTER M.Sc. ELECTRONICS EXAMINATIONMODEL QUESTION PAPER

ELS1C01- APPLIED MATHEMATICS

Time: 3 Hours **Total Weightage: 30**

PART A
Answer any ***four*** questions. (2 Weightages each)

1. By using Newton Raphson Method find the root of the equation $cosx = xe^x$ correct to 3 decimal places using initial approximation $x_0=1$
2. What you mean by distribution of random variables. Which are the two types?
1. Define vector space with an example
2. Express the following LP model in standard form

Max Z = $2x_1 + 3x_2 + 5x_3$
Sub to $+x_2 - x_3 \geq -5$
$-6x_1 + 7x_2 - 9x_3 \leq 4$
$x_1 + x_2 + 4x_3 = 10$
$x_1, x_2 \geq 0$, unrestricted

3. A random variable X has the following probability distribution

x	0	1	2	3	4	5	6	7	8
P(x)	a	$3a$	$5a$	$7a$	$9a$	$11a$	$13a$	$15a$	$17a$

a) Find
b) $(X \leq 2)$
c) Find distribution function of X
d) Find mean of X

4. Solve by Gauss Seidel Method

$$27x + 6y - z = 85$$
$$6x + 15y + 2z = 72$$
$$x + y + 54z = 110$$

7. Find the numerical solution of the initial value problem $\frac{dy}{dx} = \frac{y+x}{y-x}, y(0) = 1$ at $x = 0.4$ taking h=0.2.

(2 x 4 = 8 weightages)

PART B
Answer any ***four*** questions. (3 Weightages each)

8. Determine the feasible space for each individual constraint, given that $x_1, x_2 \geq 0$

$-3x_1 + x_2 \leq 7$
$x_1 - 2x_2 \geq 5$
$2x_1 - 3x_2 \leq 8$
$x_1 - x_2 \leq 0$
$-x_1 + x_2 \geq 0$

9. If μ_r denote the r^{th} central moment of a Binomial distribution with parameters n & p, prove that $\mu_{r+1} = pq\left(nr\mu_{r-1} + \frac{d\mu}{dp}\right)$

10. Solve by Gauss elimination method

$x_1 + 2x_2 + 3x_3 = 7$
$2x_1 + 7x_2 + 15x_3 = 26$
$3x_1 + 15x_2 + 41x_3 = 26$

11. (a) Distinguish improper integral of 1^{st} kind and 2^{nd} kind

$(b) evaluate \int_1^{\infty} \frac{1}{x^2} dx$

12. Solve the system using Gauss-Jordan method

$x + 2y + z = 8$
$2x + 3y + 4z = 20$
$4x + 3y + 2z = 16$

13. Which of the following functions $T: R^2 \to R^2$ are linear transformation?

$(a) T(x_1, x_2) = (1 + x_1, x_2)$

(b) $(x_1, x_2) = (x_2, x_1)$

14. Let $T: R^2 \to R^2$ is linear transformation defined by $T(x, y) = (2x - 3y, x + y)$.

Find matrix of T with respect to the ordered basis B = {(1, 0), (0, 1)} and $B^{'}$ = {(1, 2), (2, 3)}

(3 x 4 = 12 weightages)

PART C

Answer any ***two*** questions. (5 Weightages each)

15. (a) State and prove Baye's theorem

(b) If x represents the outcome when a fair die is tossed. Find the MGF of x and hence

E(x) and Variance

16. State and prove Rank Nullity theorem

17. Using VAM method, Find out the objective value

	1	2	3	4	supply
1	10	2	20	11	15
2	12	7	9	20	25
3	4	14	16	18	10
Demand	5	15	15	15	

18. $\frac{dy}{dt} = \frac{y-t}{y+t}$ with initial condition y=1 at t=0, find y at t=0.1 in 5 steps using modified Euler method.

(5 x 2 = 10 weightages)

PATTERN OF QUESTION PAPER (MSc)

SEMESTER: M.Sc. 1st Semester

BRANCH: ELECTRONICS

ELS1C01- APPLIED MATHEMATICS

Contact Hours per Week : 5

Number of Credits : 4

Number of Contact hours : 90

Maximum Weightage : 30 Weightage

Duration of Exam : 3 Hr

Module Blue Print For Question Paper Setting / Scrutiny			
Maximum Weightage: 30			
Question Paper			Syllabus
Sections or Parts	Weightage	Question Numbers	MODULE:
A	2	1.	1
		2.	4
		3.	5
		4.	3
		5.	4
		6.	1
		7.	2
B	3	8.	3
		9.	4
		10.	1
		11.	2
		12.	1
		13.	5
		14.	5
C	5	15.	4
		16.	5
		17.	3
		18.	2
Total Weightage >>>>			55

