DR. B.C. ROY SOCIETY ENGINEERING
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Course Name: Advanced Communication Networks
Course Code: ECM- 101
Course Type: PC
(Semester I)
Course Broad Category: Major

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1. **Course Prerequisite:**
   Basic Knowledge of Communication Networks.

2. **Course Learning Objectives:**
   i. This course introduces the Advance Concepts of how Communication Networks functions.
   ii. Students will also learn to Analysis different Techniques & Protocols associated with Communication Networks.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology –Lectures, Presentations, and Assignments.
   Evaluation System –
   A. Continuous Internal Assessment I (40 Marks).
   B. Continuous Internal Assessment II (40 Marks).
   C. End-Semester Exam (60 Marks)

4. **Course Content:**
   Course Name: Advanced Communication Networks
   Course Code: ECM-101
   Hours per Week: 3L: 0T: 0P
   Credits: 3

Module	Topics	36L
1	Network Design & Performance Issues, Centralized and Distributed networks, Layered and Layer less Communication, Cross layer design of Networks, Circuit Switching and Packet Switching, Data Multiplexing.	7L
2	Data Networks and their Design, Link layer design- Link adaptation, Link Layer Protocols. ARQ Schemes: Go Back N, Selective Repeat protocols, Hybrid ARQ (HARQ), and their analysis.	7L
3	Queuing Models of Networks, Traffic Models, Little's Theorem, Markov chains, M/M/1 and other Markov systems, Multiple Access Protocols, Aloha System, Carrier Sensing, Examples of Local area networks.	7L
4	Inter-networking, Bridging, Global Internet, IP protocol and addressing, Sub netting, Classless Inter domain Routing (CIDR), IP address lookup, Routing Algorithms in Internet.	7L
5	TCP and UDP, Congestion Control, Additive Increase/Multiplicative Decrease, Slow Start, Fast Retransmit/ Fast Recovery. Congestion avoidance, TCP Throughput Analysis, Quality of Service in Packet Networks. Network Calculus, Packet Scheduling Algorithms.	8L

5. References:

Text Books:

- Data Communications and Networking, Behrouz A Forouzan, McGraw Hill Publishers. 2017.
- Data and Computer Communications, William Stallings, Pearson Publishers, 2017.

Reference Books:

- Computer Networks, Andrew Tanenbum, Pearson Publishers, 2022.
- Computer Networking, Kurose & Ross, Perason Publishers, 2022.

***** End of Syllabus*****

DR. B.C. ROY SOCIETY ENGINEERING
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Course Name: Advanced Digital Signal Processing
Course Code: ECM-102
Course Type: PC
(Semester – I)
Course Broad Category: (Major)

1. **Course Prerequisite:**
   Signals and System and Digital Signal Processing
2. **Course Learning Objectives:**
   i. This course introduces the concepts about IIR and FIR filter and their applications.
   ii. Students will also learn to design and analyze of impulse response and transfer function of known LTI System.
3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Continuous Internal Assessment I (40 Marks).
   B. Continuous Internal Assessment II (40 Marks).
   C. End-Semester Exam (60 Marks)
4. **Course Content:**
   Course Name: Advanced Digital Signal Processing
   Course Code: ECM-102
   Hours per Week: 3L: 0T: 0P
   Credits: 3

Module	Topics	30L
1.	**Basic elements of digital signal Processing:** Concept of frequency in continuous time and discrete time signals –Sampling theorem Discrete time signals. Discrete time systems –Analysis of Linear time invariant systems –Z transform –Convolution and correlation.	6L
2.	**Introduction to DFT:** Efficient computation of DFT Properties of DFT – FFT algorithms – Radix-2 and Radix-4 FFT algorithms – Decimation in Time – Decimation in Frequency algorithms – Use of FFT algorithms in Linear Filtering and correlation.	6L
3.	**Structure of IIR:** System Design of Discrete time IIR filter from continuous time filter – IIR filter design by Impulse Invariance. Bilinear transformation – Approximation derivatives – Design of IIR filter in the Frequency domain.	5L
4.	**Symmetric & Anti-symmetric FIR filters:** Linear phase filter – Windowing techniques – rectangular, triangular, Blackman and Kaiser windows – Frequency sampling techniques – Structure for FIR systems.	5L
5.	**Multi rate digital signal processing**: Concepts, design of practical sampling rate converters, Decimators, interpolators. Polyphase decompositions. Application of DSP – Model of Speech Wave Form – Vocoder.	6L

Module	Topics	30L
6.	**Finite word length effects in FIR and IIR digital filters and Wavelet:** Quantization, round off errors and overflow errors. Origin of Wavelets, Classification (CWT & DWT), Filter Bank	4L

5. References:

Text Books:

- Oppenheim A V and Sehafer R W, "Discrete Time Signal Processing", Prentice Hall (1989).
- Proakis J G and Manolakis D G, "Digital Signal Processing", Pearson Education India.

