Kavayitri Bahinabai Chaudhari
NORTH MAHARASHTRA UNIVERSITY,
JALGAON (M.S.)

Final Year Engineering

(Electronics and Telecommunication Engineering)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
3rd Cycle

SYLLABUS STRUCTURE

Semester – VII & VIII

W.E.F. 2020 – 21

Syllabus Structure for Final Year Engineering (Semester – VII) (Electronics and Telecommunication Engineering) (w.e.f. 2020 – 21)

Name of the Course	Group	Teaching Scheme				Evaluation Scheme					Credits
						Theory		Practical		Total	
		Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE		
Digital Signal Processing	D	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – III	E	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – IV	E	3	-	-	3	40	60	-	-	100	3
Open Elective Course – III	F	3	-	-	3	40	60	-	-	100	3
Communication Lab - I	D	-	-	2	2	-	-	25	25 (PR)	50	1
Digital Signal Processing Lab	D	1	-	2	3	-	-	25	25 (PR)	50	2
Project (Stage – I)	G	-	-	12	12	-	-	50	50 (OR)	100	6
Essence of Indian Traditional Knowledge	H	-	-	-	-	-	-	-	-	-	-
		13		**16**	**29**	**160**	**240**	**100**	**100**	**600**	**21**

ISE: Internal Sessional Examination ESE: End Semester Examination ICA: Internal Continuous Assessment

Professional Elective Course – III		Professional Elective Course – IV		Open Elective Course – III	
1	Fiber Optic Communication	1	Satellite Communication	1	Artificial Intelligence and Machine Learning
2	Speech and Audio Processing	2	Digital Image and Video Processing	2	Big Data Analysis
3	Nanoelectronics	3	Mixed Signal Design	3	Mechatronics

Syllabus Structure for Final Year Engineering (Semester – VIII) (Electronics and Telecommunication Engineering) (w.e.f. 2020 – 21)

Name of the Course	Group	Teaching Scheme				Evaluation Scheme					Credits
						Theory		Practical		Total	
		Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE		
Computer Network	D	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – V	E	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – VI	E	3	-	-	3	40	60	-	-	100	3
Open Elective Course – IV	F	3	-	-	3	40	60	-	-	100	3
Communication Lab - II	D	-	-	2	2	-	-	25	25 (OR)	50	1
Computer Network Lab	D	2	-	2	4	-	-	25	25 (PR)	50	3
Project	G		-	6	6	-	-	50	50 (OR)	100	3
		14	**0**	**10**	**24**	**160**	**240**	**100**	**100**	**600**	**19**

ISE: Internal Sessional Examination ESE: End Semester Examination ICA: Internal Continuous Assessment

Professional Elective Course – V		Professional Elective Course – VI		Open Elective Course – IV	
1	Microwave Theory and Technique	1	Embedded System	1	Automotive Electronics and Electric Vehicle
2	Adaptive Signal Processing	2	Mobile Communication and Network	2	Cyber Security
3	Antenna and Wave Propagation	3	High Speed Electronics	3	Robotics

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SYLLABUS

Semester – VII

W.E.F. 2020 – 21

Digital Signal Processing					
COURSE OUTLINE					
Course Title:	**Digital Signal Processing**	**Short Title:**	**DSP**	**Course Code:**	

Course description:

Digital Signal Processing (DSP) is concerned with the representation, transformation and manipulation of signals on a computer. After half a century advances, DSP has become an important field, and has penetrated a wide range of application systems, such as consumer electronics, digital communications, medical imaging, power applications and so on. With the dramatic increase of the processing capability of signal processing, it is the expectation that the importance and role of DSP is to accelerate and expand.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	14	42	03

Prerequisite course(s):

Knowledge of Mathematics, control system, Signal and System.

Course objectives:

The objective of this course is
1. To introduce finding DFT, IDFT and FFT of discrete signal.
2. To design IIR filter form analog filters.
3. To convert IIR filter to FIR filters using various techniques.
4. To introduce finite world length effect in digital filter and multirate signal processing.
5. Study of DSP processor and its application.

Course outcomes:

After successful completion of this course the student will be able to:

1. Able to understand findings the DFT, IDFT and FFT of discrete signal.
2. Understand the concept of analog filter and design of IIR digital filters.
3. Understand the need and design of FIR digital filters.
4. Analyze finite word length effects on signal and multirate signal processing
5. Understand Digital Signal Controllers and their Applications

COURSE CONTENT

Digital Signal Processing		Semester:	VII
Teaching Scheme:		**Examination scheme**	
Lectures: 03	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	No. of Lectures: 09 Hours	Marks: 12

Discrete Fourier Transform & Fast Fourier Transform

DSP Preliminaries

Discrete time signals: Sequences; representation of signals on orthogonal basis, Basic elements of DSP and its requirements, advantages of Digital over Analog signal processing.

Definition and Properties of DFT, IDFT, Circular convolution of sequences using DFT and IDFT

(Maximum N=8). Twiddle factor. Fast Fourier Transforms (FFT), Radix-2 decimation in time and decimation in frequency FFT algorithms, inverse FFT, and introduction to composite FFT.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

IIR Digital Filters

Concept of analog filter design (required for digital filter design), Design of IIR filters from analog filters by impulse invariance method, Bilinear transformation method.
IIR filter realization using direct form, cascade form, parallel form and transposed form.
Butterworth filter, Chebyshev, Elliptic Approximation
Lowpass, High pass, Bandpass and Bandstop filters design using frequency transformation (Design of all filters using Lowpass filter)

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

FIR Digital Filters

Advantages and disadvantages of FIR over IIR filter, Minimum Phase, Maximum Phase, Mixed Phase and Linear Phase Filters.
Location of the zeros of linear phase FIR filters.
Design of FIR filters using Window techniques (Rectangular, Hamming, Hanning, Blackmann, Kaiser),
Design of FIR filters using Frequency Sampling technique, Comparison of IIR and FIR filters. Gibbs phenomenon.
FIR filters realization using direct form, cascade form and linear phase form.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Finite Word Length effects in Digital Filters

Quantization, truncation and rounding, Effects due to truncation and rounding, Input quantization error, Product quantization error, Coefficient quantization error, Zero-input limit cycle oscillations, Overflow limit cycle oscillations, Scaling. Quantization in Floating Point realization of IIR digital filters, Finite word length effects in FIR digital filters.
Multirate DSP, Introduction to Up sampler, Down sampler and two channel filter bank, Application of Multirate signal processing in communication, Music processing, Image processing and Radar signal processing.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

DSP Processors and Application

Introduction, Computer Architectures for signal processing, General purpose Digital signal Processors, selecting digital signal processors, Special purpose DSP Hardware, Architecture of TMS320C67X, Features of C67X processors, CPU, General purpose register files, Functional units and operation, Data paths, Control register file, Functional units, Internal memory, External memory, on chip peripherals, Interrupts, Instruction set and addressing modes, Fixed point instructions, Floating point instructions, Conditional operations, Parallel operations, Pipeline operations, Code Composer studio, Application programs in C67X.

Applications of Digital Signal Processing

Application of DSP for ECG signals analysis, Dual Tone Multi Frequency signal detection, Radar Signal Processing.

Text Books:
Text Books: 1. S. Salivahanan, “Digital Signal Processing”, McGraw Hill Education; 3rd edition, 2017. 2. P. Ramesh Babu, “Digital Signal Processing”, Scitech Publications (India) Pvt.Ltd., 6th edition, 2014. 3. Emmanuel C. Ifeachor, Barrie W. Jervis, “Digital Signal Processing”, A Practical Approach by, Pearson Education 4. Tarun Kumar Rawat,Digital Signal Processing”, Oxford University Press, 2015.
Reference Books:
1. Proakis J., Manolakis D., "Digital Signal Processing", 4th Edition, Pearson Education. 2. Sanjit K. Mitra , Digital Signal Processing – A Computer Based Approach – 4th Edition McGraw Hill Education (India) Private Limited. 3. Oppenheim A., Schafer R., Buck J., "Discrete Time Signal Processing", 2nd Edition, Pearson Education. 4. B. Venkata Ramani and M. Bhaskar, “Digital Signal Processors, Architecture, Programming and Applications”, McGraw Hill Second Edition. 5. L. R. Rabiner and B. Gold, “Theory and Applications of Digital Signal Processing”, Prentice-Hall of India, 2006. 6. TMS320C67XX User manual: www.ti.com .

Fiber Optic Communication
(Professional Elective Course – III)

COURSE OUTLINE

Course Title:	**Fiber Optic Communication**	**Short Title:**	**FOC**	**Course Code:**	

Course description:

This course provides knowledge about optical fiber technology that emerged as major innovation in telecommunication.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	14	42	03

Prerequisite course(s):

Knowledge of Light wave theory, Basic concept of analog and digital Communication

Course objectives:

The main objective of this course is

1. To introduce student with light ray theory of transmission and its application in optical communication.
2. To understand the construction of fiber and signal degradation in fiber.
3. To study various optical sources and optical detectors.
4. To understand Optical link design for fiber optics.
5. To study Optical Switching and networking technology concepts.

Course outcomes:

After successful completion of this course the student will be able to:

1. Able to know the fundamentals of Light theory and its application in optical communication.
2. Able to know the construction of various optical fiber and causes of signal degradation in fiber
3. Experience with the Knowledge of working of various optical sources and optical detectors.
4. Able to know about Optical link design for fiber optics.
5. Develop the knowledge on Optical Switching and networking technology.

COURSE CONTENT

Fiber Optic Communication		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme**	
Lectures: 03	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Optical Fibers-Structures Wave guiding and Fabrication

Introduction to vector nature of light, Ray model, wave model**.** Block diagram of Optical communication system, Light system components, Optical transmitters, optical Receivers Advantage and Disadvantage of OFCS over other communication systems.

Ray theory of transmission and concept of acceptance angle and Numerical Aperture (Numerical based on Ray theory),

Propagation of light, Meridonial and skew propagation,

Wave theory of optical propagation: cut – off wavelength. Group velocity and Group delay. Fabrication methods of fibers –OVD, MCVD, VAD Process.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Optical Fibers and Signal Degradation

Different types of optical fibers-

Fiber profiles-Step index fibers, Graded index fibers

Fiber modes –Optical modes Normalized frequency Single mode step index, Multimode step index, Multimode Graded index (Numerical on mode theory).

Signal degradation on optical fiber due to dispersion and attenuation.

Attenuation, Absorption, Absorption due to atomic defects, Extrinsic Absorption ,Intrinsic , Absorption ,scattering loss- Linear and Nonlinear loss, bending losses.

Signal distortion in optical fiber: Information capacity determination,

Material dispersion, waveguide dispersion, intermodal dispersion, Pulse broadening in Graded Index fiber (Numerical on pulse dispersion and pulse broadening)

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Optical Sources and Detectors

Sources : Factors or Characteristics for their selection in OFCS,

Light Emitting diodes: Surface emitter, LEDS, Edge emitter LEDS, LED operating Characteristics, Radiation patterns of surface and Edge emitters,

Laser diode: Laser principles, semiconductor laser diode, Hetero junction Laser, stripgromentry lasers, laser diode.

Detector parameters: Cutoff wavelength ,Quantum efficiency, Responsivity, speed of Response (Numerical based on detector parameter)

Detectors: Characteristics or factors for their Selection, P-N photo diode, P-I-N Photo diode, Avalanche photodiode. (No Numerical on Detectors)

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Optical Receivers.

Optical link design- Power budget, Rise time budget.(No Numerical)

Sources of power penalties, Modal Noise, Dispersion Broadening, Mode partition noise, Frequency Chipring. BER calculation, Quantum limit.(Derivation not required and No Numerical)

Fiber Splicing-Fusion Splicing, V-groove Splicing. Fiber Connectors- ST,SC,MTRJ(only Overview)

Optical Fiber Measurements: Measurement of Attenuation, refractive index. Optical time domain reflectometry (OTDR).

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Advanced Optical Systems

Advanced Techniques: Wavelength Division Multiplexing (WDM), Dense Wavelength Division Multiplexing (DWDM).

WDM components-2*2 Fiber Coupler, Star Coupler, Optical Isolator.

Optical amplifiers,- Semiconductor Amplifier, Raman Amplifier, EDFA.

Optical Networks- SONET (Synchronous Optical Network)-Transmission format and SONET Ring.
Text Books:
1. J. Keiser, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition). 2. T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975. 3. J. Gowar, Optical communication systems, Prentice Hall India, 1987. 4. S.E. Miller and A.G. Chynoweth, eds., Optical fibers telecommunications, Academic Press, 1979. 5. Govind Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed. 1994. 6. Govind Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York, 1997 7. F.C. Allard, Fiber Optics Handbook for engineers and scientists, McGraw Hill, New York (1990). 8.Joseph C palais , Fiber optic Communication, Prentice Hall International Edition, Fourth Edition (1992)..
Reference Books:
1. John M. Senior , "Optical Fiber Communication (Principles & Practice)",Pearson Education.

