SDM College of Engineering and Technology, Dharwad-02

Department of Electronics and Communication Engineering

2018 UG **Scheme**

III Semester ECE

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	*Max. Marks	Duration in Hrs.	Max. Marks	Duration in Hrs.
18UMAC300	BS	Engg. Mathematics-III	3 - 0 - 0	3	50	100	3	-	-
18UECC300	PC	Electromagnetic Theory	3 - 2 - 0	4	50	100	3	-	-
18UECC301	PC	Digital Circuit Design	3 - 0 - 0	3	50	100	3	-	-
18UECC302	PC	Network Analysis	3 - 2 - 0	4	50	100	3	-	-
18UECC303	PC	Analog Electronic Devices and Circuits	4 - 0 - 0	4	50	100	3	--	--
18UECC304	PC	Signals & Systems	3 - 0 - 0	3	50	100	3	--	--
18UECL305	PC	Analog Electronic Devices and Circuits Laboratory	0 - 0 - 3	1.5	50	--	--	50	3
18UECL306	PC	Digital Circuit Design Laboratory	0-0 -3	1.5	50	--	--	50	3
	Total		**19- 4-6**	**24**	**400**	**600**		**100**	

BS- Basic Science, PC- Program Core

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination

L: Lecture **T**: Tutorials **P**: Practical

*SEE for theory courses is conducted for 100 marks and reduced to 50 marks

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IV Semester

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	*Max. Marks	Duration in Hrs.	Max Marks	Duration in Hrs.
18UMAC400	BS	Engg. Mathematics-IV	3 - 0 - 0	3	50	100	3	-	-
18UECC400	PC	CommunicationSystems - I	4 - 0 - 0	4	50	100	3	-	-
18UECC401	PC	Control Systems	3 - 2 - 0	4	50	100	3	-	-
18UECC402	PC	Microcontroller	3 - 2 - 0	4	50	100	3	-	-
18UECC403	PC	HDL Programming Using Verilog	3 - 0 - 0	3	50	100	3	--	--
18UECC404	PC	Linear ICs and Applications	3 - 0 - 0	3	50	100	3	--	--
18UECL405	PC	HDL Programming Laboratory	0 - 0 - 3	1.5	50	--	--	50	3
18UECL406	PC	Linear Integrated Circuits Laboratory	0 - 0- 3	1.5	50	--	--	50	3
18UECL407	PC	Introductory Project	0 - 0- 2	1	50	--	--	--	--
	Total		**19 - 4 - 8**	**25**	**450**	**600**		**100**	

BS- Basic Science, PC- Program Core

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination
L: Lecture **T**: Tutorials **P**: Practical
*SEE for theory courses is conducted for 100 marks and reduced to 50 marks

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Scheme and Syllabus

V Semester

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	*Max. Marks	Duration in Hrs.	Max. Marks	Duration in Hrs.
18UHUC500	HU	Management, Entrepreneurship and IPR	4 - 0 - 0	4	50	100	3	-	-
18UECC500	PC	CMOS VLSI Design	4 - 0 - 0	4	50	100	3	-	-
18UECC501	PC	Communication Systems -II	4 - 0 - 0	4	50	100	3	-	-
18UECC502	PC	Digital Signal Processing	3 - 0 - 0	3	50	100	3	-	-
18UECC503	PC	Information Theory & Coding	3 - 0 - 0	3	50	100	3	--	--
18UECE5XX	**PE**	**Program Elective-I**	3 - 0 - 0	3	50	100	3	--	--
18UECL504	PC	Communication Systems Laboratory	0 - 0 - 3	1.5	50	--	--	50	3
18UECL505	PC	DSP Laboratory	0 – 0 - 3	1.5	50	--	--	50	3
18UECL506	PC	Minor Project-1	0 – 0 - 2	1	50	--	--	--	--
18UHUL507	HU	Soft skills/Aptitude	0 - 0 - 2	1	50	--	--	--	--
Total			**21- 0 -10**	**26**	**500**	**600**		**100**	

Program Elective-I

18UECE510	PE	Object Oriented Programming using C++	3 - 0 - 0	3	50	100	3	--	--
18UECE511	PE	Telecommunication Networks	3 - 0 - 0	3	50	100	3	--	--
18UECE512	PE	Scientific Computing using Python	3 - 0 - 0	3	50	100	3	--	--
18UECE513	PE	Sensors and Transducers	3 - 0 - 0	3	50	100	3	--	--

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VI Semester

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	*Max. Marks	Duration in Hrs.	Max. Marks	Duration In Hrs.
18UECC600	PC	Analog& Mixed Mode VLSI Design	4 - 0 - 0	4	50	100	3	-	-
18UECC601	PC	IOT & Embedded System Design	4 - 0 - 0	4	50	100	3	-	-
18UECE6XX	PE	**Program Elective-II**	3 - 0 - 0	3	50	100	3	-	-
18UECE6XX	PE	**Program Elective-III**	3 - 0 - 0	3	50	100	3	-	-
18UECE6XX	OE	**Open Elective**	3 - 0 - 0	3	50	100	3	-	-
18UECL602	PC	Embedded Laboratory	0 - 0 - 3	1.5	50	--	--	50	3
18UECL603	PC	VLSI Laboratory	0 - 0 - 3	1.5	50	--	--	50	3
18UECL604	PC	Minor Project-2	0 - 0 - 4	2	50	--	--	50	3
18UHUL605	HU	Soft skills/Aptitude	0 - 0 - 2	1	50	--	--	--	--
		Total	**17 - 0 -12**	**23**	**450**	**500**		**150**	

Program Elective-II

18UECE610	PE	System Verilog	3 - 0 - 0	3	50	100	3	-	-
18UECE611	PE	Advanced Digital System Design	3 - 0 - 0	3	50	100	3	-	-
18UECE612	PE	Image Processing & Computer Vision	3 - 0 - 0	3	50	100	3	-	-
18UECE613	PE	Operating System	3 - 0 - 0	3	50	100	3	-	-

Program Elective-III

18UECE620	PE	Speech Processing	3 - 0 - 0	3	50	100	3	-	-
18UECE621	PE	Robotics	3 - 0 - 0	3	50	100	3	-	-
18UECE622	PE	Data structure using C++	3 - 0 - 0	3	50	100	3	-	-
18UECE623	PE	Artificial Intelligence	3 - 0 - 0	3	50	100	3	-	-

Open Elective

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18UECO630	OE	Cryptography	3 - 0 - 0	3	50	100	3	--	--
18UECO631	OE	Soft Computing	3 - 0 - 0	3	50	100	3	--	--
18UECO632	OE	Automotive Electronics	3 - 0 - 0	3	50	100	3	--	--
18UECO633	OE	Multimedia Communication	3 - 0 - 0	3	50	100	3	--	--
18UMAO675	OE	Applied Mathematics	3 - 0 - 0	3	50	100	3	--	--