ST.THOMAS' COLLEGE (AUTONOMOUS), THRISSUR.
FIRST SEMESTER M.Sc. ELECTRONICS EXAMINATIONMODEL QUESTION PAPER

ELS1C02-MICROCONTROLLER BASED SYSTEM DESIGN

Time: 3 Hours **Total Weightage: 30**

PART A
Answer any *four* questions. (2 Weightages each)

1. Describe about memory and IO interfacing
2. Write a short note on data serialization
3. Explain about power on reset with momentary switch
4. What is meant by LCD and keyboard interfacing
5. Write a short note on sensor interfacing and signal conditioning
6. Explain about Arduino IDE
7. Explain about technical specification of Raspberrypi

(2 x 4 = 8 weightages)

PART B
Answer any *four* questions. (3 Weightages each)

8. Explain about data conversion programs
9. Brief description about 8051 serial port programmingwith example.
10. Write a short note on RS 232
11. Explain about RTC programming in c
12. Brief description about 8051 interfacing to external memory
13. Explain about Arduinouno and its pin out
14. Brief description of python programming for Raspberry pi

(3 x 4 = 12 weightages)

PART C
Answer any *two* questions. (5Weightages each)

15. Write a short note on
    I) Interfacing DIP switch
    II) Seven segment LED displays
16. What is meant by interrupts and also explain about interrupt priority
17. Describe embedded c programming for arduino and its applications
18. Write a short note on
    I) Accessing the GPIO pins on Raspberrypi
    II) Interfacing applications

(5 x 2 = 10 weightages)

PATTERN OF QUESTION PAPER (MSc)

SEMESTER: M.Sc. 1st Semester

BRANCH: ELECTRONICS

ELS1C02: MICROCONTROLLER BASED SYSTEM DESIGN

Contact Hours per Week : 5

Number of Credits : 4

Number of Contact hours : 90

Maximum Weightage : 30 Weightage

Duration of Exam : 3 Hr

Module Blue Print For Question Paper Setting / Scrutiny			
Maximum Weightage: 30			
Question Paper			Syllabus
Sections or Parts	Weightage	Question Numbers	MODULE:
A	2	1.	1
		2.	1
		3.	2
		4.	3
		5.	3
		6.	4
		7.	5
B	3	8.	1
		9.	2
		10.	2
		11.	3
		12.	3
		13.	4
		14.	5
C	5	15.	1
		16.	2
		17.	4
		18.	5
Total Weightage >>>>			55

ST.THOMAS' COLLEGE (AUTONOMOUS), THRISSUR.
FIRST SEMESTER M.Sc. ELECTRONICS EXAMINATIONMODEL QUESTION PAPER

ELS1C03-MODERN DIGITAL AND OPTICAL COMMUNICATION

Time: 3 Hours **Total Weightage: 30**

PART A

Answer any ***four*** questions. (2 Weightages each)

1. Distinguish between MAN and WAN.
2. Explain VPN.
3. Explain the design issues of network layer.
4. Distinguish between switches and hubs.
5. Distinguish between bounded and unbounded media?
6. What is meant by BER?
7. What is meant by WDM?

(2 x 4 = 8 weightages)

PART B

Answer any ***four*** questions. (3 Weightages each)

8. Write a short note on ISO OSI model?
9. Detail about the concept of 'framing'.
10. Differentiate between bound and unbound media.
11. Discuss briefly about structured cabling for LAN environment.
12. Write a short note on optical switches.
13. What are solitons? Explain different types of solitons.
14. Write a note on Raman amplifiers.

(3 x 4 = 12 weightages)

PART C

Answer any ***two*** questions. (5Weightages each)

15. Explain in detail about the layers of TCP/IP model
16. Explain in detail about the different routing Algorithms used in Network Layer.
17. Write note on the various power penalties associated with the design of an optical link.
18. Explain the amplification mechanism, architecture and power conversion efficiency of EDFA. **(5 x 2 = 10 weightages)**

PATTERN OF QUESTION PAPER (MSc)

SEMESTER: M.Sc. 1st Semester.