Reference Books:

- Tamal Bose, "Digital Signal and Image Processing", WILEY India Pvt. Ltd.
- Sanjit K Mitra "Digital Signal Processing" TMH.

***** End of Syllabus*****

DR. B.C. ROY SOCIETY ENGINEERING
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Course Name: Wireless and Mobile Communication
Course Code: ECM-103
Course Type: PE
(Semester – I)
Course Broad Category: (Major)

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1. **Course Prerequisite:**

   Subject knowledge of Signals and System and DSP, Digital Communication required.

2. **Course Learning Objectives:**

   i. This course introduces the concepts wireless System Structure and Propagation Techniques.
   ii. Students will also learn to design and analyse of different modulation scheme and Network.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Continuous Internal Assessment I (40 Marks).
   B. Continuous Internal Assessment II (40 Marks).
   C. End-Semester Exam (60 Marks)

4. **Course Content:**
   Course Name: Wireless and Mobile Communication
   Course Code: ECM-103
   Hours per Week: 3L: 0T: 0P
   Credits: 3

Module	Topics	37L
1.	**Cellular Communication Fundamentals:** Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and adjacent channel interference, interference reduction techniques and methods to improve cell coverage, Frequency management and channel assignment	6L
2.	**Mobile Radio Propagation: Large Scale Path Loss:** Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration into Buildings. Small Scale Fading and Multipath Propagation: Impulse Response Model, Multipath Measurements, Parameters of Multipath channels, Types of Small-Scale Fading: Time Delay Spread; Flat, Frequency selective, Doppler Spread; Fast and Slow fading.	8L
3.	**Structure of IIR:** System Design of Discrete time IIR filter from continuous time filter – IIR filter design by Impulse Invariance. Bilinear transformation – Approximation derivatives – Design of IIR filter in the Frequency domain.	5L
4.	**Multiple access technologies:** TDMA, FDMA and CDMA, Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas.	4L

Module	Topics	37L
5.	**Diversity: Receiver diversity:** selection combining (SC), maximal ratio combining (MRC), equal gain combining (EGC), transmitter diversity: channel known at the transmitter, channel unknown at the transmitter, Alamouti scheme, diversity analysis for non-coherent and differentially coherent modulation.	4L
6.	**GSM architecture and interfaces:** GSM architecture details, GSM subsystems, GSM Logical Channels, Data Encryption in GSM, Mobility Management, Call Flows in GSM.	4L
7.	**Modulation Techniques:** Minimum Shift Keying (MSK)Modulation, GMSK, Spread Spectrum, Orthogonal Frequency-Division Multiplexing Introduction, Motivation and Multicarrier Basic	6L

5. References:

Text Books:

- Principles of Wireless Networks – Kaveh Pah Laven and P. Krishna Murthy, 2002, PE.
- Wireless Digital Communication – Kamilo Feher, 1999, PHI.

Reference Books:

- Principles of Modern Wireless Communication Systems- Aditya K Jagannatham 2016 McGraw Education.

***** End of Syllabus*****

DR. B.C. ROY SOCIETY ENGINEERING
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Course Name: Optical Fiber Communication
Course Code: ECM-104
Course Type: PE
(Semester – I)
Course Broad Category: (Major)

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1. **Course Prerequisite:**
   Semiconductor Devices.
   Analog Electronic Circuits.
   Electromagnetic Waves and Transmission Lines.
   Digital Communication.
2. **Course Learning Objectives:**
   i. To understand the fundamentals of optical communication, including basic communication principles, advantages of optical links, and Shannon's capacity theorems for noiseless and noisy channels.
   ii. To study different types of optical fibers, their materials and fabrication techniques, and analyze light propagation using ray optics and wave optics in step-index and graded-index fibers.
   iii. To examine propagation characteristics such as attenuation and dispersion in optical fibers and to learn about passive optical components including connectors, couplers, filters isolators, circulators, and attenuators.
   iv. To understand the operating principles, characteristics, and design considerations of optical transmitters and receivers, including LEDs, semiconductor lasers, photodetectors, and coherent detection methods.
   v. To explore the principles of WDM/DWDM systems, wavelength multiplexing and demultiplexing techniques, system architectures, fiber amplifiers, SONET/SDH transmission, and optical modulation formats such as NRZ, RZ, and DPSK.
3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Continuous Internal Assessment I (40 Marks).
   B. Continuous Internal Assessment II (40 Marks).
   C. End-Semester Exam (60 Marks)

4. **Course Content:**
   Course Name: Optical Fiber Communication
   Course Code: ECM-104
   Hours per Week: 3L: 0T: 0P
   Credits: 3