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VII Semester

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	*Max. Marks	Duration in Hrs.	Max. Marks	Duration In Hrs.
18UECC700	PC	Antenna & Wave Propagation	4 - 0 - 0	4	50	100	3	-	-
18UECC701	PC	Computer Communication Networks	4 - 0 - 0	4	50	100	3	-	-
18UECE7XX	PE	**Program Elective-IV**	3 - 0 - 0	3	50	100	3	-	-
18UECO7XX	OE	**Open Elective**	3 - 0 - 0	3	50	100	3	-	-
18UECL702	PC	CCN Laboratory	0 - 0 - 2	1	50	--	--	50	3
18UECL703	PC	Major Project Phase-1	0- 0 -4	2	50	--	--	50	3
18UECL704	PC	Internship	4 w e e k s	2	50	--	--	50	3
	Total		**14 - 0 -6**	**19**	**350**	**400**		**150**	

18UECE7XX	PE	**Program Elective-IV**
18UECE710		MEMS
18UECE711		ASIC Design
18UECE712		VLSI DSP Systems
18UECE713		Optical Fiber Communication
18UECO7XX	OE	**Open Elective**
18UECO720		Machine Learning
18UECO721		Pattern Recognition
18UECO722		Multi Core Programming
18UECO723		Mobile Computing

PC- Program Core, PE-Program Elective, OE- Open Elective

VIII Semester

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Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	*Max. Marks	Duration in Hrs.	Max. Marks	Duration In Hrs.
18UECC800	PC	Wireless Communication	4 - 0 - 0	4	50	100	3	-	-
18UECE8XX	PE	**Program Elective-V**	3 - 0 - 0	3	50	100	3	-	-
18UECO8XX	OE	**Open Elective**	3 - 0 - 0	3	50	100	3	--	--
18UECL801	PC	Technical Seminar	0 - 0 - 2	1	50	--	--	--	--
18UECL802	PC	Major Project Phase-2	0-0 -12	7	50	--	--	50	3
	Total		**10- 0 - 14**	**18**	**250**	**300**	**--**	**50**	**--**

2nd

18UECE8XX	PE	**Program Elective-V**
18UECE810		Adhoc Wireless Networks
18UECE811		Re-configurable Design
18UECE812		Low Power VLSI Design
18UECE813		Digital Signal Compression
18UECO8XX	OE	**Open Elective**
18UECO820		DSP Architecture
18UECO821		CAD for VLSI
18UECO822		Operation Research
18UECO823		Advanced Computer Architecture

PC- Program Core, PE-Program Elective and OE- Open Elective

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18UECC400	Communication Systems - I	(4-0-0)4

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on time and frequency domain description of various analog modulation techniques, their generation and detection with necessary mathematical analysis. Various types of noise and performance of radio receivers in the presence of noise is covered in the course. The course also deals with theoretical bounds on sampling rates, practical aspects of sampling, quantization and various encoding methods.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Analyze** various analog modulation techniques in time and frequency domain	1,2		
CO-2	**Describe** the generation and detection of various analog modulation techniques		1,3,13	12
CO-3	**Explain** various types of noise and **evaluate** the performance of the receiver in presence of noise		1,2,3	
CO-4	**Derive** sampling rates to convert signal from analog to digital and practical aspects of sampling	1,2	3	
CO-5	**Describe** types of quantization and various source encoding techniques for data transmission		1,2,3,13	12

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.4	2.5	2	-	-	-	-	-	-	-	-	1	2	-

Pre-requisites: Fourier analysis, Analog Electronic Circuits.

Contents:

Unit-I

Amplitude Modulation: Introduction to communication system, Need for modulation, AM, DSBSC, SSB, VSB: time domain description, frequencydomain description, modulation index, bandwidth, power relations, modulation by several sine waves, generation, detection, quadrature carrier multiplexing, comparison of various amplitude modulation techniques, frequency translation, frequency division multiplexing, applications: AM radio. **12 Hrs**

Unit-II

Angle Modulation: Frequency modulation, Phase modulation, time domain description, spectrumanalysis of FM waves, transmission bandwidth, narrowband FM, wideband FM, generation of FM waves: indirect FM, direct FM, demodulation: balancedfrequencydiscriminator, zerocrossing detector, phase lockedloop, applications: FM radio, FM stereomultiplexing.**09 Hrs**

Unit-III

Noise in CW Modulation systems: Introduction, various types of noise, narrow band noise, noisy receiver model, noise in DSB-SC receivers, noise in SSB receivers, noise in AM receivers, noise in FM receivers, pre-emphasis and de-emphasis in FM **09 Hrs**

Unit-IV

Sampling Process: Introduction, sampling theorem, signal distortion in sampling, practical aspects of sampling: natural sampling, flat top sampling, sample and hold circuit, time division multiplexing, T1 carrier multiplexing, pulse modulation techniques: PAM, PWM, PPM **12 Hrs**

Unit-V

Waveform Coding Techniques: Quantization, quantization noise, signal to quantization noise ratio, robust quantization, Pulse Code Modulation, Differential Pulse Code Modulation, Delta Modulation, Adaptive Delta Modulation. **10 Hrs**

Reference Books:

1) Simon Haykin, “An introduction to analog and digital communications”, John Wiley India Pvt. Ltd., 2008.
2) Simon Haykin, “Communication systems”, 5/e, John Wiley India Pvt. Ltd., 2009.
3) Simon Haykin, “Digital Communications”, John Wiley India Pvt. Ltd., 2009.

18UECL407 Introductory Project (0-0-2) 1

Contact Hours: 24

Course Learning Objectives (CLOs):

The course provides an exposure to the students to identify simple societal problems and propose a technical solution. It also helps them to find related material, use appropriate tool to obtain the solution and prepare a report based on the work carried out.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Conduct a**survey** and **identify** the community needs.	-	6, 7	2

CO-2	**Formulate** the problem statement.	-	2	1
CO-3	**Propose** a solution by applying the fundamental knowledge of basic sciences and basic engineering courses	-	1,2	3
CO-4	**Develop** the team spirit, communication and management skills.	-	9,10,12	11
CO-5	**Prepare** a report and present the findings.	-	9,12	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	1.5	1.7	1	-	-	2	2	-	2	2	1	2	-	-

Contents:
Introductory Project is introduced with an objective of understanding and identifying the community expectation in terms of possible engineering solutions by applying the fundamental knowledge of basic sciences and basic engineering courses. The Project shall be engineering oriented in terms of problem definition, related literature survey and existing solutions. Students are supposed to meet the faculty members, discuss the problem definition and formulate the project. Project Team size Minimum of 03 and Maximum of 04 Students. The synopsis format shall be strictly adhered failing which may lead to rejection of the proposal and may cause delay in project. If the Introductory-Project idea is suggested by the faculty member, the synopsis must be duly signed by the respective faculty member. Maximum efforts will be made to allocate the same guide but may not be guaranteed. If the proposed project matches with one or more project titles, they are suggested to modify them in consultation with their respective guides and proceed with the submission.

