



DHANAMANJURI UNIVERSITY

RR. No. : 8608

Date : 23/6/26

**OFFICE OF THE DEAN
SCHOOL OF MATHEMATICAL AND PHYSICAL SCIENCES
DHANAMANJURI UNIVERSITY, MANIPUR**

Imphal, the 22nd June, 2026

No.1/3/2024-SYL/SMPS(DMU)

To

The Registrar
DMU, Manipur

Subject: Submission of Syllabi for M.Sc.1 yr and M.Sc.2 yrs programmes in *Electronics*
(2026-27)

Sir

I am to submit herewith Syllabi for M.Sc.1 yr and M.Sc.2 yrs programmes in *Electronics*
(2026-27) after approval in its BSS meeting held on 22nd July 2026 through recommendation of
corresponding DBS of the concerned departments. The syllabi for the two subjects are enclosed
herewith for your doing the needful.

With regards,

Yours faithfully

(Prof. L. Nandababu Singh)

Dean

School of Mathematical and Physical Sciences
DMU, Manipur

Encl.: As stated above.

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DR. A. C.
23-6-2026

Arfaa
24/6/26

Proceedings of the BSS Meeting under School of Mathematical and Physical Sciences, DMU held on 22/06/2026

Proceedings of BSS meeting held on 22/06/2026 at 1p.m. in the Office of the Dean with Prof. L.Nandababu Singh in the Chair, are detailed below.

Agenda of the meeting:

- 1.Approval of syllabi for M.Sc. 1yr and M.Sc.2 yrs programmes in Chemistry and Statistics
- 2.Approval of Guideships.

The following members were present in the meeting:

- 1.Prof.R.K. London Singh(Chemistry Dept.,DMU)-Member
- 2.Prof.N.Sharat Singh(Statistics Dept.,DMU)-Member
- 3.Prof.M.Kuber Singh(Mathematics Dept.,DMU)-Member
- 4.M.Shomananda Singh(Assoc.Prof.,Physics Dept.,DMU)-Member
- 5.Thingom Biswajit(Asst.Prof.,Electronics Dept.,DMU)
- 6.Dr.S.Sobita Devi(Asst.Prof.,Statistics Dept.,DMU)
- 7.Dr.M.Aken Singh(Asst.Prof.,Chemistry Dept.,DMU)

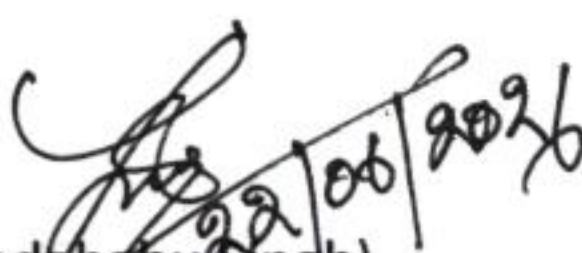
In the meeting, the following resolutions were taken:

Resolution1: The syllabi for M.Sc.1 yr and M.Sc.2yrs programmes in Chemistry, and statistics recommended from corresponding DBSs, were further approved.

Resolution2: Recommendation of Dr.S.Samarendra Singh(Assoc. Prof.,Dept. of Mathematics,DMU) as supervisor for Durgamohon Polem(Asst. Prof.,Dept. of Computer Science,DMU)by BSD of Mathematics Department,DMU, has been further approved in the BSS meeting.

Resolution3: Three faculty members-(a)Dr. Th. Birkramjit Singh(Asst.Prof.,Department of Mathematics,DMU)(b) Dr.Kh.Babina Devi(Asst.Prof.,Department of Mathematics,DMU), and (c) Dr.Ch. Sonia (Asst.Prof.,Department of Mathematics,DMU),who were recommended for Guideships by BSD of Mathematics Department,DMU, have been further approved in the BSS meeting.

The meeting ended with thanks from Chairperson.


(Prof.L.Nandababu Singh)
Chairperson(Dean),

School of Mathematical and Physical Sciences,DMU

Dean
School of Mathematical and Physical Sciences
Dhanamanjuri University, Manipur

Date:.....