Module	Topics	30L
1.	**Introduction to Optical Communication:** Fundamentals of communication systems and the benefits of using optical links; Shannon's theorems for noiseless and noisy channels.	4L
2.	**Optical Fiber:** Types of optical fibers, materials used, and fabrication techniques; analysis of light propagation using ray optics and wave optics in both step-index and graded-index fibers; discussion of modes, phase and group velocities, and power transmission in step-index fibers.	5L

Module	Topics	30L
3.	**Propagation Behavior in Optical Fibers:** Fiber loss mechanisms, various forms of dispersion, their classifications, and their influence on data transmission; overview of fiber connectors, couplers, optical filters, isolators, circulators, and attenuators.	5L
4.	**Optical transmitter:** Fundamental principles and properties of LEDs and semiconductor injection lasers, along with transmitter design considerations.	4L
5.	**Optical Receiver:** Basic operation of optical detection devices such as p-n, p-i-n, avalanche, and MSM photodetectors; direct detection techniques; introduction to coherent communication, detection methods, implementation aspects, modulation/demodulation approaches, and heterodyne and homodyne detection.	5L
6.	**Wavelength division multiplexing (WDM) and Dense wavelength division multiplexing (DWDM):** Techniques for multiplexing wavelengths, system topologies, architectural frameworks, wavelength conversion, WDM demultiplexing, and optical add/drop multiplexing; system-level design aspects and the functioning of multiplexers and demultiplexers; use of fiber amplifiers in DWDM systems; SONET/SDH transmission methods; modulation schemes including NRZ, RZ, and DPSK-based system modeling.	7L

5. References:

Text Books:

- J. M. Senior, “Optical Fiber Communications”, PHI, 2nd Ed.
- G. Keiser, “Optical Fiber Communication”, McGraw Hill, 3rd Ed.
- Ghatak &Thyagarajan, “Introduction to fiber Optics”, Cambridge University press.
- Henry Zanger and Cynthia Zanger, Fiber Optics Communication and Other Application, Macmillan Publishing Company, Singapore 1991.

Reference Books:

- J. H. Franz & V. K. Jain, “Optical Communications”, Narosa Publishing House.
- Ghatak &Thyagarajan, “Contemporary Optics”, Series Title: Optical Physics and Engineering, Springer
- Amnon Yariv and Pochi Yeh, Photonics: Optical electronics for Modern Communication,6th Ed., New York, Oxford University Press

***** End of Syllabus*****

DR. B.C. ROY SOCIETY ENGINEERING
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Course Name: Statistical Information Processing
Course Code: ECM-105
Course Type: PE
(Semester – I)
Course Broad Category: (Major)

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1. **Course Prerequisite:**

   Subject knowledge of Signals and System
   Digital Signal Processing
   Digital Communication.

2. **Course Learning Objectives:**

   i. Characterize and apply probabilistic techniques in modern decision systems, such as information systems, receivers, filtering and statistical operations.
   ii. Demonstrate mathematical modeling and problem solving using such models.
   iii. Comparatively evolve key results developed in this course for applications to signal processing, communications systems.
   iv. Develop frameworks based in probabilistic and stochastic themes for modeling and analysis of various systems involving functionalities in decision making, statistical inference, estimation and detection.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Continuous Internal Assessment I (40 Marks).
   B. Continuous Internal Assessment II (40 Marks).
   C. End-Semester Exam (60 Marks)

4. **Course Content:**
   Course Name: Statistical Information Processing
   Course Code: ECM-105
   Hours per Week: 3L: 0T: 0P
   Credits: 3

Module	Topics	33L
1.	**Review of random variables**: Probability Concepts, distribution and density functions, moments, independent, uncorrelated and orthogonal random variables; Vector-space representation of Random variables, Vector quantization, Tchebaychef inequality theorem, Central Limit theorem, Discrete &Continuous Random Variables. Random process: Expectations, Moments, Ergodicity, Discrete-Time Random Processes Stationary process, autocorrelation and auto covariance functions, Spectral representation of random signals, Properties of power spectral density, Gaussian Process and White noise process.	8L