18UECL506 Minor Project-1 (0-0-2) 1

Contact Hours: 30

Course Learning Objectives (CLOs):
Minor project –1 is introduced at V semester level to encourage students mainly to solve real time societal problems by integrating the knowledge gained in previous semesters. It may involve the investigation of a problem and the specification and implementation of a solution. Minor project help students to develop problem solving, analysis, synthesis and evaluation skills. It also helps in developing collaborative work culture and team work. In focus with this, students understand the basics of electronics, communication and programming languages in depth and then work on Planning, analyzing, designing and executing a hardware/software project.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13,14)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	**Identify** technical / social problemand**formulate** a problem statement	1,2	6	-
CO-2	**Propose** technical approach towards solution	2	6,7	11
CO-3	**Implement** the solution in hardware and / or software	3,5	13,14	11
CO-4	**Organize** the topics in a systematicmanner and **Prepare** the report in a specific format	9,10	12	-
CO-5	**Present** the work in a systematic manner	10	12	-

POs/PSO	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	3	3	3	-	3	2	2	-	3	3	1	2	2	2

Prerequisites:
Basics of Electronics, Communication and Programming languages.

Guidelines for Conduction Spirit of the Course:

To ensure that undergraduates successfully apply the knowledge they have gained in different courses and integrate material learnt at different stages of the curriculum up to the 5th semester so as to complete the project work within the stipulated time duration following guidelines are framed.

1. Project groups are formed with 3-4 students in each team.
2. Project coordinators instruct student project batches to submit synopsis in the prescribed format in the field of their choice.
3. Project coordinators allot guides based on their field of specialization. However students can have further discussions on the project topic and can modify their project title.
4. Students are instructed to report to their respective guides on weekly basis for discussion.
5. Students are instructed to maintain separate project diary/notebook to show the progress work while having discussion with guide and review committee members.

6. Two reviews are fixed in a semester to monitor the progress of the project.

Assessment: CIE- Guides evaluate project for 30 marks and 20 marks are allotted by reviewers by conducting 2 reviews. Total marks for project is 50 (CIE only). **SEE:**There is no semester end exam (SEE) component for minor project-1.
Note:

- Designated committee is constituted with 2-4 committee members to monitor the process of Mini Project-1
- An internal guide is allotted per group who guides and monitors the project
- progress.
- Problem statements can be derived from industry, society, etc., after interacting with them.
- Course outcomes (4 or more) are written and mapped toprogram outcomes and program specific outcomes. In addition to that other POs can also be included if those POs are deemed suitable.
- At the end of the course, students are required to document the project in the form of report.

18UHUL507	**Soft skills/Aptitude**	**(0-0-2)1**

Contact Hours: 24

Course Learning Objectives (CLOs):

This is included with the objectives of improving the communication skills, proficiency in English language and aptitude ability of the student to enhance the employability.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Explain** the significance of communication in the profession.	-	10	-
CO-2	**Use**the English language with proficiency	-	10	12
CO-3	**Solve** Aptitude related problems	-	9	12
CO-4	**Demonstrate** the competency in the placement activities.	-	9	-

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	-	-	-	-	-	-	-	-	2.0	2.0	-	1.0	-	-	-

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Contents:

Training on communication skills, proficiency in English language and aptitude ability involving the internal and external resource.

Evaluation:

Both the internal and external resource persons shall be engaged in imparting the related knowledge and shall have only CIE as the evaluation component. There shall be one test conducted at the end for 25 marks in Aptitude testing and there shall be one presentation by the student for 25 marks or any other suitable testing components. The arrangement for CIE evaluation is to be done by the department and maintain the relevant documents.

18UECC601 IOT and Embedded Systems Design (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on architectural features and instructions of -ARM Cortex M3, Develop Programs using the various instructions of ARM Cortex M3 and C language for differentapplications.Develop the prototype using hardware software co-design approach.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Describe** the architectural features and instructions of ARM Cortex M3.	-	2	1
CO-2	**Program** ARM Cortex M3 for different applications	-	1,2	-
CO-3	**Develop** an embedded system application using component engineering.	3	2,12	-
CO-4	**Develop** the hardware software co-design and firmware design approaches.	5	3,13	1,2
CO-5	**Demonstrate** the need of real time operating system and IoT.	5	2,12	14

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	1.33	1.8	2.5	-	3	-	-	-	-	-	-	2	2	1

Pre-requisites: Microcontrollers and Operating systems.

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Contents:

Unit-I

ARM Microcontroller: Thumb-2 technology and applications of ARM, Architecture of ARM Cortex M3, Various Units in the architecture, Debugging support, General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence **10 Hrs**

Unit-II

ARM Cortex M3 Instruction Sets and Programming: Assembly basics, Instruction list anddescription, Thumb and ARM instructions, Special instructions, Useful instructions, CMSIS, Assembly and C Language Programming **10 Hrs**

Unit-III

Embedded System Components: Embedded Vs General computing system, Classification ofEmbedded systems, Major applications and purpose of embedded systems. Elements of an Embedded System,Differences between RISC and CISC, Harvard and Princeton architectures, Big andLittle Endian formats, Memory (ROM and RAM types), Sensors, Actuators, Opt-coupler, Communication Interfaces. **10Hrs**

Unit-IV

Embedded System Design Concepts: Characteristics and Quality Attributes of EmbeddedSystems, Operational and non-operational quality attributes, Embedded Systems-Application andDomain specific, Hardware Software Co-Design and Program Modeling,Embedded firmware design and development **10Hrs**

Unit-V

Real Time Operating Systems: RTOS basics,Types of operating systems, Task, process and threads, Thread preemption, Preemptive Taskscheduling techniques, Task Communication, Task synchronization issues – Racing andDeadlock, Concept of Binary and counting semaphores, How to choose an RTOS.

Introduction to IoT and applications: Introduction to IoT, Illustrating the Device-to-Device/ Machine-to-Machine Integration Concept, Explaining the Aspect of Device-to-Cloud (D2C) Integration, The Emergence of the IoT Platform as a Service (PaaS),Digging into the Cloud-to-Cloud (C2C) Integration Paradigm, Describing the Sensor-to-Cloud Integration Concept, Azure IoT Hub Device Management, The Prominent IoT Realization Technologies, Architecture for IoT Using Mobile Devices, Mobile Technologies for Supporting IoT Ecosystem, Layered Architecture for IoT, Protocol Architecture of IoT **12 Hrs**

Reference Books:

1) Joseph Yiu, “The Definitive Guide to the ARM Cortex-M3”, 2nd Edition, Newnes, (Elsevier), 2010.
2) Shibu K V, “Introduction to Embedded Systems”, Tata McGraw Hill Education Private Limited, 2nd edition.