Speech And Audio Processing
(Professional Elective Course – III)

COURSE OUTLINE

Course Title:	**Speech And Audio Processing**	**Short Title:**	**SAP**	**Course Code:**	

Course description:

1. Basic properties of audio and speech signals, Basic concepts and operations of audio signal processing, Introduction to acoustics and hearing;
2. Processing of digital audio signals, equalization, perceptual audio coding, sound synthesis.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	*14*	*42*	*3*

Prerequisite course(s):

Signals & Systems, Digital Signal Processing

Course objectives:

1. To be able to relate human physiology and anatomy with signal processing paradigms.
2. To acquire the knowledge of speech generation and speech recognition models.
3. To understand methods/techniques used in speech signal estimation & detection.

Course outcomes:

After successful completion of this course the student will be able to:

1. Mathematically model the speech signal .
2. Analyze the quality and properties of speech signal.
3. Modify and enhance the speech and audio signals.
4. Summarize the various speech coding techniques.
5. Analyze application of speech processing in speech compression, speech recognition, and speech synthesis.

COURSE CONTENT

Speech And Audio Processing		**Semester:**	*VII*
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I: Speech Processing	**No. of Lectures: 09 Hours**	**Marks: 12**

Speech Production and Modeling Human Auditory System; General structure of speech coders The process of speech production, Acoustic theory of speech production, Digital models of speech signals of speech signal.

Unit–II: Speech Analysis	**No. of Lectures: 09 Hours**	**Marks: 12**

Time and frequency domain analysis of speech, Linear predictive coding (LPC) analysis, Cepstral analysis, Speech parameter (pitch) estimation. Speech Signal Processing.

Unit–III: Speech Synthesis	**No. of Lectures: 08 Hours**	**Marks: 12**
Principles of speech synthesis, Generic CELP encoders and decoders. Excitation code book search-state save method ,zero-input zero state method .CEPL based on adaptive codebook, Adaptive codebook search.		
Unit–IV: Coding of Speech and Quantization	**No. of Lectures: 08 Hours**	**Marks: 12**
Introduction, Scaler Quantization, uniform quantizer, logarithmic quantizer ,adaptive quantizer Speech redundancies, Vector quantization-distortion measures, codebook design, codebook types., Linear delta modulation, Adaptive delta modulation,		
Unit–V Audio Compression	**No. of Lectures: 08 Hours**	**Marks: 12**
Digital Audio, Lossy sound compression, μ-law and A-law companding, DPCM and ADPCM audio compression, MPEG audio standard, frequency domain coding, format of compressed data.		
Text Books:		
1."Digital Speech" by A.M.Kondoz, Second Edition (Wiley Students Edition), 2004. 2. "Speech Coding Algorithms: Foundation and Evolution of Standardized Coders", W.C. Chu, WileyInter science, 2003. 3. "Digital Processing of Speech Signals", Rabiner and Schafer, Prentice Hall, 1978.		
Reference Books:		
1. "Discrete-Time Speech Signal Processing: Principles and Practice", Thomas F. Quatieri, Publisher: Prentice Hall. 2. "Speech and Audio Signal Processing: Processing and Perception of Speech and Music", Nelson Morgan and Ben Gold, John Wiley & Sons. 3. "Speech and Audio Signal Processing", Gold & Morgan, 1999, Wiley and Sons.		

Nano Electronics
(Professional Elective Course – III)

COURSE OUTLINE

Course Title:	**Nano Electronics**	**Short Title:**	**NE**	**Course Code:**	

Course description:

The rapid growth of the integrated circuit (IC) industry has led to the emergence of nano microelectronics process engineering as a new advanced discipline. Thus, there is a need to impart quality education at a sufficiently advanced level in the current state of art Nano electronics discipline

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	*14*	*42*	*3*

Prerequisite course(s):

Elements of Electrical and Electronics Engineering, CMOS Design, Electronics Devices.

Course objectives:

Nano Electronics course is designed to encompass all these aspects, viz., nano and micro regime design, simulation and fabrication and all types of IC's . It is expected that, after undergoing this course, the students will acquire both theoretical knowledge and practical skills in diverse upcoming areas of current technology and will be able to get into any one of these areas or be a bridge between these advanced areas to face the upcoming challenges and up-liftment of society.

Course outcomes:

After successful completion of this course the student will be able to:

1. Students will understand the divers electronic device fabrication.
2. Students will have in-depth technical knowledge in one or more areas of specialization.
3. Students will have practical understanding of the major engineering concepts and demonstrate application of their theoretical knowledge of the concepts and help to get the academic and industrial jobs.
4. Students will be able to interact scientifically with industry both within and outside of a Classroom setting.
5. Students will develop an appreciation of continuing educational and professional development.

COURSE CONTENT

Nano Electronics		**Semester:**	*VII*
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Tunnel junction and applications of tunneling, Tunneling Through a Potential Barrier, Metal—Insulator, Metal-Semiconductor, and Metal-Insulator-Metal Junctions, Coulomb Blockade, Tunnel Junctions, Tunnel Junction Excited by a Current Source. Spintronics and Foundations of

nano-photonics.		
Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**
Field Emission, Gate—Oxide Tunneling and Hot Electron Effects in nano MOSFETs, Theory of Scanning Tunneling Microscope, Double Barrier Tunneling and the Resonant Tunneling Diode.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Introduction to lithography- Contact, proximity printing and Projection Printing, Resolution Enhancement techniques, overlay-accuracies, Mask-Error enhancement factor (MEEF), Positive and negative photoresists, Electron Lithography, Projection Printing, Direct writing, Electron resists. Lithography based on Surface Instabilities: Wetting, De-wetting, Adhesion, Limitations, Resolution and Achievable / line widths etc. Lift off process, Bulk Micromachining.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Introduction to MEMS and NEMS, working principles, as micro sensors (acoustic wave sensor, biomedical and biosensor, chemical sensor, optical sensor, capacitive sensor, pressure sensor and thermal sensor), micro actuation (thermal actuation, piezoelectric actuation and electrostatic actuation–micro gripers, motors, valves, pumps, accelerometers, fluidics and capillary electrophoresis, active and passive micro fluidic devices, Pizoresistivity,Pizoelectricity and thermoelectricity, MEMS/NEMS design, processing, Oxidation, Sputter deposition, Evaporation, Chemical vapor deposition etc.		
Unit–V	**No. of Lectures: 09 Hours**	**Marks: 12**
Introduction – Scaling of physical systems – Geometric scaling & Electrical system scaling. The Single-Electron Transistor: The Single- Electron Transistor Single-Electron Transistor Logic, Other SET and FET Structures, Carbon Nanotube Transistors (FETs and SETs), Semiconductor Nanowire FETs and SETs,Coulomb Blockade in a Nanocapacitor,Molecular SETs and Molecular Electronics.		
Text Books:		
1. Stephen D. Sentaria, *Microsystem Design, Kluwer Academic Press* 2. Marc Madou, *Fundamentals of microfabrication & Nanofabrication.* 3. T. Fukada & W.Mens, *Micro Mechanical system Principle & Technology, Elsevier, 1998.* 4. Julian W.Gardnes, Vijay K. Varda, *Micro sensors MEMS & Smart Devices, 2001.*		
Reference Books:		
1. Nano Terchnology and Nano Electronics – Materials, devices and measurement Techniques by WR Fahrner – Springe 2. Nano: The Essentials – Understanding Nano Scinece and Nanotechnology by T.Pradeep; Tata Mc.Graw Hill. 3. Spin Electronics by M. Ziese and M.J. Thornton 4. Nanoelectronics and Nanosystems – From Transistor to Molecular and Quantum Devices by Karl Goser, Peter Glosekotter, Jan Dienstuhl		

5. Silicon Nanoelectronics by Shunri Odo and David Feny, CRC Press, Taylor & Franicd Group
6. Nanotubes and nanowires by C.N.R. Rao and A. Govindaraj, RSC Publishing
7. Quantum-Based Electronic Devices and Systems by M. Dutta and M.A. Stroscio, World Scientific.
8. James R Sheats and Bruce w.Smith, "Microlithography Science and Technology", Marcel Dekker Inc., New York, 1998.
9. J.P. Hirth and G.M.Pound "Evaporation: Nucleation and Growth Kinetics" Pergamon Press, Oxford, 1963

Satellite Communication
(Professional Elective Course – IV)

COURSE OUTLINE

Course Title:	**Satellite Communication**	**Short Title:**	**SC**	**Course Code:**	

Course description:

This course describes the basics of Satellite communication to the undergraduate students. Satellite communications enable wireless communication in regions. The program gives you an in-depth understanding of the engineering aspects of these important current and future technologies

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	13	42	03

Prerequisite course(s): Advanced Digital Communication

Orbital Equations, Link Budget, Various Antennas and Various Architecture of Satellite System

Course objectives:

1. To study the basics concept of various satellite communication.
2. To Understand the principle and architecture of satellite communication.
3. To familiarize the concept of 2G,3G,4G and 5G system.
4. Provide strong foundation for understanding of Satellite Link Budget and various antennas.
5.To Learn the modern trends in Mobile Communication Engineering.

Course outcomes:

After successful completion of this course the student will be able to:

1 Describe the basic concepts and applications of satellite systems.
2. Analyze, test and use various link budget, power budget.
3. Describe the concept of 2G,3G,4G and 5G system.
4.Apply the concept for measurement of various parameters of C/N ratio.
5. To describe the modern trends in satellite communication engineering.

COURSE CONTENT

Satellite Communication		**Semester:**	*VII*
Teaching Scheme:		**Examination scheme**	
Lectures: 03	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Overview of Satellite Systems, Orbits and Launching Methods-Introduction – Frequency Bands used for Satellite Communication, Intelsat, Polar Orbiting Satellites. Kepler's First , Second and Third Law, Definitions of Terms for Earth orbiting Satellites – Orbital Elements – Apogee and Perigee Heights,Concept of Solar Day and Sidereal Day Orbital Perturbations, and sun-synchronous orbit

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Geostationary orbit, Wave Propagation and Polarization-Antenna look angles, antenna mount, limits of visibility, Earth eclipse of satellite, sun transit outage, launching of geostationary

satellites, Atmospheric losses, ionospheric effects, rain attenuation, Antenna polarization,polarization of satellite signals,cross polarization discrimination, Ionospheric depolarization rain depolarization, ice depolarization.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Satellite Antenna and Link Design-Overview of Satellite Link Budget, Antenna basics, aperture antennas. Parabolic reflectors, Offset feed, double reflector antenna, Introduction, equivalent isotropic radiated power, Transmission losses, The link power budget equation, System noise, carrier to noise ratio, The uplink & downlink, Effects of rain, combined Uplink and Downlink C/N ratio, Calculation in clear air and in rainy condition.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Introduction to Wireless Communications and Modern Wireless Communications system-Evolution of Mobile radio communication, Mobile Radio systems around the world, wireless communication system, Trends in cellular radio and personal communications, Second generation(2G) cellular networks, Third generation(3G) wireless networks, Fourth generation(4G) wireless networks, Fifth generation(5G) wireless networks, wireless local loop(WLL) and wireless Local Area Networks(WLANs).		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Cellular Concept and System Design Fundamentals, Wireless systems and Standards- Introduction, Frequency reuse, channel assignment strategies, Handoff strategies, Interference and system capacity, Trucking and grade of service, Improving coverage and capacity in cellular systems, Global System for Mobile (GSM).		
Text Books:		
1. D. Roddy, "Satellite Communications", Tata McGraw-Hill, 4th Edition, ISBN-0-07-007785-1 2. T. Rappaport, "Wireless Communications-Principles and Practice, 2nd Edition, ISBN-978-81-317-3186-4.		
Reference Books:		
1. Timothy Pratt Charles W Bostian, Jeremy E. Allnutt, "Satellite Communications", Wiley India second edition 2002. 2. Tri T. Ha, "Digital Satellite Communications", Tata McGraw-Hill,2009.		