BRANCH: ELECTRONICS

ELS1C03-MODERN DIGITAL AND OPTICAL COMMUNICATION

Contact Hours per Week : 5

Number of Credits : 4

Number of Contact hours : 90

Maximum Weightage : 30 Weightage

Duration of Exam : 3 Hr

Module Blue Print For Question Paper Setting / Scrutiny			
Maximum Weightage: 30			
Question Paper			Syllabus
Sections or Parts	Weightage	Question Numbers	MODULE:
A	2	1.	1
		2.	1
		3.	2
		4.	3
		5.	3
		6.	4
		7.	5
B	3	8.	1
		9.	2
		10.	3
		11.	3
		12.	4
		13.	4
		14.	5
C	5	15.	1
		16.	2
		17.	4
		18.	5
Total Weightage >>>>			55

ST.THOMAS' COLLEGE (AUTONOMOUS), THRISSUR.

FIRST SEMESTER M.Sc. ELECTRONICS EXAMINATION MODEL QUESTION PAPER

ELS1C04-ADVANCED DIGITAL SYSTEM DESIGN

Time: 3 Hours Total Weightage: 30

PART A

Answer any ***four*** questions. (2 Weightages each)

1. Explain Shannon expansion theorem
2. Explain theorems of threshold logic
3. Write short note on PLA
4. Find octal designation of f(A,B,C,D) = AB'+CD
5. What are the features of FPGA?
6. With the help of an example explain state diagram
7. Explain about PLD with block diagram

(2 x 4 = 8 weightages)

PART B

Answer any ***four*** questions. (3 Weightages each)

8. Implement full adder using i) PLA ii) PAL
9. What is the difference between mealy and moore machines?
10. Synthesize the following using product map method

    $f_1(a,b,c)= \sum m(0,2,3,5,6) f_2(a,b,c)= \sum m(0,1,2,3,4,7)$ $f_3(a,b,c)= \sum m(2,3,4,5,6)$
11. Distinguish total and partial symmetric functions with example
12. What are the different types of FPGA?
13. What is essential hazard and how can you remove essential hazard?
14. Explain in detail about the structure of CPLD

(3 x 4 = 12 weightages)

PART C

Answer any ***two*** questions. (5 Weightages each)

15. Solve the function $\sum m(0,1,2,3,5,6,7,8,9,10,14)$ usingQuineMcCluskey method
16. With the help of neat diagram explain configurable logic block and IO block of

XC4000 series

17. Explain in detail about static hazards and its detection
18. Design an asynchronous sequential circuit working in fundamental mode and pulse mode **(5 x 2 = 10 weightages)**

PATTERN OF QUESTION PAPER (MSc)

SEMESTER: M.Sc. 1st Semester

BRANCH: ELECTRONICS

ELS1C04-ADVANCED DIGITAL SYSTEM DESIGN

Contact Hours per Week : 5

Number of Credits : 4

Number of Contact hours : 90

Maximum Weightage : 30 Weightage

Duration of Exam : 3 Hr

Module Blue Print For Question Paper Setting / Scrutiny			
Maximum Weightage: 30			
Question Paper			Syllabus
Sections or Parts	Weightage	Question Numbers	MODULE:
A	2	1.	1
		2.	2
		3.	4
		4.	1
		5.	5
		6.	3
		7.	4
B	3	8.	4
		9.	3
		10.	1
		11.	2
		12.	5
		13.	3
		14.	4
C	5	15.	2
		16.	5
		17.	1
		18.	3
Total Weightage >>>>			55

ST.THOMAS' COLLEGE (AUTONOMOUS), THRISSUR.
SECOND SEMESTER M.Sc. ELECTRONICS EXAMINATION
MODEL QUESTION PAPER

ELS2C05: HIGH PERFORMANCE COMMUNICATIONNETWORKS

Time: 3 Hours Total Weightage: 30

PART A

Answer any ***four*** questions. (2 Weightages each)

1. What is meant by CATV?
2. What do you mean by virtual connections?
3. What do you mean by channel capacity of a transmission system?
4. Explain about FDDI network.
5. Explain the MAC sublayer of Ethernet network.
6. What is the need of AAL layer?
7. What is meant by Optical LAN?

(2 x 4 = 8 weightages)

PART B

Answer any ***four*** questions. (3 Weightages each)

8. Write a short note on network elements and network mechanism.
9. Write a short note on connection oriented and connectionless services.
10. Explain DQDB.
11. Write a short note on SMDS.
12. Write a short note on BISDN.
13. What are the duties of an ATM switch?
14. Discuss the role of WDM systems in high performance communication networks.

(3 x 4 = 12 weightages)

PART C

Answer any ***two*** questions. (5 Weightages each)

15. Clearly explain the role of all layers of OSI reference model.
16. Explain on ATM header structure in detail with neat diagram.
17. Explain TDS and SDS.
18. Discuss the various types of buffers such as packet switching, distributed, shared input and output buffers.