To,

The Registrar,
Dhanamanjuri University, Manipur

Through: The Dean, School of Mathematical and Physical Sciences, D.M. University

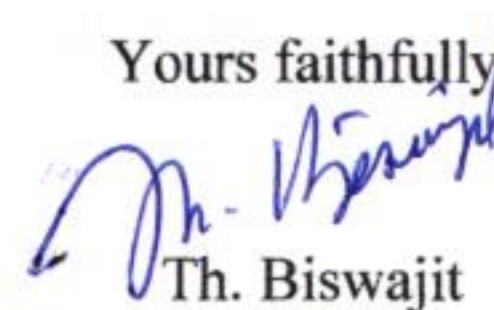
Subject: Submission of Syllabus of One-Year and Two-Year P.G. Programme
in Electronics

Sir,

I have the honour to submit herewith the Syllabus of One-Year and Two-Year
Postgraduate Programme in Electronics for your kind information and necessary action.

I, therefore, request you to kindly accept the enclosed document and take further
necessary steps.

Yours faithfully,

 22/6/26

Th. Biswajit

Head

Department of Electronics

D.M. University, Manipur

Head

Department of Electronics

D.M. College of Science,

Dhanamanjuri University, Imphal

Proceedings of the DBS Meeting of Department of Electronics

Proceedings of DBS meeting held on 22/06/2026 at 11:00 a.m. in the Department of Electronics with Th. Biswajit in the chair are detailed below.

Agenda of the meeting:

1. Recommendation of syllabi for M.Sc. 1 year and M.Sc. 2 year Programmes in Electronics
2. Misc.

The following members were present in the meeting:

- | | |
|---|----------|
| 1. Kshetrimayum Dinesh Singh (Assistant Professor, D.M.U.) | - Member |
| 2. Dr. Khoirom Johnson Singh (Assistant Professor, D.M.U.) | - Member |
| 3. Dr. Sinam Ajitkumar Singh (Assistant Professor, D.M.U.) | - Member |
| 4. Dr. Nongthombam Chingkhei Meitei (Assistant Professor, D.M.U.) | - Member |

In the meeting, the following resolution were taken:

Resolution 1: The syllabi for M.Sc. 1 year and M.Sc. 2 years Programmes in Electronics (to be commenced from 2026-2027) were recommended.

Resolution 2: Eligibility criteria for PG was also discussed very well.

The meeting ended with thanks from Chairman.



(Th. Biswajit)

Chairman/Head

Department of Electronics
Dhanamanjuri University, Manipur

Head
Department of Electronics
D M. College of Science,
Dhanamanjuri University, Imphal

DHANAMANJURI UNIVERSITY

Master of Science in Electronics

COURSE STRUCTURE OF

2-YR PG PROGRAMME (FOUR-SEMESTERS PG PROGRAMME)

AND

✓ 1-YR PG PROGRAMME (TWO-SEMESTERS PG COURSE)

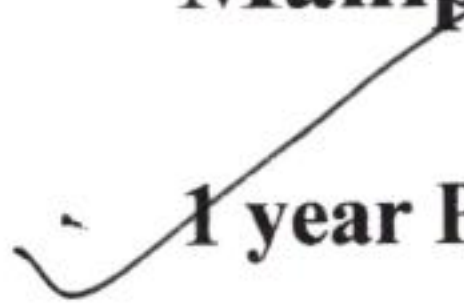


2026

**Department of Electronics
School of Mathematical and Physical Sciences
Dhanamanjuri University
Imphal-795001
Manipur**

DHANAMANJURI UNIVERSITY

Manipur

 **1 year P.G.**

Syllabus of Master of Science (M.Sc.)

in

ELECTRONICS

(To be effective from Academic Session 2026-2027)

SYLLABUS OF M.Sc. (ELECTRONICS)

DEPARTMENT OF ELECTRONICS DHANAMANJURI UNIVERSITY , MANIPUR

COURSE STRUCTURE OF M.Sc. (ELECTRONICS)

M.Sc. 1st Semester (1 year P.G.)

Paper Code	Paper Title	Internal Assessment Marks	University Examination Marks	Total Marks	No. of Credit
ELE-833	Nanoelectronics	20	80	100	04
ELE-834	Signal and System	20	80	100	04
ELE-835	VLSI Technology	20	80	100	04
ELE-836	Power and Industrial Electronics	20	80	100	04
ELE-837	Practical – I	--	--	100	04
				Total marks = 500	Total Credits = 20

M.Sc. 2nd Semester (1 year P.G.)