Digital Image and Video Processing (Professional Elective Course – IV)						
COURSE OUTLINE						
Course Title:	Digital Image and Video Processing		**Short Title:**	DIVP	**Course Code:**	
Course description:						
To learn the basic principles and tools used to process images and videos, and how to apply them in solving practical problems of commercial and scientific interests.						
Lecture	**Hours/week**	**No. of weeks**	**Total hours**		**Semester credits**	
	3	*14*	*42*		*3*	
Prerequisite course(s):						
Digital Communication, Signals & Systems, Digital Signal Processing						
Course objectives:						
1. Provide the student with the fundamentals of digital image processing. 2. Introduce the students to some advanced topics in digital image processing. 3. Give the students a useful skill base that would allow them to carry out further study in the field of Image processing.						
Course outcomes:						
After successful completion of this course the student will be able to:						
1. Understand theory and models in Image and Video Processing. 2. Process these images for the enhancement of certain properties . 3. Develop algorithms for image compression and coding. 4. Apply quantitative models of image for various engineering applications 5. Understand theory and models in Video Processing.						
COURSE CONTENT						
Digital Image and Video Processing		**Semester:**		*VII*		
Teaching Scheme:		**Examination scheme**				
Lectures:	**3 hours/week**	**End semester exam (ESE):**			**60 marks**	
		Duration of ESE:			**03 hours**	
		Internal Sessional Exams (ISE):			**40 marks**	
Unit–I: : Introduction	**No. of Lectures: 09 Hours**			**Marks: 12**		
Digital Image Processing: Problems and Applications, Image representation and Modeling, Image Enhancement ,Image Analysis, Image Reconstruction from Projections and Image Data Compression..Basic relationship between pixels- neighborhood, adjacency, connectivity, distance measures.						
Unit–II: Image Perception	**No. of Lectures: 09 Hours**			**Marks: 12**		

Introduction, Light luminance, brightness and contrast, MTF of the visual system, Monochrome Visual Model, Image fidelity criterion. Color image processing-,color models-RGB,YUV,HIS;. Color transformations, measures, Color image smoothing and sharpening. Color Segmentation-Image Segmentation.		
Unit–III: Image Sampling and Quantization	**No. of Lectures: 08 Hours**	**Marks: 12**
Image scanning, two dimensional sampling theory, extension of sampling theory, limitations in sampling and reconstruction, image quantization. Detection of discontinuities. Wavelets and multi-resolution image processing.		
Unit–IV: Image Transform	**No. of Lectures: 08 Hours**	**Marks: 12**
Two dimensional orthogonal and Unitary transform, Properties of unitary transform, The one dimensional discrete Fourier transform, , Wavelets and sub-band. Wavelet packets. Image compression-Redundancy-inter-pixel and psycho visual. Lossless compression-predictive, entropy. Lossy compression- Predictive and transform coding. Discrete Cosine transforms.		
Unit–V: Fundamentals of Video Coding	**No. of Lectures: 08 Hours**	**Marks: 12**
Inter-frame redundancy, motion estimation techniques, full search, fast search strategies. Predictive Techniques: Forward and backward motion prediction, Frame classification-I,P and B. Video coding standard-MPEG and H.26X Video segmentation-Temporal Segmentation.		
Text Books:		
1) Gonzalez and Woods, "Digital Image Processing", Pearson Education, 2) Arthur Weeks Jr., "Fundamentals of Digital Intake Processing", PHI. 3) S Jayaraman, “Digital Image Processing”, Tata McGraw Hill Publications. 4) 4. Anil Kumar Jain, "Fundamentals of Digital Image Processing"; Pearson Education 2nd edition 2015.		
Reference Books:		
1. Pratt William, "Digital Image Processing", John Wiley & Sons 2. Milan Sonka, Vaclav Hlavac and Roger Boyle, “Image Processing, Analysis and Machine Vision”, Second Edition, Thomson Learning, 2001		

Mixed Signal Design
(Professional Elective Course – IV)

COURSE OUTLINE

Course Title:	**Mixed Signal Design**	**Short Title:**	**MSD**	**Course Code:**	

Course description:

This course focuses on the concepts of mixed signal VLSI design. The course will give practical aspect of mixed signal VLSI blocks such as comparators, data converters, oscillators and phase locked loop. As a part of this course, the students will use industry standard softwares and tools such as Cadence's Virtuoso schematic, Spectre simulator and MentorGraphics' Eldo and Calibre for post layout simulations along with the parasitic extractions. The design problems given in the form of assignments will be designed and simulated in a standard CMOS technology by students. The study will cover design issues on the PVT variations and statistical mismatches in temperature and process (MonteCarlo). In summary, the course is designed with considering the need of VLSI design industry.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	*14*	*42*	*3*

Prerequisite course(s):

CMOS Design, VLSI

Course objectives:

To design and to implement the product level design blocks for VLSI applications.
1. To learn Switched Capacitor Circuits.
2. To learn advance design techniques for bandgap references, comparators, oscillators and PLL.
3. To understand data converter fundamentals DAC.
4. Learn Nyquist Rate A/D Converters
5. Understand oversampling converters, continuous time filters.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the concepts of Switched capacitors Circuits
2. Able to understand the design and application of PLLS.
3. To study concepts of Data Converter Fundamentals.
4. Understand the concepts of Nyquist Rate A/D Converters ,and applications
5. Understand concepts of the Oversampling Converters, Continuous-Time Filters , CMOS Trans conductors.

COURSE CONTENT

Mixed Signal Design		**Semester:**	*VII*
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**

	Internal Sessional Exams (ISE):	**40 marks**
Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**
Switched Capacitor Circuits: Introduction to Switched Capacitor circuits basic building blocks, Operation and Analysis, Non-ideal effects in switched capacitor circuits, Switched capacitor integrators first order filters, Switch sharing, Biquad filters.		
Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**
Phased Lock Loop (PLL): Basic PLL topology, Dynamics of simple PLL, Charge pump PLLs-Lock acquisition, Phase/Frequency detector and charge pump, Basic charge pump PLL, Non-ideal effects in PLLs-PFD/CP non idealities, Jitter in PLLs, Delay locked loops, applications.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Data Converter Fundamentals: DC and dynamic specifications, Quantization noise, Nyquist rate D/A converters- Decoder based converters, Binary-Scaled converters, Thermometer-code converters, Hybrid converters		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Nyquist Rate A/D Converters: Successive approximation converters, Flash converter, Two-step A/D converters, Interpolating A/D converters, Folding A/D converters, Pipelined A/D converters, Time-interleaved converters. Electronics & Communication Engineering		
Unit–V	**No. of Lectures: 09 Hours**	**Marks: 12**
Oversampling Converters: Noise shaping modulators, Decimating filters and Interpolating filters, Higher order modulators, Delta sigma modulators with multi-bit quantizers, Delta sigma D/A **Continuous-Time Filters:** Introduction to Gm-C Filters, Bipolar Trans conductors , CMOS trans conductors Using Triode and Active Transistors, Bi CMOS Tran conductors, MOSFET-C Filters.		
Text Books:		
1. Design of Analog CMOS Integrated Circuits- Behzad Razavi, TMH Edition, 2002 2. Analog Integrated Circuit Design- David A. Johns,Ken Martin, Wiley Student Edition, 2013		
Reference Books:		
1. CMOS Mixed-Signal Circuit Design - R. Jacob Baker, Wiley Interscience, 2009. 2. CMOS Analog Circuit Design –Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010. **WEB REFERENCES** 1. NPTEL online courses.		

Artificial Intelligence & Machine Learning
(Open Elective Course – III)

COURSE OUTLINE

Course Title:	**Artificial Intelligence & Machine Learning**	**Short Title:**	**AI-ML**	**Course Code:**	

Course description:

This course is to introduce the students to the fundamentals of Artificial Intelligence, Expert Systems and Neural Networks & Fuzzy logic and enable them to apply these concepts for solving real world problems.
Machine learning uses interdisciplinary techniques such as statistics, linear algebra, optimization, and computer science to create automated system. Machine learning as a field is now incredibly pervasive, with applications spanning from business intelligence to homeland security. This class will familiarize students with a broad cross-section of models and algorithms for machine learning, and prepare students for research or industry application of machine learning techniques

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
	03	14	42	

Prerequisite course(s):

Course objectives:

1. To understand the various characteristics of Intelligent agents.
2. To introduce students to the basic concepts and techniques of Neural Network.
3. To understand fundamental concept of Fuzzy Logic.
4. To introduce students to the basic concepts and techniques of Machine learning.
5. To gain skills for solving practical problems by machine learning.

After successful completion of this course the student will be able to:

Course Outcome :

1. Use appropriate search algorithms for any AI problem
2. Apply basic concept to describe neural network.
3. Apply basic knowledge to describe concept of Fuzzy logic.
4. Recognize the characteristics of machine learning that make it useful to real-world problems.
5. Able to use regularized regression and Classification algorithms.

COURSE CONTENT

Artificial Intelligence & Machine Learning		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme**	
Lectures: 03	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Artificial Intelligence

Definitions of AI, History, Turing test, AI Problem and Techniques: Problem as State Space

Search, Problem characteristics, Production System: Water Jug problem. Knowledge Representation Issues, Knowledge Representation using Predicate Logic, Knowledge Representation using Rules .		
Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Neural Network Characteristics of Neural Networks: Features of Biological Neural Networks, Biological Neural Networks, Performance Comparison of Computer and Biological Neural Networks Artificial Neural Networks: Terminology, Models of Neuron: McCulloch-Pitts Model, Perception, Adeline Topology, Basic Learning Laws ,Learning Methods: Supervised and unsupervised, Introduction to Multilayer Perceptron, various activation functions.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Fuzzy Logic Introduction to fuzzy sets and fuzzy logic systems, Fuzzy set definitions, operations, Fuzzy rules, Fuzzy reasoning. Fuzzy inference systems, Fuzzy models.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Introduction to Machine Learning: Types of Machine Learning Algorithms, Supervised Learning, Unsupervised learning, Reinforcement Learning, Classification of Machine Learning Concept, Distance Based Machine learning Methods, K-Nearest Neighbor (kNN). Introduction to Clustering Techniques, Possible Applications, Requirements of clustering algorithm, Problems associated with using Clustering Technique, Types of Clustering Methods, Clustering Strategies.		
.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Classification / Regression: Classifications, decision tree **learning**, naive bayes, linear regression, logistic regression, Linear regression models, support vector machine, beyond binary classifications: multiclass or multinomial classification.		
Text Books:		
1. Elaine Rich, Kevin Knight and Shivshankar Nair "Artificial Intelligence". 3rd Edition TMH. 2. V.K. Jain, Machine Learning, Khanna Publishing House. 3. Rajiv Chopra, Deep Learning. Khanna Book Publishing, New Delhi. 4. Vinod Chandra S.S., Artificial Intelligence & Machine Learning, PHI. 5. Rajasekaran and G.A. Vijayalakshmi, “Neural Networks, Fuzzy Logic, and Genetic Algorithms”, PHI .		
Reference Books:		
1. Rajiv Chopra, Machine Learning, Khanna Book Publishing, New Delhi. 2. Mitchell Tom, Machine Learning. McGraw Hill, 1997. 3. Ethem Alpaydin, Introduction to Machine Learning, PHI. 4. Timothy J Ross, “Fuzzy Logic with Engineering Application”, TMH. 5. S. N. Sivanandam & S. N. Deepa, Principles of Soft Computing, Wiley - India, 2007		

Big Data Analytics
(Open Elective Course – III)

COURSE OUTLINE

Course Title:	**Big Data Analytics**	**Short Title:**	**BDA**	**Course Code:**	

Course description:

Data Analysis is an ever-evolving discipline with lots of focus on new predictive modeling techniques coupled with rich analytical tools that keep increasing our capacity to handle big data.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite course(s):

Data Mining

Course objectives:

1. To understand the concepts of big data
2. To understand the concepts of Data science
3. To do the data analysis
4. To apply the concepts of data visualization
5. To apply data analytics tools

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the concepts of big data
2. Understand the concepts of Data science
3. Do the data analysis
4. Apply the concepts of data visualization
5. Apply data analytics tools

COURSE CONTENT

Big Data Analytics		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Big Data: Big data, 3V's, 4 V's of big data, Types of Big data, Analytics, Industry examples of Big data, Data risk, Big data technologies, Big data architecture, operational and analytical big data technologies, big data and eGovernance, Benefits of Big data, analytics and cloud computing, Crowd sourcing analytics.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Data Science: Data Science, Terminology Related with Data Science, Methods of Data Repository, Personnel Involved with Data Science, Types of Data, The Data

Science Process (DSP), Popular Data Science Toolkits, Familiarity with Example Applications		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Data Analysis: Introduction to Applied Statistical Techniques, Types of Statistical Data, Types Of Big Data Analytics, Collecting Data for Sampling and Distribution, Probability, Frequency Distribution, Population and Parameters, Central Tendency or Central Value, Measures Of Central Tendency, Different Types of Statistical Means, Problems of Estimation : Population or Sample, Normal Distribution Curve		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Data Visualization: Data Visualization, Importance of Data Visualization, Conventional Data Visualization Methods, Retinal Variables, Mapping Variables to Encodings, Case Study, Recent trends in various data collection and analysis techniques, Various Big Data Visualization Tools, Visualizing Big Data, Preattentive Attributes, Challenges of Big Data Visualization, Potential Solutions, Future Progress of Big Data Visualization		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Advanced Analytics: Technology and Tools: Hadoop: Architecture, components of Hadoop framework, Analysing big data with Hadoop. MapReduce: Overview, Map Operations, HIVE: features, architecture, working, data models. PIG: Introduction, components, pig vs MapReduce, Pig vs HIVE,		
Text Books:		
1. V.K.Jain, "Data Science and Analytics", Khanna Book Publishing Co.(P) LTD. Edition 2018 2. V.K.Jain, "Big Data and Hadoop", Khanna Book Publishing Co.(P) LTD. Edition 2017		
Reference Books:		
1. Maheshwari Anil, Rakshit, Acharya, "Data Analytics", McGraw Hill, ISBN: 789353160258. 2. Mark Gardner, "Beginning R: The Statistical Programming Language", Wrox Publication,ISBN: 978-1-118-16430-3 3. David Dietrich, Barry Hiller, "Data Science and Big Data Analytics", EMC education services, Wiley publications, 2012, ISBN0-07-120413-X 4. Ashutosh Nandeshwar , "Tableau Data Visualization Codebook", Packt Publishing, ISBN 978-1-84968-978-6 5. Luís Torgo, "Data Mining with R, Learning with Case Studies", CRC Press, Talay and Francis Group, ISBN9781482234893 6. Carlo Vercellis, "Business Intelligence - Data Mining and Optimization for Decision Making", Wiley Publications, ISBN: 9780470753866.		