Module	Topics	33L
2.	**Random signal modeling:** MA(q), AR(p), ARMA (p, q) models, Hidden Markov Model & its applications, Linear System with random input, Forward and Backward Predictions, Levinson Durbin Algorithm.	4L
3.	**Statistical Decision Theory**: Bayes' Criterion, Binary Hypothesis Testing, M-ary Hypothesis Testing, Minimax Criterion, Neyman-Pearson Criterion, Composite Hypothesis Testing. **Parameter Estimation Theory:** Maximum Likelihood Estimation, Generalized Likelihood Ratio Test, Some Criteria for Good Estimators, Bayes' Estimation Minimum Mean-Square Error Estimate, Minimum, Mean Absolute Value of Error Estimate Maximum A Posteriori Estimate, Multiple Parameter Estimation Best Linear Unbiased Estimator, Least-Square Estimation Recursive Least-Square Estimator.	8L
4.	**Spectral analysis:** Estimated autocorrelation function, Periodogram, Averaging the period gram (Bartlett Method), Welch modification, Parametric method, AR(p) spectral estimation and detection of Harmonic signals.	4L
5.	**Information Theory and Source Coding**: Introduction, Uncertainty, Information and Entropy, Source coding theorem, Huffman, Shannon Fano, Arithmetic, Adaptive coding, RLE, LZW Data compaction, LZ-77, LZ-78. Discrete Memory less channels, Mutual information, channel capacity, Channel coding theorem, Differential entropy and mutual information for continuous ensembles.	5L
6.	**Application of Information Theory:** Group, Ring & Field, Vector, GF addition, multiplication rules. Introduction to BCH codes, Primitive elements ,Minimal polynomials, Generator polynomials in terms of Minimal polynomials, Some examples of BCH codes,& Decoder, Reed- Solomon codes & Decoder, Implementation of Reed Solomon encoders and decoders.	4L

5. References:

Text Books:

- Papoulis and S.U. Pillai, "Probability, Random Variables and Stochastic Processes",4th Edition, McGraw-Hill, 2002.
- D.G. Manolakis, V.K. Ingle and S.M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.

Reference Books:

- Moored Bearcat, "Signal Detection and Estimation", Artech House, 2nd Edition, 2005.
- R G. Gallagher, "Information theory and reliable communication", Wiley, 1st edition, 1968.
- F. J. Mac Williams and N. J. A. Sloane, "The Theory of Error-Correcting Codes", New York, North-Holland, 1977.
- Rosen K.H, "Elementary Number Theory", Addison-Wesley, 6th edition, 2010.

***** End of Syllabus*****

DR. B.C. ROY SOCIETY ENGINEERING
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Course Name: Cognitive Radio
Course Code: ECM-107
Course Type: PE
(Semester – I)
Course Broad Category: (Major)

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1. **Course Prerequisite:**

   Combining traditional wireless communication expertise with modern computer science and signal processing techniques to enable intelligent spectrum management.

2. **Course Learning Objectives:**

   i. Understand the fundamental concepts of cognitive radio networks.
   ii. Develop the cognitive radio, as well as techniques for spectrum holes detection that cognitive radio takes advantages in order to exploit it.
   iii. Understand technologies to allow an efficient use of TVWS for radio communications based on two spectrum sharing business models/policies.
   iv. Understand fundamental issues regarding dynamic spectrum access, the radio-resource management and trading, as well as a number of optimization techniques for better spectrum exploitation.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Continuous Internal Assessment I (40 Marks).
   B. Continuous Internal Assessment II (40 Marks).
   C. End-Semester Exam (60 Marks)

4. **Course Content:**
   Course Name: Cognitive Radio
   Course Code: ECM-107
   Hours per Week: 3L: 0T: 0P
   Credits: 3

Module	Topics	35L
1.	**Introduction to Cognitive Radios**: Digital dividend, cognitive radio (CR) architecture, functions of cognitive radio, dynamic spectrum access (DSA), components of cognitive radio, spectrum sensing, spectrum analysis and decision, potential applications of cognitive radio.	6L
2.	**Spectrum Sensing**: Spectrum sensing, detection of spectrum holes (TVWS), collaborative sensing, geo-location database and spectrum sharing business models (spectrum of commons, real time secondary spectrum market).	8L
3.	**Optimization Techniques of Dynamic Spectrum Allocation**: Linear programming, convex programming, non-linear programming, integer programming, dynamic programming, stochastic programming.	5L
4.	**Dynamic Spectrum Access and Management:** Spectrum broker, cognitive radio architectures, centralized dynamic spectrum access, distributed dynamic spectrum access, learning algorithms and protocols.	6L

Module	Topics	35L
5.	**Spectrum Trading**: Introduction to spectrum trading, classification to spectrum trading, radio resource pricing, brief discussion on economics theories in DSA (utility, auction theory), classification of auctions (single auctions, double auctions, concurrent, sequential).	6L
6.	**Research Challenges in Cognitive Radio**: Network layer and transport layer issues, cross layer design for cognitive radio networks.	4L

5. References:

Text Books:

- Ekram Hossain, Dusit Niyato, Zhu Han, "Dynamic Spectrum Access and Management in Cognitive Radio Networks", Cambridge University Press, 2009.
- Kwang-Cheng Chen, Ramjee Prasad, "Cognitive radio networks", John Wiley & Sons Ltd., 2009.