Paper Code	Paper Title	Internal Assessment Marks	University Examination Marks	Total Marks	No. of Credit
ELE-838	Digital VLSI Design	20	80	100	04
ELE-839	Introduction to Machine Learning	20	80	100	04
ELE-840	Practical - II	--	--	100	04
ELE-841	Research Methodology and Computer Application	20	80	100	04
ELE-842	Research (Thesis)	--	--	150	06
				Total marks = 550	Total Credits = 22

M.Sc. I-Semester

ELE-833 : Nanoelectronics

100 Marks (4 Credits)

- Explain the fundamental principles governing electron behavior at the nanoscale, including quantum confinement, tunneling, ballistic transport, and Coulomb blockade.
- Identify key nanoelectronic devices, such as single-electron transistors, quantum dots, carbon nanotube transistors, graphene-based devices, and tunnel field-effect transistors (TFETs).
- Solve quantum mechanical problems relevant to nanoelectronics, such as the Schrödinger equation for quantum wells, wires, or dots, to predict electronic behavior.
- Use computational tools (e.g., TCAD, COMSOL, or Quantum ESPRESSO) to simulate nanoelectronic device performance and analyze quantum effects.

Unit-I : Single Electron and Few Electron Phenomena

25 Marks

Tunneling through a potential Barrier, Application of Tunneling : Field Emission, Gate -Oxide Tunneling and Hot Electron Effects in MOSFETs, Double Barrier Tunneling and Resonant Tunneling Diode, Coulomb Blockade in a Nanocapacitor, Tunnel Junction, Tunnel Junction Excited by a Current Source, Coulomb Blockade in a Quantum Dot Circuit, Single Electron Transistor (SET) and its Logic, Carbon Nanotube Transistor (FETs and SETs), Semiconductor Nanowire FETs and SETs, Molecular SETs and Molecular Electronics

Unit-II : Many Electron Phenomena

25 Marks

Density of States, Density of States in Lower Dimension and Semiconductor, Semiconductor Heterostructures and Quantum Well, Confinement Models and Two Dimensional Electron Gas, Energy Band Transition in Quantum Wells, Quantum Wires and Nanowires, Quantum Dots and Nanoparticles, Application of Semiconducting Quantum Dots, Plasmon Resonance and Metallic Nanoparticles, Functionalized Metallic Nanoparticles, Conductivity of Metallic Nanowires : The influence of Wire Radius, Ballistic Transport : Electron Collision and Length Scales, Ballistic Transport Model, Quantum Resistance and Conductance, Origin of Quantum Resistance, Graphene, Carbon Nanotubes, Transport of Spin, Spintronic Devices and Applications.

Unit-III : Fiber Optic Sensors (FOSs)

25 Marks

Basic Concepts, Architecture of Fiber Optics Sensors (FOSs), Applications- Temperature, Liquid Level, Fluid Flow and Microbend Sensor. Seismic Sensors, Micro Electro Mechanical Sensors (MEMs) Resonating Quartz Sensors, Piezoelectricity, Resonance and Quartz properties, Electronic equipments for Quartz Sensors, Surface Acoustic Wave Sensors (SAW), SAW Sensors Operation- Chemical and Physical Sensors, Magnetic Field Sensors, Gas sensor.

Unit-IV : Biosensors

25 Marks

Introduction and Definition, Receptor : Molecular Recognition Element, Immobilization methods, Electrochemical Sensing principles, Ion-Selective membrane electrode, Ion Selective field effect transistors, Optical biosensors, Introduction & sensing applications in environmental, food and clinical analysis, defense.

Suggested Books.

1. Fundamentals of Nanoelectronics, George W. Hanson, Pearson Education, New Delhi, India
2. Nanoelectronics, A.S. Bhatia, NuTech Books, New Delhi, India
3. Low Dimensional Semiconductors: Materials, Physics, Technology & Devices, M.J.Kelly, Clarendon Press Oxford, N.Y., USA
4. Nanoelectronics: Principles and Devices, Mircea Dragoman and Daniele, Artech House Publication, N.Y. USA
5. Semiconductor Heterojunctions and Nanostructures, Omar Manasreh, McGraw Hill, N.Y., USA
6. Quantum Wells, Wires and Dots, P.Harrison, Wiley, N.Y., USA
7. Silicon Nanoelectronics, Shunri Oda and David Ferry, Taylor & Francis, N.Y., USA
8. Sensors for Domestic Applications Alnaldo D'Amico and Giorgio Sbeveglieri, World Scientific Co. (USA) Advance in Biosensors A.P.F. Turner, Jai Press Ltd., N.Delhi (INDIA)
9. Sensors and Transducers(Second Edition) D. Patranabis, Prentice/Hall of India Private Limited, N.Delhi
10. Biosensors - An Introduction Beian Eggins Wiley Teuinee
11. Biosensors Principles & Applications Loic J. Blum and Pierre R. Coulet, Marcel Dekker, Inc. (USA)