Mechatronics
(Open Elective Course – III)

COURSE OUTLINE

Course Title:	**Mechatronics**	**Short Title:**	**MTX**	**Course Code:**	

Course description:

In this course, students take on the roles of mechanical engineers, computer scientists and electrical engineers. Students research dynamics, kinematics and sensors. Topics such as such as motion planning and obstacle avoidance, velocity and acceleration, serial chain mechanisms, pneumatic actuators, and drive circuits are covered.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite course(s):

Course objectives:

1. To understand the concept and key elements of Mechatronics system, representation into block diagram
2. To understand principles of sensors their characteristics
3. To Understand of various data presentation and data logging systems
4. To Understand concept of actuator
5. To Understand various case studies of Mechatronics systems .

Course outcomes:

After successful completion of this course the student will be able to:

1. Identification of key elements of mechatronics system and its representation in terms of block diagram
2. Understanding basic principal of Sensors and Transducer.
3. Able to prepare case study of the system given.

COURSE CONTENT

Mechatronics		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Unit I :Introduction to Mechatronics

Basics of Mechatronics Systems : Definition of Mechatronics, Key elements of Mechatronics Systems, Levels of mechatronics systems, Measurement Characteristics, Examples of Mechatronics systems in daily life as ,Washing Machines, Digital Cameras, CD Players, camcorders, Mechatronics design process, phases of mechatronics design process,

integrated design approach.

Mechanical Components and Servo mechanism : Mechanical System and Motion, Mass Inertia and Dashpot, Gears, types of Gears, Servomechanism(Concepts and Theory, Problems).Case study Mechatronics Design of Coin Counter/Coin Separator

.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12

Overview of Sensors, Transducers and their Characteristics Specifications :

Classification and selection of transducers:

Force: Load Cell, Cantilever Beam (Design aspect example) **Pressure:** Strain Gauge, Piezoelectric **Motion:** Rotary and Linear motions, Proximity sensors Inductive, Capacitive and Magnetic, sources detectors in optical proximity sensors. Comparison of Various proximity sensors **Temperature:** Optical Fibre and its use in temperature measurement**,** Fibre Optic Temperature sensors, Ultrasonic Transducersfor applications as position, level, flow measurement. Gas sensors, Wind sensors: Gyroscope, Accelerometer, Magnetometer (As used in smart phones) **Smart Sensors**: Concept, Radiation Sensors - Smart Sensors - Film sensor, IR- temperature sensors Introduction to MEMS& Nano Sensors . Rotary Optical Encoder

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Hydraulic Systems

Introduction to Hydraulic Actuators Fluid Power systems, Concept of Actuators, Classification of Actuators: Pneumatic, Hydraulic and Electrical Actuators, Fluid Power systems.

Physical Components of a Hydraulic systems, Hydraulic Pumps (e.g. Gear Pumps, Vane Pumps, Piston Pumps and Axial Piston Pumps) , Filters and Pressure Regulation, Relief Valve, Accumulator. .

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Pneumatic Systems

Introduction to Pneumatic a Actuators Physical Components of a Pneumatic Systems, Pneumatic Cylinders, Pneumatic Actuators (e.g. Spring Actuator and Spring Actuator with positioner), Air compressor, Air Receiver, Air Dryer Air Service Treatment: Air Filter, air regulator and Gauge, Air Lubricator and Pressure regulation Intake and Air Filter. Case study of Robotic Pick and Place robot

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Electron-Mechanical Actuator:

Selection criteria and specifications of stepper motors, solenoid valves, relays (Solid State relays and Electromechanical relays). Selection Criterion of control valve, Single acting and Double acting Cylinders. Electro-Pneumatic: Pneumatic Motors, Valves: Electro Hydraulic: 3/2 Valves, 4/2 Valves, 5/3 Valves Cables: Power cable and Signal cables .

Boat Autopilot, High Speed tilting trains, Automatic car parking systems, Engine Management,

Antilock Brake systems (ABS) ,CNC Machines(Only Black Diagram and explaination)
Text Books:
1) W. Boltan ―Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, 6th Edition, Pearson Education, 2016 ‘ 2)David Alciatore and MaichaelB Histand, ―Introduction to Mechatronics and Measurement Systems,4th Edition, Tata McGraw Hill 2013.
Reference Books:
1) Nitaigour P. Mahalik , Mechatronics-Principles, Concepts and Applications , Tata McGraw Hill, Eleventh reprint 2011. 2) Devdas Shetty and Richard A.Kolk, ―Mechatronics System Design, Thomson India Edition 2007.

Communication Lab-I					
LAB COURSE OUTLINE					
Course Title:	**Communication Lab-I**	**Short Title:**	**CL-I**	**Course Code:**	
Course description:					
The communication Lab –I is based on the application of optical fiber in communication system and Digital Image and Video Processing is described.					
Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	2	**14**	**28**	**1**	
End Semester Exam (ESE) Pattern:		**Practical (PR)**			
Prerequisite course(s):					
Course objectives:					
1. Student will understand the fundamentals and advantages in optical communication system. 2. Student will learn various types basic properties and transmission characteristic of optical fibers. 3. Student will learn working of optical transmission system with analog as well as digital data transmission. 4. Student will gain the knowledge of various losses in optical communication and apply the remedies to reduce losses. 5. To study the image fundamentals and mathematical transforms necessary for image processing. 6. To study the image enhancement techniques. 7. To study image restoration procedures. 8. To study the image compression procedures.					
Course outcomes:					
Upon successful completion of lab Course, student will be able to:					
1. Able to know the fundamentals, advantages and advances in optical communication system. 2. Familiarize with types, basic properties and transmission characteristic of optical fibers. 3. Experience with the Knowledge of working of optical transmitter and the receiver with analog and digital data. Transmission. 4. Able to know various losses in optical communication and reduce the losses. 5. Review the fundamental concepts of a digital image processing system and analyze images in the frequency domain using various transforms. 6. Evaluate the techniques for image enhancement and image restoration. 7. Categorize various compression techniques and interpret Image compression standards. 8. Interpret image segmentation and representation techniques.					
LAB COURSE CONTENT					
Communication Lab-I		**Semester:**		**VII**	
Teaching Scheme:		**Examination scheme:**			
Practical:	**2 hours/week**	**End Semester Exam (ESE): (PR)**		**25 marks**	

	Internal Continuous Assessment (ICA):	**25 marks**

(Note: Minimum EIGHT experiments to be performed from Group - A / Group - B)

Group - A

1. Electrical Characteristics of different type LED.
2. To study Laser Diode.
3. Photometric characteristics of LED/Laser Diode (Polar plot/Intensity Measurement)
4. NA Measurement for Single/Multi mode, Graded Index/Single Index optical Fiber
5. Attenuation Measurement and bending losses measurement of optical fiber
6. Spectral characteristics of LED/LD.
7. Analog Signal transmission using LED source.
8. Digital Signal transmission using LED source.
9. Study of OTDR
10. Study of optical connectors.

Group - B

1. Study of different file formats e.g. BMP, TIFF and extraction of attributes of BMP.
a. BMP.
b. TIFF and extraction of attributes of BMP.
2. Study of statistical properties- mean, standard deviation, profile, variance and Histogram plotting.
a. Study of statistical properties-mean, standard deviation and profile.
b. Study of statistical properties- variance and Histogram plotting.
3. Histogram equalization and modification of the image.
a. Histogram equalization of the image.
b. modification of the image.
4. Gray level transformations such as contrast stretching, negative, power law transformation.
a. Contrast Stretching, negative.
b. Power Law Transformation.
5. Spatial Domain filtering- smoothing and sharpening filters.
a. Spatial Domain filtering- smoothing filters.
b. Spatial Domain filtering- sharpening filters.
6. DCT / IDCT of given image.
a. DCT of given image.
b. IDCT of given image.
7. Edge detection using Sobel, Prewitt and Roberts operators.
a.Edge detection using Sobel,Prewitt operators.
b.Edge detection using Roberts operators.
8. Capturing image through grabber card from camera and Process it.
9. Application Development
a. Biometric Authentication such as Face / Finger Print / Signature Recognition.
b.Human Expression Detection.
10. Creating noisy image and filtering using MATLAB.

Text Book

1. J. Keiser, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition).
2. T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975.
3. J. Gowar, Optical communication systems, Prentice Hall India, 1987.
4. S.E. Miller and A.G. Chynoweth, eds., Optical fibers telecommunications, Academic Press, 1979.
5. Govind Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed. 1994.
6. Govind Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York, 1997.
7. Rafel C. Gonzalez and Richard E. Woods, 'Digital Image Processing', Pearson Education Asia, Third Edition, 2009.
8. S. Jayaraman, E.Esakkirajan and T.Veerkumar, "Digital Image Processing" TataMcGraw Hill Education Private Ltd, 2009.

Reference Books:

1.John M. Senior , "Optical Fiber Communication (Principles & Practice)",Pearson Education.
2. Anil K. Jain, "Fundamentals and Digital Image Processing", Prentice Hall of India Private Ltd,Third Edition
3. S. Sridhar, "Digital Image Processing", Oxford University Press, Second Edition, 2012.
4. Robert Haralick and Linda Shapiro, "Computer and Robot Vision", Vol I, II, Addison Wesley, 1993.

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignments.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification.

Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

Digital Signal Processing Lab					
LAB COURSE OUTLINE					
Course Title:	**Digital Signal Processing Lab**	**Short Title:**	**DSPL**	**Course Code:**	
Course description:					
Digital Signal Processing Lab objectives is practical implementation of the convolution, correlation, DFT, IDFT, Block convolution, Signal smoothing, filtering of long duration signals, and Spectral analysis of signals					
Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	2	**14**	**28**	**1**	
End Semester Exam (ESE) Pattern:		**Practical (PR)**			
Prerequisite course(s):					
Signal and System					
Course objectives:					
1. Design and implement a DSP system using tools like MATLAB 2. Analyze and describe the functionality of a real world DSP system 3. Work in teams to plan and execute the creation of a complex DSP system 4. Apply DSP system design to real world applications and demonstrate Finite word length effect. 5. To study the architecture of DSP processor.					
Course outcomes:					
Upon successful completion of lab Course, student will be able to:					
1. Understand the handling of discrete/digital signals using MATLAB **2.** Understand the basic operations of Signal processing **3.** Analyse the spectral parameter of window functions **4.** Design IIR, and FIR filters for band pass, band stop, low pass and high pass filters. **5.** Design the signal processing algorithm using MATLAB					
LAB COURSE CONTENT					
Digital Signal Processing Lab		**Semester:**	**VII**		
Teaching Scheme:		**Examination scheme:**			
Practical:	**2 hours/week**	**End Semester Exam (ESE): (PR)**		**25 marks**	
		Internal Continuous Assessment (ICA):		**25 marks**	
(Note: Minimum EIGHT experiments to be performed) 1. To find DFT / IDFT of given DT signal 2. Implementation of FFT of given sequence 3. Determination of Power Spectrum of a given signal 4. Implementation of LP and HP FIR filter for a given sequence					

5. Implementation of LP and HP IIR filter for a given sequence
6. Implementation of Decimation Process
7. Implementation of Interpolation Process
8. Implementation of I/D sampling rate converters
9. To study the effect of different windows on FIR filter response.
10. Design Butterworth filter using bilinear transformation method for LPF.
11. Study of Code Composer Studio to demonstrate / implement DFT / IDFT
12. Study of Code Composer Studio to demonstrate / implement FFT /IIT

Text Books:

1. S. Salivahanan, “Digital Signal Processing”, McGraw Hill Education; 3rd edition, 2017.
2. P. Ramesh Babu, “Digital Signal Processing”, Scitech Publications (India) Pvt.Ltd., 6th edition, 2014.
3. Emmanuel C. Ifeachor, Barrie W. Jervis, “Digital Signal Processing”, A Practical Approach by, Pearson Education
4. Tarun Kumar Rawat,Digital Signal Processing”, Oxford University Press, 2015.

Reference Books:

1. Proakis J., Manolakis D., "Digital Signal Processing", 4th Edition, Pearson Education.
2. Sanjit K. Mitra , Digital Signal Processing – A Computer Based Approach – 4th Edition McGraw Hill Education (India) Private Limited.
3. Oppenheim A., Schafer R., Buck J., "Discrete Time Signal Processing", 2nd Edition, Pearson Education.
4. B. Venkata Ramani and M. Bhaskar, “Digital Signal Processors, Architecture, Programming and Applications”, McGraw Hill Second Edition.
5. L. R. Rabiner and B. Gold, “Theory and Applications of Digital Signal Processing”, Prentice-Hall of India, 2006.
6. TMS320C67XX User manual: www.ti.com .