(5 x 2 = 10 weightages)

PATTERN OF QUESTION PAPER (MSc)

SEMESTER: M.Sc. 1st Semester.

BRANCH: ELECTRONICS

ELS2C05: HIGH PERFORMANCE COMMUNICATIONNETWORKS

Contact Hours per Week : 5

Number of Credits : 4

Number of Contact hours : 90

Maximum Weightage : 30 Weightage

Duration of Exam : 3 Hr

Module Blue Print For Question Paper Setting / Scrutiny			
Maximum Weightage: 30			
Question Paper			Syllabus
Sections or Parts	Weightage	Question Numbers	MODULE:
A	2	1.	1
		2.	1
		3.	1
		4.	2
		5.	2
		6.	3
		7.	4
B	3	8.	1
		9.	1
		10.	2
		11.	2
		12.	3
		13.	3
		14.	4
C	5	15.	2
		16.	3
		17.	4
		18.	4
Total Weightage >>>>			55

ST.THOMAS' COLLEGE (Autonomous) THRISSUR
FIRST SEMESTER M.Sc. ELECTRONICS MODEL QUESTION PAPER

ELS2C06- WIRELESS COMMUNICATION

Time: 3 Hours Total Weightage: 30

PART A

Answer any Four(2 Weightage each)

1. Explain about personal area network
2. What are cellular system design fundamentals?
3. What is GPRS?
4. What is cordless telephone systems?
5. What is meant by spectral efficiency?
6. Explain ground reflection model
7. Explain power amplification (4×2 = 8Weightages)

PART B

Answer any Four (3 Weightage each)

8. What is digital enhanced cordless telecommunication?
9. Explain TDMA spread spectrum
10. Write a note on WLAN
11. What are the design fundamentals of cellular systems?
12. Explain speech and channel coding
13. Explain MIMO systems
14. What is WIMAX technologies? Explain its features (4×3 = 12 Weightages)

PART C

Answer any two (5 Weightages each)

15. Explain in detail about the digital modulation techniques
16. Explain about enhanced data rate for global evolution
17. Explain free space propagation and ground reflection model
18. Explain about channel assignment strategies

(2×5 = 10Weightages)

PATTERN OF QUESTION PAPER(MSc)

SEMESTER: M.Sc. 2nd Semester

BRANCH: ELECTRONICS

ELS2C06-WIRELESS COMMUNICATION

Contact Hours per Week : 5
Number of Credits : 4
Number of Contact hours : 90
Maximum Weightage : 30 Weightage
Duration of Exam : 3 Hr

Module Blue Print For Question Paper Setting / Scrutiny			
Maximum Weightage: 30			
Question Paper			Syllabus
Sections or Parts	Weightage	Question Numbers	MODULE:
A	2	1.	1
		2.	2
		3.	4
		4.	1
		5.	5
		6.	3
		7.	5
B	3	8.	4
		9.	3
		10.	1
		11.	2
		12.	5
		13.	3
		14.	1
C	5	15.	5
		16.	4
		17.	3
		18.	2
Total Weightage >>>>			55

ST. THOMAS' COLLEGE (AUTONOMOUS), THRISSUR
SECOND SEMESTER M.SC ELECTRONICSMODEL QUESTION PAPER

ELS2C07: DESIGN OF EMBEDDED SYSTEMS

Hours: 3 Hrs **Max Weightage: 30**

PART A

Answer any four questions (2 weightages each)

1. Briefly explain Hardware software Partitioning.
2. Explain the selection process of the product.
3. What is development environment and execution environment?
4. What are kernels?
5. What is multiprocessing and multitasking?
6. What are semaphores?
7. Explain message passing.

(2x4=8Weightages)

PART B

Answer any four questions (3 weightages each)

8. Briefly explain the RTOS availability of products.
9. Discuss the issues in selection process.
10. Explain ASIC revolution.
11. What is Host based debugging.
12. Explain preemptive and non-preemptive scheduling.
13. Explain communication among processes.
14. What are the different phases of embedded product Development Life Cycle?

(2x4=8Weightages)

PART C

Answer any two questions (4 weightages each)

15. Explain interrupts and ISRS.
16. Explain the Logic analyzer.
17. Compare the RTOS features of - RTOS Lite, Full RTOS, VxWorks, µC/OS-II, RT Linux.
18. Explain the case study of embedded system- Digital camera.