ELE-834 : Signal and System**100 Marks (4Credits)**

- Design, implementation, analysis and comparison of digital filters for processing of discrete time signals
- Integrate computer-based tools for engineering applications
- Employ signal processing strategies at multidisciplinary team activities.

Unit-I : Introduction to Signals and Systems**25 Marks**

Signals and systems everyday life, biomedical, instrumentation domestic and industries. Representations of Signals, Classifications of Signals – Continuous time, Discrete time, comparison among Analog, Digital and Discrete Signals, Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, and the complex exponential. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples.

Unit-II : Mathematical operations on Signals and Systems**25 Marks**

Addition, subtraction, multiplication and division of the signals, parallel and series combinations of the systems, cascading of the systems, impulse response characterization and convolution integral for CT- LTI system, signal responses to CTLTI system, properties of convolution, LTI system response properties from impulse response, Examples. Impulse response characterization and convolution sum, Causal signal response to DT-LTI systems. Properties of convolution summation, Impulse response of DT-LTI system. DT-LTI system properties from Impulse response. System analysis from difference equation model, examples.

Unit-III : Fourier, Laplace and z-transforms**25 Marks**

Representation of periodic functions, Fourier series, Frequency spectrum of aperiodic signals, Fourier Transform, Relation between Laplace Transform and Fourier Transform and its properties. Parseval's Theorem. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

Unit-IV : Sampling & reconstruction**25 Marks**

The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system

SYLLABUS OF M.Sc. (ELECTRONICS)

theory: modulation for communication, filtering, feedback control systems.

Suggested Books.

1. Signals and Systems, Alan V. Oppenheim, Alan S. Willsky and Nawab, Prentice Hall
2. Signals and Systems, K. Gopalan, Cengage Learning (India Edition)
3. Signals and Systems, Michal J. Roberts and Govind Sharma, Tata Mc-Graw Hill Publications
4. Signals and Systems, Simon Haykin and Bary Van Veen, Wiley- India Publications
5. Linear Systems and Signals, B.P.Lathi, Oxford University Press
6. Signal, Systems and Transforms, Charles L. Philips, J. M. Parr and E. A. Riskin, Pearson Education
7. Signal and Systems, Anand Kumar, 3rd Edition, PHI
8. Internet of Things: Technologies, Applications, Challenges and Solutions, B. K. Tripathy & J. Anuradha, CRC Press, 2017.

SYLLABUS OF M.Sc. (ELECTRONICS)

ELE-835 : VLSI Technology

100 Marks (4 Credits)

- Discuss the differences and similarities between different vacuum based deposition techniques
- Evaluate and use models for nucleating and growth of thin films,
- Assess the relation between deposition technique, film structure, and film properties, discuss typical thin film applications.
-
- Develop thin film based devices for various applications.

Unit-I: Semiconductor Materials

25 Marks

Crystal structures, Energy bands, Intrinsic Carrier concentration, Donors and Acceptors, Electron Mobility, Resistivity and conductivity, Crystal Growth, Electron Grade Silicon, Czochralski Crystal Growth, Float Process, Characterization, Wafer preparation, Epitaxy, Chemical Vapor Deposition(CVD), Growth model, Growth Chemistry, Doping and Autodoping, Reactors, Defects, Selective Epitaxial Growth, Low – temperature Epitaxy(LTE) and Molecular Beam Epitaxy(MBE) and Rapid Thermal Epitaxy(RTE)

Unit-II : Oxidation

25 Marks

Theory of Oxide growth, Experimental Fits – Orientation Dependence and Effects of Impurities, High Pressure Oxidation, Plasma Oxidation and Rapid thermal oxidation, Oxide properties, Dopant Redistribution at the Interface, Lithography, Clean Room, Optical Lithography, Masks, Photoresist, Pattern Transfer, Electron Lithography, X-Ray Lithography, Ion Lithography, Comparison of Lithographic Techniques