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignments.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification.

Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

Project (Stage – I)					
LAB COURSE OUTLINE					
Course Title:	**Project (Stage – I)**	**Short Title:**	**PROJ-SI**	**Course Code:**	
Course description:					
Project represents the culmination of study towards the Bachelor of Engineering degree. The project offers the opportunity to apply and extend material learned throughout the program. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres.					

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	12	**14**	**168**	**6**

End Semester Exam (ESE) Pattern:	**Oral (OR)**

Prerequisite course(s):

Course objectives:

1. To understand the basic concepts & broad principles of projects.
2. To understand the value of achieving perfection in project implementation & completion.
3. To apply the theoretical concepts to solve problems with teamwork and multidisciplinary approach.
4. To demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Demonstrate a sound technical knowledge of their selected project topic.
2. Undertake problem identification, formulation and solution.
3. Design engineering solutions to complex problems utilizing a systems approach.
4. Conduct an engineering project
5. Demonstrate the knowledge, skills and attitudes of a professional engineer.

LAB COURSE CONTENT

Project (Stage – I)		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Practical:	**12 hours/week**	**End Semester Exam (ESE): OR**	**50 marks**
		Internal Continuous Assessment (ICA):	**50 marks**

At the final year the students shall carry out a project in a group of maximum up to 5 students. The project work spans both the semesters. By the end of Semester –VII the students shall complete the partial work, and by the end of Semester –VIII the students shall complete remaining part of the project. Assessment for the project shall also include presentation by the

students. Each teacher can guide maximum 04 groups of projects.

The students should take project work, as specified in the curriculum, based on the knowledge acquired by the students during the degree course till Semester – VI and/or during Internship. The project must be practical or involving both theoretical and practical work to be assigned by the Department. The work may also be Study/Survey/Design or R&D work. The work may also be on specified task or project assigned to the students during Internship.

Project (Stage – I) may involve literature survey, problem identification, design methodology, collection of data, conduction of experiments and analysis etc. The project work shall involve sufficient work so that students get acquainted with different aspects of design, analysis and fabrication. Approximately more than 50% work should be completed by the end of Semester – VII. Each student group should submit partial project report in the form of thermal bound at the end of Semester –VII. Assessment for the project shall also include presentation by the students.

Each student group is required to maintain separate log book for documenting various activities of the project.

Suggestive outline for the partial project report is as follows.

Abstract

Chapter 1. Introduction

- Background / Literature Survey.
- Motivation
- Problem Definition
- Scope
- Objective
- Selection of Life cycle Model for Development
- Organization of Report
- Summary

Chapter 2. Project Planning and Management

- Feasibility Study
- Risk Analysis
- Project Scheduling
- Effort Allocation
- Cost Estimation
- Summary

Chapter 3. Analysis

- Requirement Collection and Identification
- H/w and S/w Requirement (Data, Functional and Behavioral)
- Functional and non-Functional Requirements
- Software Requirement's Specification (SRS)

- Summary

Chapter 4. Design

- System Architecture and Design Methodology.
- Circuit Diagram and Data Flow Diagram / Flow chart.
- UML Diagrams (Use case, Class, Sequence, Component, Deployment, State chart, Activity diagram etc.)
- Summary

Chapter 5. Result, Conclusion & Future Work

Bibliography

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Appendix

Guide lines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge / skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Project (Stage – I) in Semester – VII shall be as per the guidelines given in Table – A.

Table – A

		Assessment by Guide					Assessment by Departmental Committee		
Sr. No.	Name of the Student	Attendance / Participation	Problem Identification / Project Objectives	Literature Survey	Methodology / Design	Report	Depth of Understanding	Presentation	Total
	Marks	5	5	5	5	5	10	15	50

Guidelines for ESE:

In End Semester Examination (ESE), the student may be asked for presentation / demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.

Essence of Indian Traditional Knowledge

Course objective:
The course aims at imparting basic principles of thought process, reasoning and inferencing, sustainability is at the core of Indian traditional knowledge system connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. The course focuses on introduction to Indian knowledge systems, Indian perspective of modern scientific world-view, and basic principles of yoga and holistic health care system, Indian artistic tradition.

Outcomes:
Ability to understand, connect up and explain basics of Indian traditional knowledge in modern scientific perspective.

Course Contents:
Introduction to:

1. Ayurveda, Charaka Samhita, Sushruta Samhita
   Principles and Terminology: Vatha, Pitha, Kapha, Ether, Earth, Water, fire and Air Tatva, Influence of these on human health.
2. Architecture: Temple Architecture, Indo – Islamic Architecture, Mughal Architecture, Indian Rock Cut Architecture, Vastu Shastra.
3. Importance of Yoga for Physical and Mental health, Yoga Sutras of Patanjali, Meditation, International day of Yoga.
4. Indian Classical Music, Hindustani and Carnatic Music, Raga, Tala, Dhrupad, Khyal, Tarana and Thumri, Sangitaratnakara, Work of Tansen, Purandara Dasa, Bhimsen Joshi, Ustad Bismillah Khan, Bal Gandharva etc.
   Folk Music and Dances such as Rajasthani, Marathi, Gujrati, Punjabi etc.
5. Indian Classical Dances: Shastriya Nritya, Natya Shastra, Bharatanatyam, Kathak, Kuchipudi, Odissi, Kathakali, Sattriya, Manipuri, Mohiniyattam and Chhau dance forms.

References:

1. Amit Jha, “Traditional knowledge system in India”, Atlantic Publisher, ISBN 978812691223
2. Basanta Kumar Malhotra, “Traditional Knowledge System and Technology in India”, Pratibha Prakashan, ISBN 8177-023101
3. Nitin Singhania, “Indian Art and Culture”, McGraw Will Publication.
4. Dr. Bramhand Tripathi, “Charak Sanhita”, Chaukhambha Surbharti Prakashan, ISBN: 9381-4847-59
5. Dr. Anantram Sharma, “Sushrut Samhita”
6. Valiatham M.S., “An Introduction to Ayurveda” Orient Bkackswan Publication.
7. Valiathan M.S., “The legacy of Charaka” University Press.
8. Valiathan M.S., “The legacy of Susruta” University Press.
9. Garg Maheshwari, “Ancient Indian Architecture”, CBS Publisher and Distributors
10. Sharmin Khan, “History of Indian Architecture”, CBS Publisher and Distributors.

11. Bindia Thapar, Surat ku. Manto, Suparana Bhalla, “Introduction to Indian Architecture”, Periplus Editions Ltd.
12. Vijay Prakash Singh, “An Introduction to Hindustani Classical Music”, Lotus Publisher
13. Leeta Venkataraman, Avinash Pasricha, “Indian Classical Dance” Lustre Publisher
14. Shovana Narayan, “Indian Classical Dances” New Dawn Press
15. Kapila Vatsyayan, “Indian Classical Dance”, Ministry of Information and Broadcasting, Govt of India.
16. Mahadevan Ramesh, “A Gentle introduction to Carnatic Music”, Oxygen books Publisher.

Kavayitri Bahinabai Chaudhari

NORTH MAHARASHTRA UNIVERSITY,

JALGAON (M.S.)

Final Year Engineering

(Electronics and Telecommunication Engineering)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
3rd Cycle

SYLLABUS

Semester – VIII

W.E.F. 2020 – 21

Computer Network					
COURSE OUTLINE					
Course Title:	**Computer Network**	**Short Title:**	**CN**	**Course Code:**	

Course description:

This course describes the basics concept of Computer Network, architecture, protocol and its Applications.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	13	42	

Prerequisite course(s): Analog & Digital Communication, Signal and System

Course objectives:

1. To study the basics concept of Computer Network.
2. To Understand the principle of various types of Computer Network.
3. To familiarize the concept of Various Protocols.
4. Provide strong foundation for understanding of Congestion and Quality of Service.
5.To Learn the Network Security & Authentication Protocols.

Course outcomes:

After successful completion of this course the student will be able to:

1 Describe the basic concepts of Computer Network systems.
2. Analyze various types of noisy protocols.
3.Describe the concept of circuit switching and packet switching.
4.Apply the concept for Congestion control and techniques to improve quality of service.
5. To describe the modern trends in Network Security and Public Key Algorithm.

COURSE CONTENT

Computer Network		**Semester:**	VIII
Teaching Scheme:		**Examination scheme**	
Lectures: 03	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Computer Network –Network Topologies, Network components: Hubs & switches, LAN,MAN,WAN, ISO/OSI Reference Model, TCP/IP Reference Model, Guided and unguided media: Transmission media: Twisted pair, coaxial cable, Fiber optics. Wireless Transmission: Radio transmission, Microwave transmission, Infrared Transmission, ISDN: Narrowband ISDN: ISDN services, System architecture, Interface. Broadband ISDN, ATM reference model.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Data Link Layer-Design issues, Framing, Error and Flow Control Flow control, Data Link Protocols: Unrestricted Simplex Protocol, stop and wait protocol, Simplex Protocol for a Noisy Channel. Sliding Window Protocols: One bit sliding window, Using Go-Back n, Protocol using Selective Repeat, HDLC, Multiple Access Protocols: ALOHA, Carrier Sense Multiple Access,

CSMA,CSMA/CD,CSMA/CA		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Network Layer -Design Issue of Network Layer, Comparison of Virtual circuit and Datagram subnets, Routing Algorithms, Shortest Path Routing, Flooding, Hierarchical Routing, Broad Cast Routing, Multicast routing, Congestion Control Algorithms, Congestion Prevention Policies, Choke Packets, Internet Protocol: Internetworking, IPV4 Datagram, IPV6 Addresses		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Transport Layer -ARP,RARP, ICMP,IGMP, Transmission Control Protocol(TCP), User Datagram Protocol(UDP) , Congestion Control of Transport Layer, Quality of Service(QoS), Techniques to improve QoS, Remote Procedure Call		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Application Layer- Domain Name System(DNS), SNMP, Network Security, Cryptography, Public key algorithms, Digital Signature, Authentication Protocols, Firewalls, Time division switching, Space division switching.		
Text Books:		
1. Andrew S Tanebaum - Computer Networks, 4th Ed. PHI/ Pearson education. 2. Behrouz A Forouzan - Data Communication and Networks, 3rd Ed. TMH.		
Reference Books:		
1. Irvine Olifer - Computer Networks: Principles, Technology and Protocols, Wiley India. 2. William Stalling – Data and Computer communications, 7th Ed. PHI 3. S. Keshav ,"An Engineering Approach to Computer Networking", Pearson Edu.		

Microwave Theory and Techniques
(Professional Elective Course – V)

COURSE OUTLINE

Course Title:	**Microwave Theory and Techniques**	**Short Title:**	**MTT**	**Course Code:**	

Course description:

This course is designed to lay the foundation of microwave theory. The various modes of propagations through wave guides are included. Students will become familiar with the usage of active and passive components of microwave systems. Measurements of various parameters of microwave systems and Modern trends of microwave engineering.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	13	42	

Prerequisite course(s):

Electromagnetic theory, Wave propagation, Antennas and Semiconductor physics

Course objectives:

1. To study the basics concept of various mode of propagation in waveguide.
2. To Understand the fundamentals of microwave passive components.
3. To familiarize the concept of microwave active devices.
4. Provide strong foundation for understanding of microwave measurement and microwave antenna.
5. To Learn the modern trends in microwave Engineering.

Course outcomes:

After successful completion of this course the student will be able to:

1 Describe the basic concepts and applications of microwave systems.
2. Analyze, test and use various passive microwave components for different applications.
3. Describe the concept of microwave active tubes.
4. Apply the concept for measurement of various parameters of microwave system.
5. To describe the modern trends in microwave engineering.

COURSE CONTENT

Microwave Theory and Techniques		**Semester:**	*VIII*
Teaching Scheme:		**Examination scheme**	
Lectures: 03	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Microwaves-History of Microwaves, Microwave Frequency bands; General Application of Microwave, Advantages-Rectangular, Circular, & Disadvantages. Types of waveguide, Mathematical Model of Microwave Transmission-Concept of Mode, Features of TEM, TE and TM Modes, Mathematical derivation of TEM Mode, TM Mode, TE Mode, Cut off frequency ,Phase velocity, Group Velocity ,Guide wavelength, wave Impedance for rectangular waveguide.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Passive Microwave Devices- Microwave passive components: E Plane Tee, H- Plane Tee Magic Tee, Directional Coupler, Analysis with S Matrix ,Attenuator, Frequency meter, Ferrite Devices-Isolator, circulator, Microwave filters, Matched Terminations, waveguide Bends, Twist		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Active Microwave Devices: Microwave tubes: Klystron, TWT, Backward Wave Oscillator, Magnetron. Gunn Diodes, Tunnel diode, PIN diodes, Varactor diodes, IMPATT and TRAPATT diodes, Parametric Amplifiers.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Microwave Measurements: Frequency-Electronics Method, Mechanical Method, Power, VSWR, attenuation, Impedance measurement. **Microwave Antennas:** Fundamental parameters of antennas**,** Horn antenna, Parabolic reflector with all types of feeding methods, slotted antenna, Lens antenna,		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Modern Trends in Microwaves Engineering Effect of Microwaves on human body, Medical and Civil applications of microwaves, Electromagnetic interference / Electromagnetic Compatibility (EMI / EMC), Monolithic Microwave IC fabrication , RF MEMS for microwave components, **Microwave Systems** Wireless Communications system, Radar Systems, Radiometer Systems,		
Text Books:		
1. Samuel Liao, Microwave Devices and Circuits, Pearson Education, 3/e. 2. Annapurna Das, Sisir Das, Microwave Engineering, TMH, 3/e		
Reference Books:		
1. Robert E Collin, Foundations for Microwave Engineering, Wiley India, 2/e. 2. Sisodia, Gupta, Microwaves: Introduction to Circuits, Devices and Antennas, New Age, 1/e. 3. Manojit Mitra, Microwave Engineering, Dhanpat Rai, 3/e.		