Reference Books:

- Huseyin Arslan, "Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems", Springer, 2007.
- Bruce Fette, "Cognitive radio technology", Elsevier, 2nd edition, 2009.
- Francisco Rodrigo Porto Cavalcanti, Soren Andersson, "Optimizing Wireless Communication Systems" Springer, 2009.
- Linda Doyle, "Essentials of Cognitive Radio", Cambridge University Press, 2009.

***** End of Syllabus*****

DR. B.C. ROY SOCIETY ENGINEERING
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Course Name: RF and Microwave Circuit Design
Course Code: ECM-108
Course Type: PE
(Semester I)
Course Broad Category: Major

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1. **Course Prerequisite:**
   EM Theory
   Solid State Devices
   Circuit Theory

2. **Course Learning Objectives:**
   i. Understand the behavior of RF passive components and model active components.
   ii. Perform transmission line analysis.
   iii. Demonstrate use of Smith Chart for high frequency circuit design.
   iv. Justify the choice/selection of components from the design aspects.
   v. Contribute in the areas of RF circuit design.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology –Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Continuous Internal Assessment I (40 Marks).
   B. Continuous Internal Assessment II (40 Marks).
   C. End-Semester Exam (60 Marks)

4. **Course Content:**
   Course Name: RF and Microwave Circuit Design
   Course Code: ECM-108
   Hours per Week: 3L: 0T:0P
   Credits: 3

Module	Topics	34L
1.	**Transmission Line Theory:** Lumped element circuit model for transmission line, field analysis, Smith chart, quarter wave transformer, generator and load mismatch, impedance matching and tuning.	4L
2.	**Microwave Network Analysis:** Impedance and equivalent voltage and current, Impedance and admittance matrix, the scattering matrix, transmission matrix, Signal flow graph.	5L
3.	**Microwave Components:** Microwave resonators, Microwave filters, power dividers and directional couplers, Ferromagnetic devices and components.	7L
4.	**Microwave Tubes:** Electron beam & Field interaction for energy exchange in resonant (two cavity klystron, Reflex Klystron, Magnetron) and non-resonant (TWT &BWO) microwave active devices: Typical characteristics & applications.	7L
5.	**Microwave Semiconductor Devices and Modeling:** PIN diode, Tunnel diodes, Varactor diode, Schottky diode, IMPATT and TRAPATT devices, transferred electron devices, Microwave BJTs, GaAs FETs, low noise and power GaAs FETs, MESFET, MOSFET, HEMT	7L

Module	Topics	34L
6.	**Amplifiers Design:** Power gain equations, stability, impedance matching, constant gain and noise figure circles, small signal, low noise, high power and broadband amplifier, oscillators, Mixers design.	4L

5. References:

Text Books:

- Matthew M. Radmanesh, "Advanced RF & Microwave Circuit Design: The Ultimate Guide to Superior Design", Author House, 2009.
- D. M.Pozar, "Microwave engineering" ,Wiley, 4th edition, 2011.
- R. Ludwig and P.Bretchko, "R. F. Circuit Design", Pearson Education Inc, 2009.

Reference Books:

- G. D. Vendelin, A.M. Pavoi, U. L. Rohde, "Microwave Circuit Design Using Linear AndNon Linear Techniques", John Wiley 1990.
- S.Y. Liao, "Microwave circuit Analysis and Amplifier Design", Prentice Hall 1987.
- Radmanesh, "RF and Microwave Electronics Illustrated", Pearson Education, 2004.

***** End of Syllabus*****

DR. B.C. ROY SOCIETY ENGINEERING
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Course Name: DSP Architecture
Course Code: ECM-109
Course Type: PE
(Semester – I)
Course Broad Category: (Major)

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1. **Course Prerequisite:**
   A strong foundational knowledge of Digital Signal Processing and related engineering mathematics.
2. **Course Learning Objectives:**
   i. Identify and formalize architectural level characterization of P-DSP hardware.
   ii. Ability to design, programming (assembly and C), and testing code using Code Composer Studio environment.
   iii. Deployment of DSP hardware for Control, Audio and Video Signal processing applications
   iv. Understanding of major areas and challenges in DSP based embedded systems
3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Continuous Internal Assessment I (40 Marks).
   B. Continuous Internal Assessment II (40 Marks).
   C. End-Semester Exam (60 Marks)
4. **Course Content:**
   Course Name: DSP Architecture
   Course Code: ECM-109
   Hours per Week: 3L: 0T: 0P
   Credits: 3