Unit-III: Etching

25 Marks

Wet chemical etching, Dry etching, Plasma excitation and plasma interaction, Simple plasma etching systems, Diffusion, Diffusion theory, Diffusion profiles, Constant-Surface concentration diffusion, Constant-Total-Dopant diffusion, Dual diffusion Process, Extrinsic diffusion, Diffusion in silicon, Oxide masking, Lateral diffusion, Fast diffusants, Diffusion in Polysilicon, Ion Implantation, Implant Uniformity, Contamination

Unit-IV: Annealing

25 Marks

Furnace annealing, Rapid thermal annealing, Metallization, Metallization choices, Metal Corrosion, Testing – assembly and Packaging of IC, Die bonding and wire bonding, Flip – Chip technique, Hermetic and plastic packages, Through – Hole and Surface-Mounts Packages, Tape Carrier Packages.

Suggested Books.

1. Introduction to VLSI circuits and systems, John P. Uyemura, John Wiley & Sons(Asia) Pvt Ltd NY(USA)
2. VLSI Technology, SM Sze (Mc Graw – Hill International Edition, NY, USA)

3. Modern Semiconductor Fabrication Technology, Peter Gise & Richard Blanchard (Reston Book – Prentice Hall, N.J, USA)

ELE-836 : Power and Industrial Electronics**100 Marks (4 Credits)**

- To implement the algorithms and draw flowcharts for solving simple problems.
- Demonstrate an understanding of computer programming language concepts.
- To be able to develop C programs. Micropro
- To define data types and use them in simple data processing applications also he/she must be able to use the concept of array of structures.
- To design and develop Computer programs, analyzes, and interprets the concept of pointers, declarations, initialization, operations on pointers and their usage.
- To Develop confidence for self-education and ability for life-long learning needed for Computer language

Unit-I : SPECIAL POWER DEVICES**25 Marks**

Thyristor families – SCR, triggering methods of SCR - dV/dt , triggering with single pulse and train of pulses, DIAC, TRIAC, power MOSFET, IGBT, Firing and Protecting Circuits: Necessity of isolation, pulse transformer, Power BJT, Over voltage, over current and gate protections; snubbers, Principles of Three phase half wave and full wave converter

Unit-II : SMPS**25 Marks**

Introduction of Basic Components - PWM principles, DC Choppers: Introductions – Principles of Step down Operation – Step down With RL load – Principle of Step up Operation, Switch Mode Regulators: Buck Regulator – Boost Regulator – Buck Boost Regulator – Cuk Regulator, Block Diagram of SMPS, Working principle of SMPS

Unit-III : Stabilized Power Supplies**25 Marks**

Uninterrupted power supplies, online UPS, offline UPS, high frequency online UPS, programmable logic controllers, Voltage stabilizers-servo mechanism, single phase & three phase servo voltage stabilizers.

Unit-IV : Introduction to motors**25 Marks**

DC Motors: Working principle of DC motor, shunt motor, series motor, starter, closed loop control of DC drive, PLL control of DC drive. AC Motors: Working principle of AC motor, typed of AC motors, torque speed characteristics of induction motor, induction motor drives, speed control of induction motor- stator voltage control and V/f control, synchronous motor, working principle of synchronous motor.

References:

1. **Modern Power Electronics and AC Drives**, Bimal K. Bose, Pearson Education Asia
2. **Power Electronics: Converters, Applications and Design**, Ned Mohan, Tore M. Undeland and William P. Robbins
3. **Wind and Solar Power System**, Mukund R. Patel
4. **Energy Technology – Non Conventional, Renewable and Conventional**, S. Rao and Parulekar, New Delhi, Khanna Publishers
5. **Power Electronics Circuits, Devices and Applications**, M.H. Rashid, New Delhi, Prentice Hall of India

ELE-837 Practical – IV 100 Marks (4 Credits)

1. Characteristics of D.C. and A.C. Servo motors
2. Study of I-V characteristics of DIAC
3. Study of I-V characteristics of a TRIAC
4. Study of I-V characteristics of a SCR
5. SCR as a half wave and full wave rectifiers with R and RL loads
6. DC motor control using SCR.
7. DC motor control using TRIAC.
8. AC voltage controller using TRIAC with UJT triggering.