(2x4=8Weightages)

PATTERN OF QUESTION PAPER(MSc)

SEMESTER: 2

BRANCH: ELECTRONICS

ELS2C07: DESIGN OF EMBEDDED SYSTEMS

Contact Hours per Week : 5

Number of Credits : 4

Number of Contact Hours: 90

Maximum Weightage : 30 Weightage

Duration of Exam : 3 hr

Module Blue Print For Question Paper Setting / Scrutiny			
Maximum Weightage: 30			
Question Paper			Syllabus
Sections or Parts	Weightage	Question Numbers	MODULE:
A	2	1.	1
		2.	1
		3.	2
		4.	3
		5.	4
		6.	4
		7.	4
B	3	8.	1
		9.	1
		10.	2
		11.	3
		12.	4
		13.	4
		14.	5
C	5	15.	2
		16.	3
		17.	4
		18.	5
Total Weightage >>>>			55

ST.THOMAS' COLLEGE (AUTONOMOUS), THRISSUR.
SECOND SEMESTER M.Sc. ELECTRONICS EXAMINATION
MODEL QUESTION PAPER

ELS2C08: ADVANCED MICROCONTROLLERS

Time: 3 Hours Total Weightage: 30

PART A

Answer any ***four*** questions. (2 Weightages each)

1. Write the status register of PIC microcontroller?
2. List out all the addressing Modes in PIC microcontroller.
3. What is the minimum and maximum clock frequency for PIC 16CXX?
4. What is the role of TRISx register in I/O Port management?
5. List the registers associated with Timer I PIC microcontroller.
6. What are the major interrupts used in PIC?
7. Write short note on ARM organization?

(2 x 4 = 8 weightages)

PART B

Answer any ***four*** questions. (3 Weightages each)

8. Write notes on I2C Bus.
9. Write a short note on CCP modules in PIC?
10. Draw circuit diagram to interface PIC with ADC.
11. Explain the registers of PIC used for serial communication.
12. Explain delay calculation for PIC 18.
13. Explain the pipeline in ARM processor.
14. Explain the core of ARM processor.

(3 x 4 = 12 weightages)

PART C

Answer any ***two*** questions. (5 Weightages each)

15. Draw a circuit and write an assembly language program for DAC with PIC 18 family.
16. Explain serial programming with an example using PIC microcontroller.
17. Draw a circuit and write a program for interfacing ADC with PIC.
18. Explain generation of PWM in PIC microcontroller.

(5 x 2 = 10 weightages)

PATTERN OF QUESTION PAPER(MSc)

SEMESTER: M.Sc. IInd Semester.

BRANCH: ELECTRONICS

ELS2C08: ADVANCED MICROCONTROLLERS

Contact Hours per Week : 5

Number of Credits : 4

Number of Contact hours : 90

Maximum Weightage : 30 Weightage

Duration of Exam : 3 Hr

Module Blue Print For Question Paper Setting / Scrutiny			
Maximum Weightage: 30			
Question Paper			Syllabus
Sections or Parts	Weightage	Question Numbers	MODULE:
A	2	1.	2
		2.	2
		3.	1
		4.	2
		5.	3
		6.	3
		7.	5
B	3	8.	3
		9.	3
		10.	4
		11.	4
		12.	3
		13.	5
		14.	5
C	5	15.	4
		16.	4
		17.	4
		18.	4
Total Weightage >>>>			55

ST THOMAS COLLEGE (AUTONOMOUS), THRISSUR

THRID SEMESTER M.Sc ELECTRONICS DEGREE EXAMINATION
MODEL QUESTION PAPER

ELS3C10: ADVANCED DIGITAL SIGNAL PROCESSING

TIME: 3 hrs **WEIGHTAGE: 30**

Answer any 4 questions (2 weightage)

1. What is Gaussian random process?
2. What are the properties of a WSS process?
3. Define stationarity in strict sense.
4. Explain the rules on variables in MATLAB with suitable example.
5. What do you mean by signals?
6. Explain the lattice realization of filters?
7. Write the properties of power spectrum?

Answer any 4 questions (3 weightage)

8. Give a brief account of basic operator in Matlab.
9. Write a short note on Z-transform?
10. State and prove Weiner- Khintchine theorem.
11. With proof explain Spectral Factorization theorem?
12. Explain power spectrum estimation using Bartlett method.
13. Write a short note on echo cancellation over telephone channels?
14. What is filter bank implementation of wavelet expansion of signals?

Answer any 2 questions (5 weightage)

15. Explain in detail the special types of random process.
16. Explain the concept filters. Distinguish between IIR and FIR.
17. In detail explain the performance of a periodogram
18. (A) Explain in detail the poly phase realization in multirate digital signal processing.
    (B) What are the applications of sampling rate conversion in multirate digital signal processing?