Module	Topics	36L
1.	**Programmable DSP Hardware**: Processing Architectures (von Neumann, Harvard), DSP core algorithms (FIR, IIR, Convolution, Correlation, FFT), IEEE standard for Fixed and Floating Point Computations, Special Architectures Modules used in Digital Signal Processors (like MAC unit, Barrel shifters), On-Chip peripherals, DSP benchmarking.	6L
2.	**Structural and Architectural Considerations**: Parallelism in DSP processing, Texas Instruments TMS320 Digital Signal Processor Families, Fixed Point TI DSP Processors: TMS320C1X and TMS320C2X Family,TMS320C25 –Internal Architecture, Arithmetic and Logic Unit, Auxiliary Registers, Addressing Modes (Immediate, Direct and Indirect, Bit-reverse Addressing), Basics of TMS320C54x and C55x Families in respect of Architecture improvements and new applications fields, TMS320C5416 DSP Architecture, Memory Map, Interrupt System, Peripheral Devices, Illustrative Examples for assembly coding.	8L
3.	**VLIW Architecture**: Current DSP Architectures, GPUs as an alternative to DSP Processors, TMS320C6X Family, Addressing Modes, Replacement of MAC unit by ILP, Detailed study of ISA, Assembly Language Programming, Code Composer Studio, Mixed Cand Assembly Language programming, On-chip peripherals, Simple applications developments as an embedded environment.	6L

Module	Topics	36L
4.	**Multi-core DSPs**: Introduction to Multi-core computing and applicability for DSP hardware, Concept of threads, introduction to P-thread, mutex and similar concepts, heterogeneous and homogenous multi-core systems, Shared Memory parallel programming –OpenMP approach of parallel programming, PRAGMA directives, OpenMP Constructs for work sharing like for loop, sections, TI TMS320C6678 (Eight Core subsystem).	6L
5.	**FPGA based DSP Systems**: Limitations of P-DSPs, Requirements of Signal processing for Cognitive Radio (SDR), FPGA based signal processing design-case study of a complete design of DSP processor.	6L
6.	**High Performance Computing using P-DSP**: Preliminaries of HPC, MPI, OpenMP, multicore DSP as HPC infrastructure.	4L

5. References:

Text Books:

- M. Sasikumar, D. Shikhare, Ravi Prakash, "Introduction to Parallel Processing", 1st Edition, PHI, 2006.
- Fayez Gebali, "Algorithms and Parallel Computing",1st Edition, John Wiley & Sons, 2011.
- Rohit Chandra, Ramesh Menon, Leo Dagum, David Kohr, Dror Maydan, Jeff McDonald, "Parallel Programming in OpenMP", 1st Edition, Morgan Kaufman,2000.

Reference Books:

- Ann Melnichuk, Long Talk, "Multicore Embedded systems", 1st Edition, CRC Press,2010.
- Wayne Wolf, "High Performance Embedded Computing: Architectures, Applications and Methodologies", 1st Edition, Morgan Kaufman, 2006.
- E. S. Gopi, "Algorithmic Collections for Digital Signal Processing Applications Using MATLAB", 1st Edition, Springer Netherlands,2007.

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***** End of Syllabus*****

DR. B.C. ROY SOCIETY ENGINEERING
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Course Name: Research Methodology and IPR
Course Code: ECM-111
Course Type: ML
(Semester I)
Course Broad Category: Ability Enhancement

1. **Course Prerequisite:** Basic knowledge minor and major project and project report writing.
2. **Course Learning Objectives:**
   i. Understand the fundamental principles and concepts of research methodology.
   ii. Develop skills to design and conduct research systematically.
   iii. Learn techniques for data collection, analysis, and interpretation.
   iv. Foster the ability to critically evaluate and present research findings.
   v. Prepare for advanced research in academic or professional settings.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Continuous Internal Assessment I (40 Marks).
   B. Continuous Internal Assessment II (40 Marks).
   C. End-Semester Exam (60 Marks)

4. **Course Content:**
   Course Name: Research Methodology and IPR
   Course Code: ECM-111
   Hours per Week: 2L: 0T:0P
   Credits: 2

Module	Topics	30L
1.	**Introduction to Research:** Definition and Importance of Research Types of Research: Basic, Applied, Exploratory, Descriptive, Explanatory Research Process Overview Ethics in Research: Plagiarism, Consent, Confidentiality.	5L
2.	**Research Problem and Design:** Identifying and Formulating a Research Problem Characteristics of a Good Research Problem Hypothesis Development: Types, Testing, Role in Research Design: Exploratory, Descriptive, Experimental.	5L
3.	**PART-1: Literature Review**: Purpose of a Literature Review Steps in Conducting a Literature Review Sources of Literature: Primary, Secondary, And Tertiary Citation Styles and Referencing Tools: APA, MLA, and Chicago.	5L
4.	**PART-1: Data Collection Methods:** Primary Data: Surveys, Interviews, Focus Groups, Observations Secondary Data: Use of Existing Databases, Archives Measurement and Scaling: Nominal, Ordinal, Interval, Ratio Scales Sampling Techniques: Probability and Non-Probability Sampling. **PART-2: Data Analysis Qualitative Data Analysis:** Content Analysis, Thematic Analysis Quantitative Data Analysis: Descriptive and Inferential Statistics Introduction to Statistical Tools: SPSS, Excel, R, or Python Interpretation of Data: Charts, Graphs, and Tables to a Journal.	5L