IV-Semester

ELE-838 : Digital VLSI Design

100 Marks (4 Credits)

- Design complex digital systems using VLSI design methodology.
- Design a digital system using given specifications and design constraints.
- Plan and choose digital system testing strategy
- Plan digital system verification strategy

Unit-I : An overview of VLSI

25 Marks

VLSI Design Methodology, Design Flow, VLSI Road Map, Logic Design with MOSFET, Elements of Physical Design. System level physical design: Large scale physical design, Interconnectivity, Delay model, Cross talk, Floor Planning & Routing, I/O Circuits, Power Distribution & Consumption, Clock Distribution

Unit-II : Reliability & testing of VLSI Circuits

25 Marks

Introduction to Testing of VLSI Circuits, Fault Models, Gate level testing, Boundary Scan testing, Ad-hoc Testing, Test Generation Methods, D-Algorithm, Introduction to ATPG.

Unit-III : System Specification using HDL

25 Marks

Introduction to HDL, VHDL modeling concept, Scalar data type & operations in VHDL, Sequential statements, Composite data type, Basic Modeling Constructs.

Unit-IV : Subprogram in VHDL

25 Marks

Packages & USE Clauses, VHDL standard package1164, Alias, Constants, Components and configurations, Files and Input/Output. Designing with Programmable Logic Devices, Digital Design with State Machine chart, Designing with FPGAs & CPLDs, VHDL model for memory buses.

Suggested Books.

- 1. Introduction to VLSI Circuits & Systems**, John P. Uyemura, John Willey & sons (Asia) Pvt Ltd. NY,(USA)
- 2. The Designer guide to VHDL**, Peter J Ashenden, Harcourt India Pvt. Ltd., N.Delhi (INDIA)
- 3. Digital logic design principles**, Norman Balabanian & Bradely Carlson, John Willey & Sons Pvt. Ltd. . NY,(USA)
- 4. Modern VLSI Design : System on Silicon**, Wayne Wolf, Pearson education - Prentice Hall ,New Delhi (INDIA)
- 5. Principles of CMOS VLSI Design : A system perspective Neil H.E.**, Weste and Kamran Eshraghian Pearson Education -Prentice Hall New Delhi (INDIA)

- 6. Digital Integrated Circuits : A Design Perspective** , Jan M. Rabeay, Anantha Chandrakasan and Borivoje Nikolic Prentice Hall of India (EEE), New Delhi (INDIA)
- 7. Digital Systems Design using VHDL**, Charles H. Roth Jr., Thomson Brooks/ Cole (USA)

ELE-839: Introduction to Machine Learning
100 Marks (4 Credits)

Course outcomes:

Upon successful completion of this course, students will be able to:

- Understand and distinguish between major types of machine learning paradigms.
- Apply supervised learning methods such as linear regression, logistic regression, SVM, and decision trees to solve regression and classification problems.
- Implement unsupervised learning techniques including k-means clustering and principal component analysis.
- Evaluate model performance using appropriate metrics like sensitivity, specificity, F1-score, and ROC curves.
- Design and execute machine learning experiments using Python and open-source libraries (e.g., scikit-learn, TensorFlow).
- Analyze data patterns and develop predictive models for practical applications in engineering and research domains.

Unit-I: Introduction to Machine Learning:

Basics of Machine Learning: Introduction and role of machine learning, General Problem in Machine Learning, What is Data and Model and Optimization Types of Machine Learning, Various Machine Learning Paradigm. Various Types of Machine Learning: Supervised, Unsupervised and Reinforcement Learning.

Unit-II: Basics of Supervised Learning:

Supervised Learning: regression and classification problems, simple linear regression, multiple linear regression, ridge regression, logistic regression, Least Square Error, Performance parameter: Sensitivity, Specificity, Accuracy, F1 Score, ROC Curve.

Unit-III: Basic Supervised Algorithm and approaches

k-nearest neighbour, naive Bayes classifier, linear discriminant analysis, support vector machine, decision trees, bias-variance trade-off, cross-validation methods such as leave-one-out (LOO) cross-validation, k-folds cross-validation, multi-layer perceptron, feed-forward neural network;

Unit-IV: Unsupervised Learning method

Unsupervised Learning: clustering algorithms, k-means/k-medoid, hierarchical clustering, top-down, bottom-up: single-linkage, multiple-linkage, dimensionality reduction, principal component analysis.