PATTERN OF QUESTION PAPER (MSc)

SEMESTER: III

BRANCH: ELECTRONICS

ELS3C10:ADVANCED DIGITAL SIGNAL PROCESSING

Contact Hours per Week : 5

Number of Credits : 4

Number of Contact Hours : 90

Maximum Weightage : 30 Weightage

Duration of Exam : 3 hr

Module Blue Print For Question Paper Setting / Scrutiny			
Maximum Weightage: 30			
Question Paper			Syllabus
Sections or Parts	Weightage	Question Numbers	MODULE:
A	2	1.	3
		2.	3
		3.	3
		4.	2
		5.	1
		6.	1
		7.	4
B	3	8.	2
		9.	1
		10.	3
		11.	3
		12.	4
		13.	1
		14.	5
C	5	15.	3
		16.	1
		17.	4
		18.	5
Total Weightage >>>>			55

ST.THOMAS' COLLEGE (Autonomous) THRISSUR
SECOND SEMESTER M.Sc. ELECTRONICS MODEL QUESTION PAPER

ELS3E01D- SATELLITE COMMUNICATION

Time: 3 Hours **Total Weightage: 30**

PART A
Answer any Four (2 Weightage each)

1. What is modulation and mention its techniques?
2. What is an earth station and its parameters?
3. What is video conferencing?
4. Explain orbital parameters
5. Why uplink frequency is greater than downlink frequency?
6. Explain SPADE system
7. Distinguish apogee and perigee **(4×2 = 8Weightages)**

PART B
Answer any Four (3 Weightage each)

8. Explain encryption and decryption techniques
9. Explain GSM in detail
10. What is orbital perturbations?
11. Explain SSTDMA
12. Explain about klystron amplifier
13. Explain limits of visibility and sun transit outage
14. Derive noise temperature equation **(4×3 = 12 Weightages)**

PART C
Answer any One (5 Weightages each)

15. Describe the operation of VSAT system
16. Explain FDMA multiple access technique in detail
17. Describe the cassegrain method of feeding a parabolic reflector with a neat sketch
18. Derive link power budget equation **(2×5 = 10Weightages)**

PATTERN OF QUESTION PAPER (MSc)

SEMESTER: M.Sc. 2nd Semester

BRANCH: ELECTRONICS

ELS3E01D-SATELLITE COMMUNICATION

Contact Hours per Week : 5
Number of Credits : 4
Number of Contact hours : 90
Maximum Weightage : 30 Weightage
Duration of Exam : 3 Hr

Module Blue Print For Question Paper Setting / Scrutiny			
Maximum Weightage: 30			
Question Paper			Syllabus
Sections or Parts	Weightage	Question Numbers	MODULE:
A	2	1.	4
		2.	3
		3.	5
		4.	1
		5.	2
		6.	3
		7.	1
B	3	8.	3
		9.	5
		10.	1
		11.	3
		12.	4
		13.	1
		14.	2
C	5	15.	5
		16.	3
		17.	4
		18.	2
Total Weightage >>>>			55

ST.THOMAS' COLLEGE (AUTONOMOUS), THRISSUR.
FOURTH SEMESTER M.Sc. ELECTRONICS EXAMINATION
MODEL QUESTION PAPER

ELS4C12: ROBOTICS

Time: 3 Hours Total Weightage: 30

PART A

Answer any ***four*** questions. (2 Weightages each)

1. Classify the different applications of robotics? Define Robot anatomy?
2. Explain the classifications of Robotic sensors?
3. Explain the common robot configurations?
4. What are different object recognition techniques?
1. What are the different robot programming methods?
2. What are PUMA and SCARA robots?
3. What is the use of robotics in prosthetic devices?

(2 x 4 = 8 weightages)

PART B

Answer any ***four*** questions. (3 Weightages each)

4. Write short note on coordinate transformation?
5. Explain the principle proximity and range sensors?
6. Explain different drive systems used in robotic systems?
7. Discuss the role of AI in robotics?
8. Explain the term 'DOF'? How End effectors are classified?
9. Write short note on microbots?
10. List different lighting techniques used in robotic machine vision systems? Explain CCD imaging devices used in robotics?

(3 x 4 = 12 weightages)

PART C

Answer any ***two*** questions. (5Weightages each)

11. Explain in detail the manipulator kinematics, dynamics and trajectory planning in robotics?
12. Explain the different textual robot programming languages in detail?
13. Explain robotic vision systems in detail?
14. What are different robot control techniques? Explain the concept of robotic control using Voice and Infrared with relevant block diagram?