3) Pethuru Raj and Anupama C. Raman “The Internet of Things Enabling Technologies, Platforms and Use Cases” CRC press 2017, Taylor & Francis Group.
4) James K. Peckol, "Embedded systems- A contemporary design tool", John Wiley, 2008, ISBN: 978-0-471-72180-2.
5) Yifeng Zhu, “Embedded Systems with Arm Cortex-M Microcontrollers in Assembly Language andC”, 2nd E -Man Press LLC ©2015
6) Embedded real time systems by K.V. K. K Prasad, Dreamtech publications, 2003.

18UECE612Image Processing & Computer Vision (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

This course introduces to the concepts of image processing and computer vision. Topics covered include radiometry, colors, various image enhancement techniques, detection of discontinuities, edge linking and boundary detection.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSO (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Describe** the basic radiometric properties and develop models of source geometry	--	1,2	12
CO-2	**Describe** image acquisition system, its representation and human color perception	--	1	12
CO-3	**Apply** suitable image enhancement techniques in spatial and frequency domain	2	1, 3	12
CO-4	**Compare** various restoration techniques	2	1, 13	--
CO-5	**Compare** various image segmentation techniques	--	1,13	--

PO’s/PSO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2.0	2.66	2	--	--	--	--	--	--	--	--	1	2	--

Pre-requisites: Digital signal processing, Mathematics

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Contents:

Unit-I

Radiometry — Measuring light: Light in space, Light at surfaces, Important special cases: Radiosity, Hemisperic reflectance, Lambertian and specular surfaces and models

Sources Shadows and Shading: Radiometric properties of light, Qualitative radiometry, Local shading models, Photometric stereo. **08Hrs**

Unit-II

Colors: The physics of color, Human color perception, Representing color, Surface color from image color.

Digital Image Fundamentals: Image sensing and acquisition, Image sampling and quantization, Basic relationship between pixels, Linear and non-linear operations. **08 Hrs**

Unit-III

Intensity Transformation: Basic intensity transformation functions, Image negatives, Contrast stretching, Histogram processing, Histogram equalization, Enhancement using arithmetic and Logic operations.

Spatial and Frequency Filtering: Spatial Filter Masks, Smoothing spatial filters, Sharpening spatial filters, Combining spatial enhancement methods, Smoothing frequency domain filters, Sharpening frequency domain filters, Homomorphic filtering.**08Hrs**

Unit-IV

Fundamentals of Image Restoration: Introduction, noise models, Restoration in the presence of noise, Linear position invariant degradation, Degradation function.

Image Restoration Filters: Spatial filtering, Periodic noise reduction by frequency domain filtering, Inverse filtering, Minimum mean square error filtering, Constrained least squares filtering, Geometric mean filter, Geometric transformations. **08 Hrs**

Unit-V

Image Segmentation: Detection of discontinuities, Edge linking and boundary detection, Thresholding.

Advanced Topics in Segmentation: Region-based segmentation, Segmentation using morphological watersheds, Use of motion in segmentation.**07Hrs**

Reference Books:

1) C Gonzalez and Richard E Woods, Rafael, “Digital Image Processing”, 3/e, Pearson Education, 2005.
2) K.P.Soman, “Digital Signal & Image Processing”, 1/e edition, Elsevier India, 2012
3) David Forsyth and Jean Ponce, “Computer Vision, A modern Approach ”, 2/e, Pearson Education, 2012.

4) Richard Szeliski, “Computer Vision: algorithms and applications ”, 1/e, Springer-Verlag London Limited 2010

18UECE623Artificial Intelligence (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

This course focusses on overview of the main concepts in Artificial Intelligence(AI), algorithms applied in construction of intelligent systems, agents, problem solving, search, representation, reasoning, planning, communication, perception, robotics and neural networks.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Discuss**the basic concepts and characteristics of AI with illustrations of current state of the art research, solving real world problems with searching approaches.	14	2,3,4	1
CO-2	**Explain** the strengths and limitations of various state-space search algorithms along with knowledge representation, planning and constraint management.	11	1,2,3,4	13
CO-3	**Identify** the type of an AI problem with search inference, decision making under uncertainty, game theory, etc.	-	2,5	13
CO-4	**Apply** basic principles of AI in solutions that require different forms of learning and decision trees.	-	6,12,14	-
CO-5	**Demonstrate** different language models, steps in Natural language Processing (NLP) and expert systems.	-	14	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	1.5	2	3	4	2	2					3	2	1	2

Pre-requisites: Discrete Mathematics, basic probability theory and Statistics Knowledge of any programming language and data structures.

Contents:

Unit-I

Introduction: Introduction and Intelligent systems, What Is AI, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, Applications of A.I. Intelligent Agents: Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents, How the components of agent programs work.

Solving Problems by Searching: Study and analysis of various searching algorithms. Implementation of Depth-first search Problem Solving Agents, Searching for Solutions, Uninformed and informed Search Strategies.**09 Hrs**

Unit-II

Local Search Algorithms and Optimization Problems: Local Search in Continuous Spaces, Searching with Nondeterministic Actions, Searching with Partial Observations, Introduction to adversarial Search and constraint satisfaction problems with examples.

Logical Agents: Knowledge agents, first-Order Logic, Inference to First-Order Logic, Classical planning, Planning and acting in the real world, knowledge representation. **08 Hrs**

Unit-III

Quantifying Uncertainty: Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Bayes' Rule and Its Use, Representing Knowledge in an Uncertain Domain, Other Approaches to Uncertain Reasoning, Rule-based methods for uncertain reasoning, representing vagueness: Fuzzy sets and fuzzy logic, Study of fuzzy logic and Decision trees, Implementation aspects of Decision trees. **07 Hrs**

Unit-IV

Learning from Examples: Forms of Learning, Supervised Learning, Learning Decision Trees, The decision tree representation, Expressiveness of decision trees, inducing decision trees from examples. **08 Hrs**

Unit-V

Natural Language Processing: Language Models, Steps in NLP, Syntactic Analysis (Parsing), Semantic interpretation, Discourse and pragmatic Processing, Text Classification. Discourse and pragmatic 24 Processing, Implementation aspects of Syntactic Analysis (Parsing)

Expert Systems: What is Expert system, Components of Expert System, Case studies on Expert System.**07 Hrs**

Reference Books:

1) Stuart Russell, Peter Norvig**,**"Artificial Intelligence: A Modern Approach" by Pearson 3rd Edition, 2015.
2) Elaine Rich, Kevin Knight, Shivashankar B. Nair, "Artificial Intelligence",Tata McGraw-Hill Education Pvt. Ltd, 3rd Edition, 2017.
3) SarojKausik, "Artificial Intelligence", Cengage Learning, 1st edition, 2011.