Adaptive Digital Signal Processing
(Professional Elective Course – V)

COURSE OUTLINE

Course Title:	**Adaptive Digital Signal Processing**	**Short Title:**	ADSP	**Course Code:**	

Course description:

Adaptation is accomplished by adjusting the free parameters of a filter according to the input data to achieve the desired output. Such adaptive algorithms are frequently encountered in many signal processing and machine learning algorithms. The adaptive signal processing course provides a comprehensive treatment of mathematical signal processing algorithms for designing optimum and linear filters; designing, implementing, and analyzing adaptive filters applied to system identification, inverse modeling (deconvolution), adaptive control, and interference cancellation; and some selected emerging topics in signal processing.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	*14*	*40*	3

Prerequisite course(s):

Signal and System , Digital Signal Processing

Course objectives:

To provide rigorous foundations in multirate signal processing, power spectrum estimation and adaptive filters.

1. To understand Linear Prediction and Optimum Linear Filters.
2. Learn Algorithms for Adapting FIR Filters.
3. Learn Algorithms for Adapting IIR Filters.
4. Understand Frequency-Domain and Subband Adaptive Filter.
5. Learn Kalman Filters.

Course outcomes:

After successful completion of this course the student will be able to:

1. To Analyze and implement Wiener filters
2. To Analyze and implement LMS and normalized LMS Adaptive filters signals.
3. To Analyze and implement frequency domain Adaptive filters
4. To Analyze and implement Recursive Adaptive filters
5. To apply adaptive signal processing to various applications

COURSE CONTENT

Name of the Subject		**Semester:**	*FILL HERE*
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Linear Prediction and Optimum Linear Filters

Signals,Correlation Functions and Power Spectra,Innovations Representation of a Stationary Random Process,Forward and Backward Linear Prediction,Solution of Normal Equations,Properties of Linear Prediction –Error Filters,AR Lattice and ARMA Lattice-Ladder Filters,Wiener Filters for filtering and Prediction

Unit–II:	No. of Lectures: 08 Hours	Marks: 12

Algorithms for Adapting FIR Filters

Search Techniques, Gradient search Approach,Least Mean Square Algorithm,Recursive Least Squres Algorithms

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Algorithms for Adapting IIR Filters

IIR Modeling,Gradient Descent Minimization of squared Prediction Error,Parameter Identification format and Stability theory Interpretation,Filtered Error and Filtered-Regressor Algorithms,Steiglitz-McBridge Algorithm,IIR whitner,ARMAX modeling

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Frequency-Domain and Subband Adaptive Filters

Block Adaptive Filters,Fast Block-LMS algorithm,Unconstrained Frequency-Domain Adaptive Filters,Self-Orthogonalising Adaptive Filters,Adaptive Equalization,Subband Adaptive Filters,Classification of Adaptive Filtering Algorithms

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Kalman Filters

Innovations Process, Estimation of the State Using the Innovations Process Kalman Filter as the Unifying Basis for RLS filters,Variations of the Kalman Filter, Applications

Text Books:

1. S.Haykin,"Adaptive Filter Theory",Pearson,2003
2. B.Widrow and S.D.Stearns,"Adaptive Signal Processing", Pearson,2009

Reference Books:

1.J.Treichler,C.R.Johnson,M.G.Larimore,"Theory and Design of Adaptive Filters",PHI,2002
2.J.G.Proakis,D.G.Manolakis,"Digital Signal Processing:Principles,Algorithms, and Applications",2011
3. D.G.Manolakis, V. K. Ingle, and S. M. Kogon ,"Statistical and Adaptive Signal Processing", McGraw-Hill,2005
4. S.L.Marple,"Digital Spectral Analysis",1987.
5. M.H.Hays," Statistical Digital Signal Processing and Modeling", John-Wiley,2001.

Antenna and Wave Propagation
(Professional Elective Course – V)

COURSE OUTLINE

Course Title:	**Antenna and Wave Propagation**	**Short Title:**	**AWP**	**Course Code:**	

Course description:

The objective of this course is to provide an in- depth understanding of modern antenna concepts, and practical antenna design for various applications. The course will explain the theory of different types of antennas used in communication systems
Lecture

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	13	42	

Prerequisite course(s): Advanced Digital Communication

The course requires knowledge about fundamental antenna theory and advanced electromagnetic field theory. The following experience is useful: understating vector calculus, some knowledge of Maxwell's equations, electrical engineering principles.

Course objectives:

1. To study the basics concept of Antenna and Wave Propagation.
2. To Understand the principle and radiation pattern of Antenna.
3. To familiarize the concept of Huygens Principle &Babinet Principle.
4. Provide strong foundation for understanding of Smartantennas.
5.To Learn the modern trends inAntenna and Wave Propagation& different modes of radio propogation used in current practice.

Course outcomes:

After successful completion of this course the student will be able to:

1 Describe the basic concepts and applications of Antennasystems.
2. Analyze, test and use various types of radiation pattern of antenna.
3.Describe the concept of Huygens Principle &Babinet Principle..
4.Apply the concept for measurement of various parametersof Antennas.
5. To describe the modern trends in different modes of radio propogation& Smart Antennas benefits used in current practice.

COURSE CONTENT

Satellite Communication		**Semester:**	*VIII*	
Teaching Scheme:		**Examination scheme**		
Lectures: 03	**3 hours/week**	**End semester exam (ESE):**		**60 marks**
		Duration of ESE:		**03 hours**
		Internal Sessional Exams (ISE):		**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Antenna Fundamental Concepts-Definitions – Radiation intensity – Directive gain – Directivity – Power gain – Beam width – Band width – Gain and radiation resistance of current element – Half-wave dipole and folded dipole – Reciprocity principle – Effective length and effective area, Relation between gain, effective length and radiation resistance. Physical concept

of radiation, Radiation pattern, near- and far-field regions, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions.		
Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Antenna Arrays, Radiation from Wires and Loops-Antenna array concept, Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays. Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Aperture Antennas-Huygens' principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts. Broadband Antennas: Broadband concept, Log-periodic antennas, frequency independent antennas.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Microstrip Antennas-Concept, Advantages and disadvantages, Basic characteristics of microstrip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Wave Propagation -The three basic types of propagation: Ground wave, space wave and sky wave propagation. Sky Wave Propagation: Structure of the ionosphere – Effective dielectric constant of ionized region – Mechanism of refraction – Refractive index – Critical frequency – Skip distance – Effect of earth's magnetic field – Energy loss in the ionosphere due to collisions – Maximum usable frequency – Fading and diversity reception. Space Wave Propagation: Reflection from ground for vertically and horizontally polarized waves – Reflection characteristics of earth – Resultant of direct and reflectedray at the receiver – Duct propagation. Ground Wave Propagation: Attenuation characteristics for ground wave propagation – Calculation of field strength at a distance.		
Text Books:		
1. C. A. Balanis, "Antenna Theory and Design", 3rd Ed., John Wiley &Sons., 2005. 2. Antennas And Wave Propagation by: K.D.PRASAD		
Reference Books:		
1. Harish A. R., Antenna and wave propagation, Oxford University Press. Tri T. Ha, "Digital Satellite Communications",Tata McGraw-Hill,2009 2. J.D.Kraus,"Antennas,McGraw-Hill,1988		

Embedded System
(Professional Elective Course – VI)

COURSE OUTLINE

Course Title:	**Embedded System**	**Short Title:**	**ES**	**Course Code:**	

Course description:
To provide students with basic knowledge and skills in embedded systems design.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	*14*	*42*	*3*

Prerequisite course(s):
Digital System Design, Microcontrollers

Course objectives:
1. To understand advance trends in embedded system
2. To acquaint students with knowledge of embedded processor, its hardware and software.
3. To provide skills in embedded C programming and interfacing with Embedded processor.
4. To understand real time operating systems, inter-task communication and embedded software development tools.
5. Learn the internet operated system and market new trends and technology.

Course outcomes:
After successful completion of this course the student will be able to:
1. Distinguish real-time embedded systems from other systems.
2. Understand the ARM processor fundamentals.
3. Design Real World Interfacing with ARM7 Based Microcontroller
4. Evaluate the need for real-time operating system and real-time algorithm for task scheduling.
5. Understand the IoT and its application design.

COURSE CONTENT

Embedded System		**Semester:**	*VIII*
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Embedded System Introduction
Definition, Embedded Systems Vs General Computing Systems, Classification, categories, Characteristics, Recent Trends , quality attributes (Design Metric),embedded product development life cycle (EDLC), communication protocols like CAN, bluetooth and Zig-bee.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

ARM Processors
Introduction to ARM processors and its versions, ARM7, ARM9 & ARM11 features, advantages

& suitability in embedded application. Introduction to Tiva TM4C123G Series Overview, Programming model, Tivaware Library

ARM7 : registers, CPSR, SPSR, ARM and RISC design philosophy, ARM7 data flow model, programmers model, modes of operations.

ARM7 Based Microcontroller LPC2148: Features, Architecture (Block Diagram and Its Description) , System Control Block (PLL and VPB divider) , Memory Map, GPIO, timer,

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**

Real World Interfacing with ARM7 Based Microcontroller

Programming in assembly language/ Embedded C, Interfacing with LED, LCD, GLCD, KEYPAD, stepper / dc motor , simple LPC2148 GPIO Programming examples Using timers of LPC2148 to generate delay, Interrupt structure of LPC2148, programming for UART on-chip devices ADC, DAC,WDT,USB,PWM.

Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**

Real Time Operating System Concept

Types of OS, Tasks, process, Threads, Multiprocessing and ,Multitasking, Task scheduling, Threads, Process , Scheduling ,Task communications, Task synchronization, how to choose RTOS, Overview of operating system (off-the-shelf, Embedded, RTOS, Handheld), Introduction to JAVA Programming for Embedded System

Introduction to Ucos II RTOS and it's features, study of kernel structure of Ucos II.

Case study of digital camera and automatic chocolate vending machine (without codes)

Unit–V	**No. of Lectures: 09 Hours**	**Marks: 12**

Internet of Things(IoT)

Introduction to IoT, Sensing, Actuation, Basics of Networking, Basics of Networking, Communication Protocols, Sensor Networks, Machine-to-Machine Communications, Interoperability in IoT,

Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino. Introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi, Introduction to SDN, SDN for IoT.

Case Study: Smart Cities and Smart Homes, Smart Grid, Agriculture, Healthcare, Activity Monitoring.

Text Books:

1. Embedded Systems, Rajkamal , TMH, 2008.
2. Shibu. K. V, "Introduction to Embedded Systems", Tata Mcgraw Hill, 2009.
3. Frank Vahid - Embedded Systems , Wiley India, 2002
4. Jean J Labrose - MicroC / OS-II, Indian Low Price Edition 2002
5. DR.K.V.K.K. Prasad - Embedded / real time system, Dreamtech
6. Iyer, Gupta - Embedded real systems Programming , TMH
7. Embedded Microcomputer Systems – Real Time Interfacing – Jonathan W. Valvano; Cengage Learning; Third or later edition.
8. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)

9. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press).

Reference Books:

1. Embedded systems software primer, David Simon - Pearson
2. ARM System Developers Guide- Sloss, Symes, Wright, ElsevierMorgan Kaufman, 2005
3. ARM System-on-Chip Architecture, Steve Furber - Pearson 2005
4. LPC 214x User manual (UM10139) :- www.nxp.com
5. ARM architecture reference manual : - www.arm.com
6. Trevor Martin, An Engineer's Introduction to the LPC2100 series, Hitex (UK)
7. Joseph Yiu, ―The Definitive Guide to the ARM Cortex-M, Newness, ELSEVIER.
8. http://www.ti.com/

Mobile Communication Network
(Professional Elective Course – VI)

COURSE OUTLINE

Course Title:	**Mobile Communication Network**	**Short Title:**	**MCN**	**Course Code:**	

Course description:

.This course describes the fundamentals of telecommunication switching and their traffic. This course will help to understand the concept of mobile management and coding in GSM & CDMA.