(5 x 2 = 10 weightage)

PATTERN OF QUESTION PAPER (MSc)

SEMESTER: M.Sc. 4th Semester.

BRANCH: ELECTRONICS

ELS4C12: ROBOTICS

Contact Hours per Week : 5

Number of Credits : 4

Number of Contact hours : 90

Maximum Weightage : 30 Weightage

Duration of Exam : 3 Hr

Module Blue Print For Question Paper Setting / Scrutiny			
Maximum Weightage: 30			
Question Paper			Syllabus
Sections or Parts	Weightage	Question Numbers	MODULE:
A	2	1.	1
		2.	2
		3.	1
		4.	4
		5.	3
		6.	1
		7.	5
B	3	8.	1
		9.	2
		10.	1
		11.	3
		12.	2
		13.	5
		14.	4
C	5	15.	1
		16.	3
		17.	4
		18.	5
Total Weightage >>>>			55

ST.THOMAS' COLLEGE (AUTONOMOUS), THRISSUR.
FOURTH SEMESTER M.Sc. ELECTRONICS EXAMINATION
MODEL QUESTION PAPER

ELS4E03D: MICROWAVE ELECTRONICS

Time: 3 Hours Total Weightage: 30

PART A

Answer any ***four*** questions. (2 Weightages each)

1. Draw the field patterns of rectangular waveguide in TE_{10} and TM_{11} modes.
2. How to use matched load in microwave communications?
3. What are the advantages of waveguides compared to coaxial transmission lines?
4. What are the applications of Microstrip line?
5. List the difference between microwave transistors and TEDs.
6. Write shot notes on Reciprocal networks.
7. What are the possible errors occur in measurement of standing wave ratio?

(2 x 4 = 8 weightages)

PART B

Answer any ***four*** questions. (3 Weightages each)

8. Discuss different types of coaxial connectors.
9. Derive the expression for Reflection coefficient.
10. Derive S-matrix of Magic Tee and also write its characteristics.
11. Describe parabolic reflectors and its uses in microwave frequencies.
12. Explain the working of IMPATT diode with suitable structure and characteristics.
13. Define the following terms as applied to an Antenna. i) Directivity ii) Beam width iii) Effective aperture.
14. What are the different precautions have to be made while measuring parameters at Microwave range?

(3 x 4 = 12 weightages)

PART C

Answer any ***two*** questions. (5 Weightages each)

15. Explain TM mode of excitation in a rectangular waveguide and derive equations?
16. Draw the characteristics of Gunn diode and explain how negative region is obtained in it?
17. Explain the different methods for measuring impedance of a terminating load in microwave systems.

18. List the various losses that occur in a Micro strip line. Derive the expression for dielectric loss in the Substrate and ohmic loss in the Strip conductor.

(5 x 2 = 10 weightages)

PATTERN OF QUESTION PAPER (MSc)

SEMESTER: M.Sc. 4th Semester.

BRANCH: ELECTRONICS

ELS4E03D: MICROWAVE ELECTRONICS

Contact Hours per Week : 5

Number of Credits : 4

Number of Contact hours : 90

Maximum Weightage : 30 Weightage

Duration of Exam : 3 Hrs

Module Blue Print For Question Paper Setting / Scrutiny			
Maximum Weightage: 30			
Question Paper			Syllabus
Sections or Parts	Weightage	Question Numbers	MODULE:
A	2	1.	1
		2.	2
		3.	2
		4.	4
		5.	3
		6.	2
		7.	5
B	3	8.	2
		9.	2
		10.	1
		11.	4
		12.	3
		13.	5
		14.	5
C	5	15.	1
		16.	3
		17.	5
		18.	4
Total Weightage >>>>			55

APPENDIX 1

POST GRADUATE PROGRAMME IN ELECTRONICS: INTERNAL MARKS - THEORY

The evaluation for each course except the audit course shall contain two parts

(a) Internal evaluation :20% weightage

(b) External evaluation: 80% weightage

Both the internal and external evaluation shall be carried out using direct grading system as per the general guidelines of university and regulation of St. Thomas College (Autonomous).

Internal evaluation must consist of following components
i). 2 Tests (ii) One seminar (iii) One assignment and (iv) Attendance.

a) The criteria and percentage of weightage assigned to various components for internal evaluation are as follows:

(a) Theory : (Total weightage -5)			
Sl.No	**Component**	**Percentage**	**Weightage**
1	Examination /Test	40%	**2**
2	Seminars / Presentation	20%	**1**
3	Assignment	20%	**1**
4	Attendance	20%	**1**

Grades shall be given for the internal evaluation are based on the grades A+,A,B,C,D&E with grade points 5,4,3,2, 1 &0 respectively. The overall grades shall be as per the Ten Point scale.