4) N P Padhy, “Artificial Intelligence and Intelligent Systems”, Oxford University Press, 2005.

18UECE621	Robotics (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on the theory and design principles of Robotics. The course deals with utilization of Sensors, Actuators, Kinematics, Motion and Trajectory planning used in Robotics.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Identify** the different parameters of Robot and **Classify** the Robots onthe considerations.	2	4	-
CO-2	**Develop** an understanding of specifications of robot and **choose** appropriate sensors,actuators and Processing platform.	2,3	4	12
CO-3	**Rephrase** the Kinematics of the robot, **understand** and **analyze** the kinematics using suitable model	4	2	5
CO-4	**Understand analyze and build** differential motion-oriented robots.	1,2,3,4,13, 14	-	5,7,10,11,12
CO-5	Perform **analysis** ofdynamic forces motions, trajectory and achieve required goals by suitable **design**.	13,14	-	5,7,10,11,12

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	3	2.75	3	2.5	1	-	1	-	-	1	1	1	3	3

Pre-requisites: Microprocessors/Controllers, Embedded System Design

Contents:

Unit-I

Introduction: Brief History of Robotics, Working Definition of Robot, Growth of the Industry

Types of Robots: Classification by Degrees of Freedom, Classificationby Robot Motion, Classification by Platform,Classification by Power Source,Classification by Intelligence, Classification by Application Area **08Hrs**

Unit-II

Introduction to Robot Mechanics: Robot Arm Kinematics, End-Effectors, Dynamic Considerations, Obstacle Avoidance, Robot Electronic Subsystems, Robot External Sensing Systems, Motor System Design, Servo System Design, Hall-Effect Technology, Characteristics of Actuating Systems, Comparison of Actuating Systems, Hydraulic Actuators, Pneumatic Devices, Electric Motors , Microprocessor Control of ElectricMotors, Magnetostrictive Actuators, Shape-Memory Type Metals,Electroactive Polymer Actuators **08Hrs**

Unit-III

Kinematics of Robots:, Position Analysis Robots as Mechanisms ,Conventions, Matrix Representation,Homogeneous Transformation, Matrices, Representation of Transformations, Inverse of Transformation Matrices, Forward and Inverse Kinematics of Robots Forward and Inverse Kinematic Equations: Position, Forward and Inverse KinematicEquations: Orientation, Forward and Inverse Kinematic,Equations: Position and Orientation, Denavit-Hartenberg Representation of Forward Kinematic Equations of Robots, The Inverse Kinematic Solutionof Robots, Inverse Kinematic Programming of Robots, Degeneracy and Dexterity, The Fundamental Problem with the Denavit-Hartenberg Representation Design Projects **08Hrs**

Unit-IV

Differential Motions and Velocities, Differential Relationships, Jacobian,Differential versus Large-Scale Motions, Differential Motions of a Frame versus a Robot, Differential Motions of a Frame, Differential Translations, Differential Rotations about the Reference Axes ,Interpretation of the Differential, Change, Differential Changes between Frames, Differential Motions of a Robot and its Hand Frame, Calculation of the Jacobian, How to Relate the Jacobian and the Differential Operator, Inverse Jacobian, Design Projects **07Hrs**

Unit-V

Dynamic Analysis and Forces Introduction , Lagrangian Mechanics: A Short Overview , Effective Moments of Inertia , Dynamic Equations for Multiple-DOF Robots , Kinetic Energy , Potential Energy , The Lagrangian , Robot's Equations of Motion , Static Force Analysis of Robots ,Transformation of Forces and Moments between CoordinateFrames , Design Project Trajectory Planning Introduction, Path versus Trajectory ,Joint-Space versus Cartesian-Space, Descriptions , Basics of Trajectory Planning , Joint-Space Trajectory Planning , Cartesian-Space Trajectories , Continuous Trajectory Recording Design Project **08Hrs**

Reference Books:

1) HarryH. Poole,"Fundamentals ofRobotics Engineering", Springer Publication,1989.
2) Saeed Benjamin Niku, "Introduction to Robotics Analysis, Control, Applications", Second Edition, Wiley Publication, 2011

3) AshitawaGoshal, “Robotics Fundamental Concepts and Analysis”, Ninth Impression, Oxford University Press,2013.
4) Robert J. Schilling, “Fundamentals of Robotics Analysis and Control”, Prentice Hall of India,2003
1) and Standards”, Pearson Education, Asia, Second Indian reprint, 2002.
2)

18UMAO675	Applied Mathematics	(3 - 0 - 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn about mathematical modelling, use of numerical techniques to deal with engineering systems. Further, they need to learn LPP and statistical tools for interpretation. They are also expected to carry out sampling distribution analysis and use of graph theory for engineering problems.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	ObtainMathematical model of Engineering Systems using different domains.		1,2	
CO-2	FormulateLPP and obtain optimal solutions using different tools.		1,2	
CO-3	Applystatistical tools to Interpret the data using different tools.		1,2	
CO-4	DetermineType errors and test for goodness of fit usingdifferent methods.		1,2	
CO-5	Usegraph theory to obtain solution for engineering problems.		1,2	

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mapping Level	2	2	-	-	-	-	-	-		-	-	-

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Pre-requisites:
A basic course on the concepts of algebra, geometry, calculus, trigonometry and laws of physics, Statistical averages and probability theory.

Contents:

Unit-I

Introduction to Mathematical Modelling and Numerical Techniques: Introduction, Modelling technique, classification and characteristics. Mathematical modelling through algebra, geometry, calculus, trigonometry.Mathematical model of engineering system.**8 Hrs.**

Unit-II

Linear and Non-Linear programming :
Introduction, Mathematical formulation of a L.P.P, basic solution.Geometric (or graphical) method, Simplex method.Assignment problem. Non Linear Programming – Constrained extremal problems-Lagrange's multiplier method- Kuhn- Tucker conditions and solutions. **8 Hrs**.

Unit-III

Statistical Techniques :Co-efficient of Variation, Skewness, Karl Pearson's co-efficient of Skewness, Moments, Pearson's Beta and Gamma co-efficient, Kurtosis. Time series and Forecasting. **7 Hrs**.