Mobile Communication Network	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	14	42	3

Prerequisite course(s):

Knowledge of basic Computer Networking and their concept.

Course objectives:

1. To learn and understand the basic principles of Telecommunication switching, traffic and networks
2 To learn and understand basic concepts of cellular system, wireless propagation and the techniques used to maximize the capacity of cellular network.
3To learn and understand architecture of GSM and CDMA system.
4 To understand mobile management, voice signal processing and coding in GSM and CDMA system

Course outcomes:

After successful completion of this course the student will be able to:

After successfully completing the course students will be able to
1 Explain and apply the concepts telecommunication switching, traffic and networks
2 Analyze the telecommunication traffic.
3 Analyze radio channel and cellular capacity.
4 Explain and apply concepts of GSM and CDMA system

COURSE CONTENT

Mobile Communication Network		**Semester:**	
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09Hours**	**Marks: 12**

Telecommunication Switching & Traffic

Telecommunication switching: Message switching, Circuit switching, Manual System, Electronic Switching. Digital switching: Switching functions, Telecommunication Traffic: Unit of Traffic, Traffic measurement, A mathematical model, Lost- call systems: Theory, traffic performance, loss

systems in tandem, traffic tables. Queuing systems: Erlang Distribution, probability of delay, Finite queue capacity, Systems with a single server, Queues in tandem, delay tables and application of Delay formulae		
Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Switching Networksand Signaling		
Single Stage Networks, Gradings, Link Systems, Grades of service of link systems. Time Division Switching: Space and time switching, Time division switching networks, Synchronization, Call processing Functions, Common Control, Reliability, Availability and Security. Signaling: Customer line signaling. FDM carrier systems, PCM signaling, Inter-register signaling, Common channel signaling principles, CCITT signaling No. 6, CCITT signaling No. 7, Digital customer line signaling		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Cellular Concepts		
Evolution of Wireless systems, Introduction to cellular telephone system, Frequency reuse, Channel Assignment, Handoff strategies, Cell Splitting, Propagation Mechanism: Free space loss, Reflection, Diffraction, Scattering. Fading and Multipath: Small scale multipath propagation, Impulse response model of multipath channel. Multiple Access Techniques-TDMA, FDMA, CDMA		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
First and Second Generation Mobile Systems		
First Generation Cellular Systems, AMPS, GSM Cellular Telephony: Introduction, Basic GSM Architecture, Basic radio transmission parameters in GSM system, Logical Channels, GSM time hierarchy, GSM burst structure, Description of call setup procedure, Handover, Modifications and derivatives of GSM.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
GSM Services , GSM Physical layer		
Speech Coding and decoding, GMSK modulation, Data transmission in GSM: Data Services, SMS, HSCSD, GPRS, EDGE. CDMA Based Mobile Systems Motivation for CDMA use, Spreading Sequences, Basic Transmitter and Receiver schemes, IS-95 system: Frequency Range, Downlink transmission, Uplink transmission, Power control, Introduction to 3G mobile systems: W-CDMA and cdma-2000		
Text Books:		
1. J. E. Flood , "Telecommunications Switching, Traffic and Networks", Pearson Education 2. Krzysztof Wesolowski, "Mobile Communication Systems", Wiley Student Edition		
Reference Books:		
1. Theodore S Rappaport, "Wireless Communications Principles and Practice" Second Edition, Pearson Education 2. John C. Bellamy, "Digital Telephony", Third Edition; Wiley Publications 3. ThiagarajanVishwanathan, "Telecommunication Switching Systems and Networks"; PHI Publications 4. Wayne Tomasi, "Electronic Communications Systems"; 5th Edition; Pearson Education .		

High Speed Electronics
(Professional Elective Course – VI)

COURSE OUTLINE

Course Title:	**High Speed Electronics**	**Short Title:**	**HSE**	**Course Code:**	

Course description:

The course aims to give exposure on the band diagram, characteristics of hetero-junction devices and fabrication techniques.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	*14*	*42*	*3*

Prerequisite course(s):

BEEE, Semiconductor Devices

Course objectives:

As semiconductor device geometry miniaturizes, the device becomes faster and some devices move into the quantum-effect region. These higher-speed devices are the key components for future electronic systems in communications, computers, control, and consumer applications.

1. Important parameters governing the high speed performance of devices and circuits.
2. To understand material properties.
3. To learn MOS diode, MOSFET, structure and operations.
4. To learn Metal semiconductor contacts and Metal Insulator Semiconductor and MOS devices.
5. To learn High Electron Mobility Transistors.

Course outcomes:

After successful completion of this course the student will be able to:

1. Knowledge of materials and basic issues (compound semiconductor) used in high speed devices and their
2. Properties related to the high speed and devices
3. Knowledge of the advanced technologies, devices operation along with their descriptive models for high speed electron devices
4. Basic knowledge of the operation of selected optoelectronic devices and to exploit small-signal equivalent circuit models of high frequency electron devices (MESFETs, HEMTs, HBTs)
5. Ability to exploit physics-based mathematical models for the analysis and the design of high frequency electron devices (MESFETs, HEMTs, HBTs)

COURSE CONTENT

High Speed Electronics		**Semester:**	*VIII*
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Important parameters governing the high speed performance of devices and circuits:

Transit time of charge carriers, junction capacitances, ON-resistances and their dependence on the device geometry and size, carrier mobility, doping concentration and temperature; important parameters governing the high power performance of devices and circuits: Break down voltage, resistances, device geometries, doping concentration and temperature		
Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**
Materials properties: Merits of III –V binary and ternary compound semiconductors (GaAs, InP, InGaAs, AlGaAs, SiC, GaN etc.), different SiC structures, silicon germanium alloys and silicon carbide for high speed devices, as compared to silicon based devices, outline of the crystal structure, dopants and electrical properties such as carrier mobility, velocity versus electric field characteristics of these materials, electric field characteristics of materials and device processing techniques, Band diagrams, homo and hetro junctions, electrostatic calculations, Band gap engineering, doping, Material and device process technique with these III-V and IV – IV semiconductors.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
MOS Diode: Structure - band diagram - operation - C–V characteristics - effects of oxide charges - avalanche injection - high field effects and breakdown; Heterojunction Based MOSFET: Band diagram - structure - operation - I–V and C–V characteristics (analytical expressions) - MOSFET breakdown and punch through - subthreshold current - scaling down; Alternate High k-dielectric Materials: HF–MOSFETs - SOI MOSFET - buried channel MOSFET - charge coupled devices.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Metal semiconductor contacts and Metal Insulator Semiconductor and MOS devices: Native oxides of Compound semiconductors for MOS devices and the interface state density related issues. Metal semiconductor contacts, Schottky barrier diode, Metal semiconductor Field Effect Transistors (MESFETs): Pinch off voltage and threshold voltage of MESFETs. D.C. characteristics and analysis of drain current. Velocity overshoot effects and the related advantages of GaAs, InP and GaN based devices for high speed operation. Sub threshold characteristics, short channel effects and the performance of scaled down devices.		
Unit–V	**No. of Lectures: 09 Hours**	**Marks: 12**
High Electron Mobility Transistors (HEMT): Hetero-junction devices. The generic Modulation Doped FET(MODFET) structure for high electron mobility realization. Principle of operation and the unique features of HEMT, InGaAs/InP HEMT structures: Hetero junction Bipolar transistors (HBTs): Principle of operation and the benefits of hetero junction BJT for high speed applications. GaAs and InP based HBT device structure and the surface passivation for stable high gain high frequency performance. SiGe HBTs and the concept of strained layer devices; High Frequency resonant – tunneling devices, Resonant-tunneling hot electron transistors		
Text Books:		
1. C.Y. Chang, F. Kai, GaAs High-Speed Devices: Physics, Technology and Circuit Applications Wiley 2. Cheng T. Wang, Ed., Introduction to Semiconductor Technology: GaAs and Related		

Compounds,
John Wiley & Sons
3. David K. Ferry, Ed., Gallium Arsenide Technology, Howard W. Sams & Co., 1985
4. Avishay Katz, Indium Phosphide and Related materials: Processing, Technology and Devices, Artech
House, 1992.
5. S.M. Sze, High Speed Semiconductor Devices, Wiley (1990) ISBN 0-471-62307-5

Reference Books:

1. Ralph E. Williams, Modern GaAs Processing Methods, Artech (1990), ISBN 0-89006-343-5
2. Sandip Tiwari, Compound Semiconductor Device Physics, Academic Press (1991), ISBN 0-12-
691740-X
3. G.A. Armstrong, C.K. Maiti, TCAD for Si, SiGe and GaAs Integrated Circuits, The Institution of
Engineering and Technology, London, United Kingdom, 2007,ISBN 978-0-86341-743-6.
4. Ruediger Quay, Gallium Nitride Electronics, Springer 2008, ISBN 978-3-540-71890-1, (Available on
NITC intranet in Springer eBook section)
5. Prof. Dr. Alessandro Birolini, Reliability Engineering Theory and PracticeSpringer 2007, ISBN-10 3-
540- 40287-X, Available on NITC intranet in Springer eBook section)

Automotive Electronics and Electric Vehicle
(Open Elective Course – IV)

COURSE OUTLINE

Course Title:	**Automotive Electronics and Electric Vehicle**	**Short Title:**	**AEEV**	**Course Code:**	

Course description:

The objective of this course is to provide an in- depth understanding of modern **Automotive** Electronics & Electric vehicle concepts, and various types of sensors used in automobile vehicles.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	13	42	

Prerequisite course(s): Instrumentation, Microprocessor & Microcontroller and Digital Signal Processing.

The course requires knowledge about fundamental of motors, sensors,controllers, signal processors and electric vehicles containing 2 stroke & 4 stroke engine.

Course objectives:

1. To study the basics concept of sensors& actuators.
2. To understand the principle of various motors & signal processors.
3. To familiarize the concept of Hall Effect Sensors & combustion engine.
4. Provide strong foundation for understanding of Smartelectric vehicles.
5.To Learn the modern trends inhybrid engine vehicles & electronically controlled automotives.

Course outcomes:

After successful completion of this course the student will be able to:

1 Describe the basic concepts and applications of varioussensors.
2. Analyze, test and use various types of test benches for electric vehicles.
3.Describe the concept of CI & PIengines.
4.Apply the concept for measurement of various parametersof vehicles.
5. To describe the modern trends in different smart electronically controlled hybrid vehicles.

COURSE CONTENT

Automotive Electronics and Electric Vehicle		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme**	
Lectures: 03	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Use of Electronics In The Automobile -Concept of A System, Control Theory: Open Loop Control & Close loop control, Instrumentation, Signal Processing & Filtering, Electronics Fundamentals, Instrumentation application of Microcomputer

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Electronic Engine Control -Motivation For Electronic Engine Control, Concept of An Electronic Engine Control System, Engine Performance Terms, Electronic Fuel Control System, Analysis of Intake Manifold Pressure, Idle speed control, Electronic Ignition

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Sensors and Actuators -Automotive Control System Applications of Sensors And Actuators, Throttle Angle Sensor, Temperature Sensors, Sensors For Feedback Control: Knock Sensor, Automotive Engine Control Actuators, Electric Motor Actuator, Ignition System & Coil operation		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Hybrid Electric Vehicles -Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Energy Storage - Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE).		
Text Books:		
1. William B. Ribbens – Understanding Automotive Electronics-An Engineering Perspective, Butterworth-Heinemann, An imprint Elsevier, First Indian reprint 2014, ISBN 978-93-5107-1518 2. Al Santini- Automotive Technology, Cengage Learning, India Edition, 2011, ISBN 978-81-3151412-2. 3. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.		
Reference Books:		
1. K. K. Ramalingam- Automobile Engineering, Scitek Publication, Second Edition. J.D.Kraus,"Antennas, McGraw-Hill,1988. 2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015. 3. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004. 4. T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.		

Cyber Security
(Open Elective Course – IV)

COURSE OUTLINE

Course Title:	**Cyber Security**	**Short Title:**	**CS**	**Course Code:**	

Course description:

Cyber Security course focuses on cyber threats and cyber security that provides the much needed awareness in the times of growing cybercrime episodes.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite course(s):

Computer Network

Course objectives:

1. To understand Cybercrime and Cyberoffenses.
2. To understand Cybercrime through portable devices.
3. To understand tools and methods used in Cybercrime.
4. To understand Phishing and Identity theft.
5. To understand Computer Forensics.

Course outcomes:

After successful completion of this course the student will be able to:

1. Determine the act of Cyberoffenses.
2. Determine the Cybercrime through portable devices.
3. Determine the methods used in Cybercrime.
4. Determine Phishing and Identity theft.
5. Describe Computer Forensics.