Internal Examination

The average of the two examinations/tests can be used to obtain the letter grades as per the following table

Average %/grade range of 2 tests	**Grade**	**Grade point**
90 - 100% ….**(4.5 to 5)**	**A+**	**5**
75 – 89.99%... **(3.75-4.49)**	**A**	**4**
60 – 74.99%... **(3.0 to 3.74)**	**B**	**3**
40 – 59.99%... **(2 to 2.99)**	**C**	**2**
Below 40% **(Below 2.0)**	**D**	**1**
Absent	**E**	**0**

Letter grades of attendance can be derived as per the following table

Range of attendance	**Gradin**	**Grade point**

	g	
>=90%	**A+**	**5**
85% >=Attendance<90%	**A**	**4**
80% >=Attendance<85%	**B**	**3**
75% >=Attendance<80%	**C**	**2**
50% >=Attendance<75%	**D**	**1**
<50%	**E**	**0**

b) The mark distribution to award the internal continuous assessment marks for practical courses to be as follows:

(b) Lab : (Total weightage -10)			
Sl.No	**Component**	**Percentage**	**Weightage**
1	Lab skill	40%	**4**
2	Records/Viva	20%	**3**
3	Practical test	20%	**3**

c) Pattern of questions for external/ESE (Theory courses)

Sl. No.	Type of Questions	Individual weightage	Total Weightage	Number of questions to be answered
1	Short Answer type questions	2	2x4 = 8	4 out of 7
2	Short essay/ problem solving type	3	3x4 = 12	4 out of 7
3	Long Essay type Questions	5	5x2 = 10	2 out of 4
Total			30	18

Questions should be asked as far as possible from all modules following a uniform distribution, is more desirable.

d) Mark distribution for practical courses shall be as follows:

Component	Weightage
Algorithm/Circuit diagram/Program	**6**
Implementation	**6**
Result/ Output	**6**
Record	**6**
Viva	**6**
Total	**30**

End Semester Evaluation in Practical Courses shall be conducted and evaluated by both Internal and External Examiners.

e) EVALUATION OF PROJECT WORK /DISSERTATION

1. There shall be External and Internal evaluation for Project Work done and the grading system shall be followed.
2. One component among the Project Work evaluation criteria shall be Viva-voce (Project Work related) and the respective Weightage shallbe40%.
3. Consolidated Grade for Project Work is calculated by combining both the External and Internal in the Ratio of 4:1 (80% &20%).
4. For a passing Project Work, a student has to secure a minimum of P Grade in External and Internal examination combined. If the students could not secure minimum P Grade in the Project work, they will be treated as failed in that attempt and the students may be allowed to rework and resubmit the same in accordance with the final semester exam stipulations. There shall be no improvement chance for Project Work.
5. The External and Internal evaluation of the Project Work shall be done based on the following criteria and weightages as detailed below:

	Criteria	% of Weightage	Weightage	
			External	Internal
	Relevance of the topic and Statement of problem, Methodology &Analysis Quality of Report & Presentation	60%	24	6
	Viva-voce	40%	16	4
Total Weightage		100%	40	10

The first component for 60% weightage can be sub-divided into following project implementation components:

Sl. No.	Components	Weightage	
		External	Internal
1	Relevance of the Topic, Statement of Objectives, Methodology	2	2
2	Quality of Literature Survey/Product Review	2	
3	Quality of Analysis Phase	2	
4	Quality of Design Phase	2	
5	Quality of Implementation/Simulation	4	2
6	Quality of Testing/Result Analysis	2	
7	Quality of Contributions	2	
8	Identification of Future Work	1	2
9	Quality of Project Report	4	
10	Publications/Presentations out of the Project Work*	1	
11	Quality of Presentation	1	
12	Demonstration of the Project Work	1	
13	Viva-Voce	16	4
	Total	40	10

f) CONDUCT OF COMPREHENSIVE VIVA-VOCE

There shall be External and Internal Comprehensive Viva-voce; while the External Conduct of the Viva-voce is mandatory and the internal conduct of the viva-voce will be optional.

For a pass in Comprehensive viva-voce, a student has to secure a minimum of D Grade in External and Internal examination combined. If the students could not secure minimum D Grade in the Project work, they will be treated as failed in that attempt and the student may re appear for the same next time in accordance with the University exam stipulations. There shall be no improvement chance for Comprehensive viva-voce.