Unit-IV

Sampling distribution: Introduction, population and samples. Type-I and Type- II errors.Test of hypothesis for means, student's t-distribution, Chi-square Distribution as a test of goodness of fit. **8 Hrs.**

Unit-V

Graph Theory:Definition of a graph theory, incidence and degree, walks, paths, circuits, Connectedness, Eulerian and Hamiltonian graphs, Trees, basic properties of trees, Binary trees, Preorder and post order traversals, Spanning and Minimal spanning trees, Connectivity and Separability, fundamental circuits and cut sets Isomorphism of graphs, Matrix representation of graphs, adjacency and incidence matrix Graph theoretical algorithms: Dijkstra, Prims and Kruskal.8 Hrs**.**

Reference Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th edition,2017.
2. E. Kreyszig Advanced Engineering Mathematics John Wiley & Sons,10 edition, 2016.
3. Srimanta Pal et al, Engineering Mathematics, Oxford University Press, 3rd edition, 2016.

4. Dougas B. West, Introduction to Graph theory, second edition, PHLearnig Private Limited, 2009.

18UECO722	Multicore Programming	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

This course focuses on basic concepts of Multi Core programming and various practical models of Multi Core programming. Aims to provide basic insight into multicore architecture along with Parallel Programming concepts. It also exposes OpenMP and MPI constructs, threading APIs and multicore software development and debugging techniques

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Identify** different parallel computing architectures and their applicability.	1,2		4,10
CO-2	**Develop** an insight into multicore hardware architecture and threading and synchronization and **utilize** it to build applications.	1, 2,14	3	4
CO-3	**Illustrate** programming using OpenMP and MPI.	2,3,4,5	13,14	
CO-4	Examine the threading APIs.	1,3,5		14
CO-5	Distinguish multiprocessor software development products and debugging techniques.	5,12	4	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	3	3	2.7	1.8	3	-	-	-	-	-	-	3	2	2

Pre-requisites: Probability theory, Communication Systems

Contents:

UNIT-I

INTRODUCTION TOMULTI-CORE ARCHITECTURE: Motivation for Concurrency in Software, Parallel Computing Platforms (SIMD & MIMD systems, an overview

of Single-Core, Multi-Processor, Multi-Core Architectures), Parallel Computing in Microprocessors, Differentiating Multi-Core Architectures from Hyper-Threading Technology, Multi-threading on Single-Core versus Multi-Core Platforms, Understanding Performance, Amdahl's Law, Gustafson's Law 8 **Hrs.**

Unit-II

MULTI-CORE PROCESSORS: An Overview of Software Threading Defining Threads, System View of Threads: Threading above the Operating System, Threads inside the OS, Threads inside the Hardware, Application Programming Models and Threading, Virtual Environment: Virtual Machines and Platforms Runtime Virtualization, System Virtualization**.**

PARALLEL PROGRAMMING FUNDAMENTAL CONCEPTS: Designing for threads, parallel programming patterns, Threading and parallel programming constructs: Synchronization, Critical sections, Deadlock, Synchronization Primitives, and Messages **08 Hrs.**

Unit-III

OPENMP PROGRAMMING: OpenMP Challenges in Threading a loop, Minimizing Threading overhead, Performance oriented Programming, Library Functions. Solutions to parallel programming problems: Data races, deadlocks and Livelocks Non-blocking algorithms, Memory and cache related issues.

MPI PROGRAMMING: Message-Passing Model, Message-Passing Interface, MPI functions, Compiling and running MPI Programs, collective communication, data decomposition, Point-to-point communication – MPI Library. **08 Hrs.**

Unit-IV

THREADING API'S: Threading APIs for Microsoft Windows, Threading APIs for Microsoft .NET Framework: Creating Threads, Managing Threads, Thread Pools, Thread Synchronization, POSIX Threads: Creating Threads, Managing Threads, Thread Synchronization, Signaling, Compilation and Linking **07 Hrs.**

Unit-V

MULTI-THREADED DEBUGGING TECHNIQUES: General Debug Techniques, Debugging Multi-threaded Applications in Windows: Threads Window, Trace points, Breakpoint Filters, Naming Threads, Multi-threaded Debugging Using GDB.

MULTI-CORE PROCESSORS SOFTWARE DEVELOPMENT PRODUCTS: An Overview of Software tools on Multi-Core Processors, Intel Software Development Products: overview, Thread Checker, Compilers: OpenMP, Software-based Speculative Pre computation, Compiler Optimization and Cache Optimization, Debugger , Intel Libraries, Intel Threading Building Blocks , VTune Performance Analyzer , Thread Profiler , MPI Programming :Intel Support for MPI **08 Hrs.**

Reference Books:

1) ShameemAkhter and Jason Roberts, "Multi-core Programming- Increasing Performance through Software Multi-Threading", 1st Edition, Intel Press, 2006.
2) Michael J Quinn, "Parallel programming in C with MPI and OpenMP", 2nd Edition, Tata McGraw Hill, 2007.

3) Peter S. Pacheco, “An Introduction to Parallel Programming”,Morgan Kaufmann Publishers is an imprint of Elsevier,2011

18UECO723	Mobile Computing	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on basics of mobile communications, mobile computing, GSM systems, networking, transport and application layer protocols, different mobile platforms and application development and security issues.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explainthebasicsof mobile telecommunication systems	-	-	1,4,6,7
CO-2	Illustratethegenerationsoftelecommunicationsystemsinwirelessnetworks	-	1,2,4,5	12,13,14
CO-3	DeterminethefunctionalityofMAC,networklayerandIdentifyaroutingprotocolforagivenAdhocnetwork	-	2,4	12,13,14
CO-4	ExplainthefunctionalityofTransportandApplicationlayers	-	1,2,4,10	-
CO-5	Developamobileapplicationusing android/blackberry/ios/WindowsSDK	1,2,3,4,5,13, 14	-	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.0	2.25	3.0	2.0	2.5	1.0	1.0	-	-	2.0	-	1.0	1.33	1.33

Pre-requisites: Wireless communication, Digital communication Computer Communication Networks;

Contents:

Unit-I

Introduction: MobileCommunications,MobileComputing–Paradigm,Promises/NovelApplications andImpediments andArchitecture; Mobile andHandheldDevices, LimitationsofMobileandHandheldDevices.

GSM–Services,SystemArchitecture,RadioInterfaces, Protocols,Localization, Calling,Handover,Security,NewData Services,GPRS,CSHSD,DECT.**08 Hrs**

Unit-II

(Wireless)Medium AccessControl(MAC): Motivation foraspecializedMAC (Hiddenand exposed terminals, Near and far terminals), SDMA, FDMA, TDMA, CDMA, WirelessLAN / (IEEE802.11)

Mobile Network Layer: IP and Mobile IP Network Layers, Packet Delivery and HandoverManagement, Location Management,Registration,TunnellingandEncapsulation,RouteOptimization,DHCP. **08Hrs**

Unit-III

MobileTransportLayer: ConventionalTCP/IPProtocols,IndirectTCP,SnoopingTCP, MobileTCP,OtherTransportLayerProtocolsforMobileNetworks.