5.	**Research Proposal and Report Writing:** Structure of a Research Proposal Writing the Research Report: Introduction, Methodology, Findings, Conclusion Formatting and Presentation Abstract Writing and Summary Techniques.	5L
7.	**Applications of Research:** Interdisciplinary Applications Case Studies in Research Future Trends in Research Methodology.	5L

5. References:

Text Book:

- Creswell, J. W. (2018). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches.
- Kothari, C. R. (2004). Research Methodology: Methods and Techniques.
- Kumar, R. (2014). Research Methodology: A Step-by-Step Guide for Beginners.

Articles and Journals:

- Select articles from Journal of Applied Research and Research Methods in Social Science.

Online Resources:

- Access to databases like JSTOR, PubMed, or Scopus for research literature.

***** End of Syllabus*****

DR. B.C. ROY SOCIETY ENGINEERING
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Course Name: English for Research Paper Writing
Course Code: ECM- 181
Course Type: HM
(Semester I)
Course Broad Category: (Skill Enhancement)

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1. **Course Prerequisite:**
   Knowledge of the language skills required for writing research papers.
   Knowledge of editing, proof reading skills for academic writing.
   Introductory knowledge of presentation skills for academic writing.

2. **Course Learning Objectives:**
   i. Equip students with the language skills required for writing research papers.
   ii. Develop the ability to structure and articulate research ideas effectively.
   iii. Familiarize students with academic conventions, citation styles, and plagiarism guidelines.
   iv. Enhance editing, proofreading, and presentation skills for academic writing.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Continuous Internal Assessment I (40 Marks).
   B. Continuous Internal Assessment II (40 Marks).
   C. End-Semester Exam (60 Marks)

4. **Course Content:**
   Course Name: English for Research Paper Writing
   Course Code: ECM- 181
   Hours per Week: 2L: 0T: 0P
   Credits: 1

Module	Topics	30L
1.	**Basics of Academic Writing:** Characteristics of Academic Writing: Formality, Objectivity, Clarity, and Precision. Differences Between Academic and Non-Academic Writing Common Errors in Academic English. **Grammar and Style for Research Writing:** Writing Clear and Concise Sentences**.** Avoiding Common Grammar Mistakes: Tense Consistency, Subject-Verb Agreement Using Active vs. Passive Voice in Research Writing	5L
2.	**Structuring a Research Paper:** Understanding the IMRAD Structure: Introduction, Methods, Results, and Discussion Crafting Effective Titles and Abstracts Writing Introductions: Background, Research Gap, Objectives, Hypotheses. Writing Conclusions: Summary, Implications, and Future Directions. **Literature Review and Referencing:** Writing a Coherent Literature Review: Summarizing, Synthesizing, and Critiquing. Integrating Sources Effectively: Paraphrasing and Quoting Citation Styles: APA, MLA, Chicago, IEEE, and Others Avoiding Plagiarism and Understanding Copyright	5L

Module	Topics	30L
3.	**Data Presentation and Interpretation:** Using Tables, Figures, and Graphs in Research Papers. Writing Captions and Legends for Figures and Tables Describing Data and Results in Written Format	5L
4.	**Editing and Proofreading:** Techniques for Self-Editing and Peer Review Identifying and Correcting Language, Grammar, and Formatting Errors Using Software Tools for Proofreading and Editing (e.g., Grammarly) Preparing a Manuscript for Submission to a Journal	5L
5.	**Research Ethics and Academic Integrity:** Importance of Ethical Practices in Research Writing Understanding Plagiarism Detection Tools (e.g., Turnitin) Ethical Responsibilities in Publishing	5L
8.	**Presenting Research Work:** Writing Cover Letters for Journal Submission Preparing Conference Posters and PowerPoint Presentations Responding to Reviewer Comments and Revising Manuscripts	5L

5. References:

Text Books:

- Swales, J. M., & Feak, C. B. (2012). Academic Writing for Graduate Students: Essential Tasks and Skills.
- Glasman-Deal, H. (2010). Science Research Writing for Non-Native Speakers of English.
- Wallwork, A. (2016). English for Writing Research Papers

Articles and Journals:

- Select articles from *The Writing Center Journal* and *Journal of English for Academic Purposes*.