COURSE CONTENT

Cyber Security		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Introduction to Cybercrime: Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals?, Classifications of Cybercrimes

Cyberoffenses: How Criminals Plan Them: Introduction, How Criminals Plan the Attacks, Social Engineering, Cyberstalking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile device related security issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**

Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers,, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks

Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**

Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft)

Understanding Computer Forensics: Introduction, Historical Background of Cyberforensics, Digital Forensics Science, The Need for Computer Forensics, Cyberforensics and Digital Evidence, Forensics Analysis of E-Mail

Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**

Computer Forensics: Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Antiforensics

Text Books:

1. Nina Godbole and Sunil Belapure, “Cyber Security”, Wiley India Publication, 2014

Reference Books:

1. Nina Godbole , Information Systems Security , Wiley India Publication
2. V.K. Pachghare, Cryptography and Information security, PHI, Second edition

Robotics
(Open Elective Course – IV)

COURSE OUTLINE

Course Title:	**Robotics**	**Short Title:**	**RO**	**Course Code:**	

Course description:

In this course, students take on the roles of mechanical engineers, computer scientists and electrical engineers. Students research dynamics, kinematics and sensors. Topics such as such as motion planning and obstacle avoidance, velocity and acceleration, serial chain mechanisms, pneumatic actuators, and drive circuits are covered.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite course(s):

Course objectives:

1. To understand structures and classifications in robotics
2. To gain knowledge of types of actuators and sensors in robotics.
3. To understand and learn robotic transformations.
4. To know different analysis techniques for robotic kinematics and dynamics.
5. To learn control techniques for robotic programming.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain structure and classification of robots.
2. Define role of actuators, sensors and vision system in robotics
3. Describe various transformations in robots.
4. Analyze the different kinematics and dynamics in robots.
5. Apply control techniques for programming in robotics

COURSE CONTENT

Robotics		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Robotics:

Robots, History of Robots, Robots Usage, Basic Structure of Robots, Classification of Robots by Applications, classification by Coordinate Systems, Classification by Actuation System, Classification by Control System, Robot classification by programming method.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12
Robot Actuators, Sensors and Vision: Robot Actuators: Pneumatic , Hydraulic and Electric Robot Sensors: Sensor classification, Internal Sensors, External Sensors, Sensor selection Vision System in Robots.		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Transformations and Statics in Robotics: Robot Architecture, Pose of Rigid Body, Coordinate Transformation, Denavit and Hartenberg(DH) Parameters Forces and Moment balance, Recursive Calculations, Equivalent Joint Torque, Role of Jocobian in Statics.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Kinematics and Dynamics Forward Position Analysis, Inverse Position Analysis, Velocity Analysis, Inerita Properties, Eular- Lagrange Formulation, Newton – Eular Formulation, Recursive Newton – Eular Algorithm		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Robotic Control and Programming: Control Techniques, Second Order Linear Systems, Feedback Control and its Performance, Non Linear Trajectory Control, State Space Representation and Control, Stability, Cartesian and Force Controls, Robotic Programming		
Text Books:		
1. Saha, S.K., "Introduction to Robotics, 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014.		
Reference Books:		
1. Niku Saeed B., "Introduction to Robotics: Analysis, Systems, Applications", PHI, New Delhi. 2. Mittal R.K. and Nagrath I.J., "Robotics and Control", Tata McGraw Hill. 3. Mukherjee S., "Robotics and Automation", Khanna Publishing House, Delhi. 4. Craig, J.J., "Introduction to Robotics: Mechanics and Control", Pearson, New Delhi, 2009. 5. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, "Robot Modelling and Control", John Wiley and Sons Inc, 2005. 6. Steve Heath, "Embedded System Design", 2nd Edition, Newnes, Burlington, 2003.		

Communication Lab-II					
LAB COURSE OUTLINE					
Course Title:	**Communication Lab-II**	**Short Title:**	**CL-II**	**Course Code:**	
Course description:					
The communication Lab –II is based on Microwave theory and Technique and Embedded System.					
Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	2	**14**	**28**	**1**	
End Semester Exam (ESE) Pattern:		**Practical (PR)**			
Prerequisite course(s):					
Electromagnetic Wave and Microcontroller					
Course objectives:					
1. To understand Analysis of Waveguides and gain complete knowledge about Microwave Components. 2. Design of Impedance Matching and Tuning using lumped and distributed elements for network. 3. To Analysis and study characteristics of microwave tube Generators and Amplifiers. 4. To Analysis and study characteristics of microwave Semiconductor of detector, switch, generator 5. Introduce students to embedded systems design tools and hardware programmers 6. Give the students skills in both simulation and practical implementation of the basic building blocks of a ARM including timers, counters, PWM generation, I/O techniques and requirements, A/D conversion, serial communications.					
Course outcomes:					
Upon successful completion of lab Course, student will be able to:					
1. Understand various parameters of waveguide and use of component as per applications. 2. Able to design impedance matching network for any transmission line or system. 3. Able to analyze and find applications and limitations of microwave tube Generators and Amplifiers. 4. Able to analyze and find applications and limitations of microwave Semiconductor devices. 5. Able to understand basics of embedded system. 6. Understand the use of IDE tools 7. Understand the interfacing of basic I/O devices like LED, LCD, 7-Segment 8. Able to interface switch, stepper motor and implement RTOS behavior.					
LAB COURSE CONTENT					
Communication Lab-II		**Semester:**	**VIII**		
Teaching Scheme:		**Examination scheme:**			
Practical:	**2 hours/week**	**End Semester Exam (ESE): (PR)**		**25 marks**	
		Internal Continuous Assessment (ICA):		**25 marks**	

(Note: Minimum EIGHT experiments to be performed from Group - A / Group - B)

Group - A

1 Plot and study V-I Characteristics of GUNN Diode
2 Plot and study Reflex Klystron Characteristics
3 Measurement of Attenuation (Fixed and Variable)
4 Microwave Junction: Power splitting Characteristics (E / H/ EH plane tee)
5 Measurement of coupling factor, insertion loss, directivity and isolation of Directional coupler
6 Study of Circulators (Y or T Type) and Isolators (measurement of isolation)
7 Measurement of VSWR (using Vmax / Vmin method)
8 Plot radiation pattern of horn antenna.
9 Plot radiation pattern of parabolic antenna.
10 Measurement of unknown impedance using smith chart

Group - B

1. Study of IDE (integrated development environment)
2. C-Program to explore timers / counter.
3. C-programs for interrupts.
4. Program to interface LED and switch.
5. Program to interface LCD.
6. Program to interface Keyboard and display key pressed on LCD.
7. Program to interface stepper motor.
8. Writing basic C-programs for I / O operations.
9. Implementation of USB protocol and transferring data to PC.
10. Implementation of algorithm /program for the microcontroller for low power modes.

Text Book

1. Samuel Liao, Microwave Devices and Circuits, Pearson Education, 3/e,
2. Annapurna Das, Sisir Das, Microwave Engineering, TMH, 2/e
3. David M. Pozar, Microwave Engineering, Wiley India, 4/e
4. Sisodia, Gupta, Microwaves : Introduction to Circuits, Devices and Antennas, New Age, 1/e.
5. Rajkamal - Embedded Systems, TMH, Second edition
6. Andrew sloss " Arm System Developer guide"
7. Data sheet and User manual of LPC2148.
8. Dr.K.V.K.K. Prasad - Embedded / real time system, Dreamtech.

Reference Books:

1. Manojit Mitra, Microwave Engineering, Dhanpat Rai, 3/e
2. Robert E Collin, Foundations for Microwave Engineering, Wiley India, 2/e
3. Simon Ramo, Fields and Waves in Communication Electronics, Wiley India, 3/e
4. K K Sharma, Fundamentals of Microwave and Radar Engineering, S Chand. 1/e
5. Steve Furber - ARM System-on-Chip Architecture, Pearson
6. Jean J Labrose - MicroC / OS-II, Indian Low Price Edition

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignments.
Guidelines for ESE:
ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification. Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

Computer Network Lab					
LAB COURSE OUTLINE					
Course Title:	**Computer Network Lab**	**Short Title:**	**CNL**	**Course Code:**	
Course description:					

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	2	**14**	**28**	**1**

End Semester Exam (ESE) Pattern:	**Practical (PR)**

Prerequisite course(s):

Computer Fundamental and Basics of Analog and Digital Communication

Course objectives:

1. Build an understanding of the fundamental concepts of computer networking.
2. Familiarize the student with the basic taxonomy and terminology of the computer networking area.
3. Introduce the student to advanced networking concepts, preparing the student for entry Advanced courses in computer networking.
4. Allow the student to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Independently understand basic computer network technology.
2. Understand and explain Data Communications System and its components.
3. Identify the different types of network topologies and protocols.
4. Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.
5. Identify the different types of network devices and their functions within a network

LAB COURSE CONTENT

Computer Network Lab		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme:**	
Practical:	**2 hours/week**	**End Semester Exam (ESE): (PR)**	**25 marks**
		Internal Continuous Assessment (ICA):	**25 marks**

(Note: Minimum EIGHT experiments to be performed)

1. Study of different types of Network cables and Practically implement
2. The cross-wired cable and straight through cable using clamping tool.
3. Study of Network Devices in Detail.
4. Study of network IP.
5. Connect the computers in Local Area Network.

6. Performing an Initial Switch Configuration
7. Configuration of Router and Study of Routing between LANs.
8. Implementing an IP Addressing Scheme
9. Observing Static and Dynamic Routing
10. Configuring Ethernet and Serial Interfaces
11. Performance of CDMA
12. Three node point to point network
13. Transmission of Ping messages
14. Implementation of LAN using Multiuser Windows operation system.

Text Books:

1. Andrew S Tanebaum - Computer Networks, 4th Ed. PHI/ Pearson education.
2. Behrouz A Forouzan - Data Communication and Networks, 3rd Ed. TMH.

Reference Books:

1. Irvine Olifer - Computer Networks: Principles, Technology and Protocols, Wiley India.
2. William Stalling – Data and Computer communications, 7th Ed. PHI
3. S. Keshav ,"An Engineering Approach to Computer Networking", Pearson Edu.

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignments.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification.

Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

Project					
LAB COURSE OUTLINE					
Course Title:	**Project**	**Short Title:**	**PROJ**	**Course Code:**	

Course description:

Project represents the culmination of study towards the Bachelor of Engineering degree. The project offers the opportunity to apply and extend material learned throughout the program. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	6	**14**	**84**	**3**

End Semester Exam (ESE) Pattern:	**Oral (OR)**

Prerequisite course(s):

Course objectives:

1. To understand the basic concepts & broad principles of projects.
2. To understand the value of achieving perfection in project implementation & completion.
3. To apply the theoretical concepts to solve problems with teamwork and multidisciplinary approach.
4. To demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Demonstrate a sound technical knowledge of their selected project topic.
2. Undertake problem identification, formulation and solution.
3. Design engineering solutions to complex problems utilizing a systems approach.
4. Conduct an engineering project
5. Demonstrate the knowledge, skills and attitudes of a professional engineer.

LAB COURSE CONTENT

Project		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme:**	
Practical:	**6 hours/week**	**End semester exam (ESE): (OR)**	**50 marks**
		Internal Continuous Assessment (ICA):	**50 marks**

In continuation with Project (Stage – I) at Semester – VII, by the end of Semester – VIII, the students should complete implementation of ideas as formulated in Project (Stage – I). It may involve fabrication / coding, experimentation, data analysis within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability.

It may also include testing, results and report writing. Each student group should submit complete project report at the end of Semester-VIII in the form of Hard bound. Assessment for the project shall also include presentation by the students.

Each student group is required to maintain separate log book for documenting various activities of the project.

Suggestive outline for the complete project report is as follows.

Abstract

Chapter 1. Introduction

- Background / Literature Survey
- Motivation
- Problem Definition
- Scope
- Objective
- Selection of Life cycle Model for Development
- Organization of Report
- Summary

Chapter 2. Project Planning and Management

- Feasibility Study
- Risk Analysis
- Project Scheduling
- Effort Allocation
- Cost Estimation
- Summary

Chapter 3. Analysis

- Requirement Collection and Identification
- H/w and S/w Requirement (Data, Functional and Behavioral)
- Functional and non-Functional Requirements
- Software Requirement's Specification (SRS)
- Summary

Chapter 4. Design

- System Arch
- Circuit Diagram and Data Flow Diagram
- UML Diagrams (Use case, Class, Sequence, Component, Deployment, State chart, Activity diagram etc.)
- Summary

Chapter 5. Coding/Implementation

- Algorithm/Steps

- Software and Hardware for development in detail
- Modules in Project

Chapter 6. Testing

- Black Box/White Box testing
- Manual/Automated Testing
- Test Cases Identification and Execution (Test case ID, Input, Output, Expected Output, Actual Output, Result (Pass/Fail) etc.)

Chapter 7. Results and Discussion

Chapter 8. Conclusion & Future Work

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Appendix

Guide lines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge / skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Project in Semester – VIII shall be as per the guidelines given in Table – B.

Table – B

		Assessment by Guide				Assessment by Departmental Committee			
Sr. No.	Name of the Student	Attendance / Participation	Implementation	Results	Report	Depth of Understanding	Presentation	Demonstration	Total
	Marks	5	5	5	5	10	10	10	50

Guidelines for ESE:

In End Semester Examination (ESE), the student may be asked for presentation / demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.