DatabaseIssues: DatabaseHoarding&CachingTechniques, Client-ServerComputing&Adaptation,TransactionalModels,Query processing,DataRecovery Process&QoSIssues. **07 Hrs**

Unit-IV

Data Dissemination and Synchronization: Communications Asymmetry, Classification ofDataDelivery Mechanisms,DataDissemination,BroadcastModels,SelectiveTuningandIndexing Methods,DataSynchronization–Introduction,Software,andProtocols. **09Hrs**

Unit-V

Mobile Device Operating Systems – Special Constraints & Requirements – CommercialMobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry, WindowsPhone–M Commerce–Structure–Pros&Cons– MobilePaymentSystem–Security Issues.

ProtocolsandPlatformsforMobileComputing: WAP,Bluetooth,XML,J2ME, Java Card,PalmOS,WindowsCE,SymbianOS,LinuxforMobileDevices, Android. **07 Hrs**

Reference Books:

1) Jochen Schiller, “MobileCommunications” ,PHI,SecondEdition,2003.
2) RajKamal,“MobileComputing”,OxfordUniversityPress,2007,
3) PrasantKumarPattnaik,RajibMall,”FundamentalsofMobileComputing”, PHI ,2012

2018 PG (Digital Electronics) Scheme

Scheme of Teaching & Examination for M.Tech Digital Electronics

Scheme for I Semester

Course Code	Course Title	Teaching		Examination				
		L-T-P (Hrs/ Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
				Max. Marks	*Max. Marks	Duration in hours	Max. Marks	Duration In hours
18PMAC100	Advanced Mathematics	4-0-0	4	50	100	3		
18PDEC100	Digital Circuits and Logic Design	4-0-0	4	50	100	3		
18PDEE15X	Elective-I	4-0-0	4	50	100	3		
18PDEE15X	Elective –II	4-0-0	4	50	100	3		
18PDEE15X	Elective –III	4-0-0	4	50	100	3		
18PDEL101	Digital Electronics Laboratory-I	0-0-3	2	50			50	3
18PDES103	Seminar**	0-0-3	1	100				
Total		**20-0-6**	**23**	**400**	**500**		**50**	

Elective I to III

18PDEE150	Digital VLSI Design
18PDEE151	Machine Learning
18PDEE152	Digital System Design Using Verilog
18PDEE153	Automotive Electronics
18PDEE154	Nano Electronics
18PDEE155	ASIC Design
18PDEE156	Simulation, Modeling & Analysis
18PDEE157	Advanced Embedded System Design

Scheme for II Semester

Course Code	Course Title	Teaching		Examination				
				CIE	Theory (SEE)		Practical (SEE)	
		L-T-P (Hrs/Week)	Credits	Max. Marks	*Max. Marks	Duration in hours	Max. Marks	Duration In hours
18PDEC200	Modern DSP	4-0-0	4	50	100	3		
18PDEC201	Coding Theory	4-0-0	4	50	100	3		
18PDEE25X	Elective- IV	4-0-0	4	50	100	3		
18PDEE25X	Elective- V	4-0-0	4	50	100	3		
18PDEE25X	Elective-VI	4-0-0	4	50	100	3		
18PDEPL202	Digital Electronics Laboratory-II	0-0-3	2	50			50	3
18PDEP203	Mini Project	0-0-3	1	100				
Total		**20-0-6**	**23**	**400**	**500**		**50**	

Elective IV to VI

18PDEE250	Advanced Reconfigurable Computing	18PDEE254	Image & Video Processing
18PDEE251	System on Chip Design	18PDEE255	Wavelet Transforms
18PDEE252	Low Power VLSI	18PDEE256	Multimedia Communication
18PDEE253	Digital Signal Compression	18PDEE257	Micro Electro-Mechanical Systems

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination
L: Lecture **T**: Tutorials **P**: Practical
* SEE for theory courses is conducted for 100 marks and reduced to 50 marks.
** Seminar topics should be from emerging areas in Digital Electronics, preferably the contents not studied in their regular courses.
*** Select any three electives from the list.**Total Credits offered for first year: 46**

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Scheme for III Semester

Course Code	Course Title	Teaching		Examination				
				CIE	Theory (SEE)		Practical (SEE)	
		L-T-P (Hrs/Week)	Credits	Max. Marks	*Max. Marks	Duration in hours	Max. Marks	Duration In hours
18PDEC300	Advances in VLSI Design	4-0-0	4	50	100	3		
18PDEE35X	Elective VII	4-0-0	4	50	100	3		
18PDEE35X	Elective VIII / Internship***	3-0-0/2-4 weeks	3	50/50	100/-	3/-	-/50	-/3
18PDEL300	Project Phase-I**	0-0-15	9	50		.	50	3
Total		**8/11-0-15**	**20**	**200**	**300/ 200**		**50/ 100**	

Elective VII to VIII

18PDEE350	Advanced Computer Architecture
18PDEE351	Artificial Neural Networks
18PDEE352	Cryptographic Systems
18PDEE353	VLSI Digital Signal Processing
18PDEE354	IC Fabrication Technology
18PDEE355	Speech Processing
18PDEE356	Wireless Sensor Networks

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination

L: Lecture **T**: Tutorial **P**: Practical

*SEE for theory courses is conducted for 100 marks and reduced to 50 marks.

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** **Project phase-I:** The students are expected to formulate the problem and carry out the intensive literature survey along with preliminary investigations supporting the project phase-II in IV semester.

*** **Internship:** should be from the reputed industries. Duration of internship is about 2-4 weeks during 2nd to 3rd semester break period. Students who undergo Internship are to be exempted for one elective course in IIIsemester.

Scheme for IV Semester

Course Code	Course Title	Teaching		Examination				
				CIE	Theory (SEE)		Practical (SEE)	
		L-T-P (Hrs/Week)	Credits	Max. Marks	*Max. Marks	Duration in hours	Max. Marks	Duration In hours
18PDEL400	Project phase-II	0-0-20	22	100			100	3
Total		**0-0-20**	**22**	**100**			**100**	

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination

L: Lecture **T**: Tutorial **P**: Practical

** Project phase-II: The students are expected to work on the project for the full semester in the institute/ in an industry / in reputed organization with recognized R&D center

Total Credits offered for the Second year: 42

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18PDEE151	Machine Learning	(4-0-0)4

Contact Hours: 52

Course Learning Objectives(CLOs):

The course focuses on introduction to the fundamental concepts in machinelearning and popular machine learning algorithms.It includes linear modeling, Bayesian approach, classification, clustering and Principal Component Analysis. In the course also discusses various issues related to the application of machine learning algorithms.