Online Resources:

- Purdue OWL (Online Writing Lab) for Writing Resources
- Citation Management Tools: Zotero, Mendeley, EndNote.

***** End of Syllabus*****

DR. B.C. ROY SOCIETY ENGINEERING
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Course Name: Advanced Communication Networks Laboratory
Course Code: ECM-191
Course Type: PC
(Semester – I)
Course Broad Category: (Major)

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1. **Course Prerequisite:**
   Fundamentals of Communication Networks.

2. **Course Learning Objectives:**
   i. Design & Configure LAN Systems related to Communication Networks.
   ii. Develop Program Code related to Implementation of Communication Networks.

3. **Teaching methodology and evaluation system for the course:**

Teaching methodology: Instruction: This method recognizes that students have different learning styles, abilities, and backgrounds, and aims to create a learning environment that accommodates these differences.

Evaluation System –

A. **Internal Assessment (60 Marks)-** Formative Continuous Assessment [Continuous Assessment; Note Book (30 Marks), Viva Voce (20 Marks), Attendance (10 Marks)]
B. **End-Semester Exam (40 Marks) -** Summative Assessment.

4. **Course Content:**
   Course Name: Advanced Communication Networks Laboratory
   Course Code: MCE 191
   Hours per Week: 0L: 0T: 4P
   Credits: 2

Module	Topic	12P
1.	Analysis of the performance of various configurations and protocols in LAN	2P
2.	Setting-up & Configuring a Router.	2P
3.	Construction of VLAN and Implementation of PC communication with VLAN.	2P
4.	Design of LAN and Implementation of Address Resolution Protocol (ARP)	2P
5.	Programs to Implement Error Control.	2P
6.	Programs to Implement IPC Message Queue.	2P

5. **References:**
   Text Books:
   - Data Communications and Networking, Behrouz A Forouzan, McGraw Hill Publishers. 2017.
   - Data and Computer Communications, William Stallings, Pearson Publishers, 2017.

   Reference Books:
   - Computer Networks, Andrew Tanenbum, Pearson Publishers, 2022.
   - Computer Networking, Kurose & Ross, Perason Publishers, 2022.

***** End of Syllabus*****

DR. B.C. ROY SOCIETY ENGINEERING
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Course Name: Advanced Digital Signal processing laboratory
Course Code: ECM-192
Course Type: PC
(Semester – I)
Course Broad Category: (Major)

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1. **Course Prerequisite:**
   Subject knowledge of Signals and System and DSP required
2. **Course Learning Objectives:**

i. This course introduces the concepts about FIR & IIR filter and their applications.
ii. Students will also learn to design and analyze of impulse response and transfer function of known LTI System.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology: Instruction: This method recognizes that students have different learning styles, abilities, and backgrounds, and aims to create a learning environment that accommodates these differences.
   Evaluation System –

   A. **Internal Assessment (60 Marks)-** Formative Continuous Assessment [Continuous Assessment; Note Book (30 Marks), Viva Voce (20 Marks), Attendance (10 Marks)]
   B. **End-Semester Exam (40 Marks)-** Summative Assessment.

4. **Course Content:**
   Course Name: Advanced Digital Signal Processing laboratory
   Course Code: ECM-192
   Hours per Week: 0L: 0T: 3P
   Credits: 1

Module	Topics	10P
1.	**Convolution and Correlation** I. To write MATLAB code Basic Signal Representation. II. To write MATLAB code Correlation Auto and Cross.	2P
2.	**FFT** I. To write MATLAB code FFT Of Input Sequence. II. To write MATLAB code for linear filtering using circular convolution.	2P
3.	**FILTER DESIGN** I. To write MATLAB code Butterworth Low pass And High pass Filter Design. II. To write MATLAB code for FIR filter design. III. To write MATLAB code for IIR Filter design.	3P

Module	Topics	10P
4.	**Multirate Signal Processing** I. To write MATLAB code to up-sample an input sequence by a factor L=3 with a frequency of 0.042 Hz. II. To write MATLAB code to down-sample an input sequence by a factor M=3 with a frequency of 0.042 Hz.	2P
5.	**Block Sparse System Identification** I. To write MATLAB code to design an adaptive filter to extract a desired signal from noise corrupted signal by cancelling the noise.	1P

5. References:

Text Books

- Oppenheim A V and Sehafer R W, "Discrete Time Signal Processing", Prentice Hall (1989). Reference Books
- Proakis J G and Manolakis D G, "Digital Signal Processing", Pearson Education India.

Reference Books

- Tamal Bose, "Digital Signal and Image Processing", WILEY India Pvt. Ltd.
- Sanjit K Mitra "Digital Signal Processing" TMH.

***** End of Syllabus*****