Course Outcomes(COs):

Description of the Course Outcome: At the end of the course the student will b able to:		**Mapping to POs (1-6)**		
		Level 3 Substantial	**Level 2 Moderate**	**Level 1 Slight**
CO-1	**Describe** variety of mathematical modeling, inference, and prediction algorithms for machine learning	3	2	
CO-2	**Analyze** the situations of applyingvariety of mathematical models and algorithms for machine learning	2,3	1	
CO-3	**Compare and justify** mathematical models and algorithms for machine learning	1, 4		2
CO-4	**Apply** algorithms for machine learning and **solve** concerned problems	4, 6		
CO-5	**Justify**the selection of algorithms for machine learning	3	2	
CO-6	**Evaluate** the performance of algorithms for machine learning	3	1	

POs	PO1	PO2	PO3	PO4	PO5	PO6
Mapping Level	2.3	4	3	3	-	3

Pre-requisites:

Basics of probability andstatistics.

Course Contents:

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1. **Linear Modeling-A Least Squares Approach:** Linear Modeling, Making Predictions, Vector/Matrix Notation, Non-Linear Response from a Linear Model, Generalization and Over-Fitting, Regularized Least Squares. **06Hrs.**
2. **Linear Modeling-A Maximum Likelihood Approach:** Errors as Noise, Random Variables and Probability, Popular Discrete Distributions, Continuous Random Variables - Density Functions, Popular Continuous Density Functions, Likelihood, The Bias-Variance Trade-off, Effect of Noise on Parameter Estimates, Variability in Predictions. **08 Hrs.**
3. **The Bayesian Approach to Machine Learning**: A Coin Game, The Exact Posterior, The Three Scenarios, Marginal Likelihoods, Hyperparameters, Graphical Models, A Bayesian Treatment of the Olympic100m Data, Marginal Likelihood for Polynomial Model Order Selection. **08 Hrs.**
4. **Bayesian Inference:** Non-Conjugate Models, Binary Responses, A Point Estimate - The Map Solution, The Laplace Approximation, Sampling Techniques. **07Hrs.**
5. **Classification:** The General Problem, Probabilistic Classifiers, Non-Probabilistic Classifiers, Assessing Classification Performance, Discriminative and Generative Classifiers. **08Hrs.**
6. **Clustering:** The General Problem, K-Means Clustering, Mixture Models. **08Hrs.**
7. **Principal Components Analysis and Latent Variable Models:**The General Problem, Principal Components Analysis, Latent Variable Models, Variational Bayes, A Probabilistic Model for PCA, Missing Values, Non-Real-Valued Data. **07Hrs.**

Activity beyond Syllabus: Program development for the machine learning Algorithms in MATLAB and Python.

Reference Books:

1. Simon Rogers, Mark Girolami, “A First Course in Machine Learning”, CRC Press, 2017.
2. EthemAlpaydin,“Introduction to Machine Learning”,Prentice Hall of India, Third edition, 2014
3. Mohssen Mohammed, Muhammad Badruddin Khan, EihabBashier Mohammed Bashier, “Machine Learning, Algorithms and Applications”, CRC Press, 2017.
4. Tom Mitchell,“Machine Learning”, First Edition, McGraw- Hill, 1997.
5. Michael Paluszek, Stephanie Thomas, “MATLAB Machine Learning”, Apress, 2017.

18PDEE353	VLSI Digital Signal Processing	(4-0-0)4

Contact Hours: 52

Course Learning Objectives(CLOs):

The subject focuses on DSP Architecture, parallel processing issues in analyzing DSP Computation systems. The next part covers further the Systolic Architecture Design and pipe lined and parallel recursive and Adaptive filters.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to Pos (1-6)**		
		Level 3 Substantial	**Level 2 Moderate**	**Level 1 Slight**
CO-1	**Identify** the typical signal processing tasks	3		
CO-2	**Gain knowledge** possibility of reducing the computational complexity	3	6	
CO-3	**Acquire knowledge** various architectures	2		
CO-4	**Acquire knowledge** about optimization in view of power, area and speed	2, 4		
CO-5	**Acquire knowledge** about algorithms available for the purpose of optimization	1, 4, 6		
CO-6	**Compare** the techniques / architectures	6		

POs	PO1	PO2	PO3	PO4	PO5	PO6
Mapping Level	3	3	3	3	-	2.5

Pre-requisites:

Knowledge of Digital Signal Processing, Analog and digital electronics, CMOS VLSI design.

Course Contents:

1 **Introduction to DSP Systems**: Introduction to DSP Systems, **10 Hrs.**

	Iteration bound, Data Flow graphs (DFGs) representation, Loop Bound, Iteration rate, Critical loop, Critical path, Area-Speed-Power trade-offs, Algorithms for computing iteration bound, Pipelining of FIR Digital Filters, Parallel Processing, Pipelining and Parallel Processing for low power.	
2	**Algorithmic Transformations**: Retiming Definitions and properties, Retiming Techniques, Clock period minimization, Unfolding, An algorithm for unfolding, Critical path, Applications of unfolding, Sample period reduction, Folding, Folding order, Folding Factor, register minimization techniques, register minimization in folded architecture, Forward Backward Register Allocation technique, folding of multi-rate systems, Folding Bi-quad filters, Retiming for folding.	**12 Hrs.**
3	**Systolic Architecture Design and Fast Convolution:** Introduction, system array design methodology, FIR systolic arrays, , Systolic Design for space representations containing delays Systolic architecture design methodology, Design examples of systolic architectures, selection of scheduling vector, matrix-matrix multiplication and 2-D systolic array design, Hardware Utilization efficiency, Cook-Toom Algorithm, Winograd Algorithm, Iterated Convolution, Cyclic Convolution, Design of fast convolution algorithm by inspection.	**12 Hrs.**
4	**Algorithm Strength Reduction in filter:**Introduction, Parallel FIR filters, Polyphase decomposition, Discrete Cosine Transform and Inverse Discrete Cosine Transform, parallel architectures for Rank Order filters.	**10 Hrs.**
5	**Pipelined and Parallel Recursive and Adaptive Filters**: Introduction, pipelining in 1st order IIR digital filters, pipelining in higher order IIR digital filters, parallel processing for IIR filters, combined pipelining and parallel processing for IIR filters, low power IIR Filter Design using pipelining and parallel processing,	**08 Hrs.**

pipelined adaptive digital filters.

References Books:

1. Parhi, K.K., “VLSI Digital Signal Processing Systems: Design andImplementation”, John Wiley 2007.
2. Oppenheim, A.V. and Schafer, R.W., “Discrete-Time Signal Processing”, Prentice Hall, 2009, 2nd edition.
3. Mitra, S.K., Digital Signal Processing. A Computer Based Approach, McGraw Hill, 2007, 3rd edition.
4. Wanhammar, L., DSP Integrated Circuits, Academic Press, 1999, 2005, ISBN: 978-0131543188