Suggested Books

1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press (23 April 2020)
2. Tom M. Mitchell- Machine Learning- McGraw Hill Education, International Edition
3. Aurélien Géron Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media, Inc. 2nd Edition
4. Saikat Dutt, Subramanian Chandramouli, and Amit Kumar Das, Machine Learning, Pearson Education India.
5. Nikhil R. Pal and Sankar K. Pal, Fundamentals of Machine Learning, PHI Learning.
6. T.V. Geetha and N. Sreenath, Machine Learning, Tata McGraw-Hill Education.

1. Study of Data Types and Preprocessing
 - a) Reading different data types (CSV, Excel) into MATLAB.
 - b) Handling missing data and basic normalization (min-max, z-score).
 - c) Label encoding of categorical data.
2. Study of Data Visualization
 - a) Scatter plots, histograms, and boxplots.
 - b) Correlation matrices using `corrcoef`.
3. Study of Simple Linear Regression
 - c) Implement simple linear regression on synthetic or real data.
 - d) Plotting regression line and calculating MSE, R^2 .
4. Study of Logistic Regression
 - e) Binary classification (e.g., tumor detection: benign vs. malignant).
 - f) ROC curve generation using `perfcurve`.
5. Study of k-Nearest Neighbors (k-NN) Classification
 - a) Classify Iris dataset using k-NN.
 - b) Analyze the impact of k on accuracy.
6. Study of Naive Bayes Classifier
 - a) Implement Gaussian Naive Bayes classifier from scratch or using MATLAB's `fitcnb`.
7. Study of Support Vector Machine (SVM)
 - a) Use MATLAB's `fitsvm` for binary classification.
 - b) Plot decision boundary for linearly separable data.
8. Study of Decision Trees
 - a) Create and visualize decision trees using `fitctree`.
 - b) View rules and leaf nodes.
8. Study of Cross-Validation Techniques
 - a) Implement k-fold and Leave-One-Out (LOO) validation for a chosen classifier.
10. Study of k-Means Clustering
 - a) Cluster synthetic data and visualize the results.
 - b) Compare cluster labels with actual classes using confusion matrix.
11. Study of Hierarchical Clustering
 - a) Use dendrograms to understand clustering linkage methods (single, complete).
12. Study of Principal Component Analysis (PCA)
 - a) Apply PCA on high-dimensional data (e.g., images or digit datasets).
 - b) Plot explained variance and reduce dimensionality for visualization.

Unit-1	Research aptitude: Meaning, characteristics, and types of research; Steps in research process; Research ethics and plagiarism; Publication of research papers and articles; Thesis writing-characteristics and standard format	25 Marks (1 credit)
	Scientific Communication & Presentation: Preparation of seminar presentations (slides, graphs, tables, images, references); Oral and poster presentation (A0 size format); Communication skills-eye contact, body language, audience engagement; Handling question-answer sessions	
	Scientific Writing Skills: Steps for effective scientific writing; Flow method and logical organization; Style and clarity in research writing; Preparation of figures, tables, graphs, footnotes, and references	
Unit-II	Internet and Research Tools: Use of internet in research; Searching scholarly databases and journals; Downloading and managing research papers; Introduction to repositories such as preprint archives; Compilation of relevant academic websites	25 marks (1 credit)
	ICT (Information and Communication Technology): Meaning and components of ICT; Advantages and limitations; Basics of internet usage and email communication in research	
	Intellectual Property Rights (IPR): Introduction to patent laws; Process of patent filing; Copyrights and ownership; Basics of cyber laws	
Unit - III	Operating Systems and Scientific Tools: Overview of operating systems; Working in Linux environment; Basic Linux commands; Scientific documentation using LaTeX; Data visualization using Gnuplot	25 marks
	Programming Languages: Overview of programming languages-FORTRAN, C, C++, Python; Basic	

	programming concepts for scientific applications	
Unit - IV	Numerical Methods: Numerical integration (Trapezoidal and Simpson's methods); Numerical differentiation; Matrix operations- diagonalization, inverse, eigenvalues, eigenvectors; Root finding methods- Bisection and Newton-Raphson; Interpolation techniques; Solution of ODEs-Euler and Runge-Kutta methods	25 marks
	Statistics and Data Analysis: Data acquisition systems; Error analysis and propagation; Curve fitting and least squares method; Sampling and parameter estimation; Maximum likelihood method; Time series analysis and periodicity detection; Fast Fourier Transform (FFT) and power spectrum	
	Simulation and Monte Carlo Methods: Simulation of random variables (discrete and continuous); Monte Carlo integration; Estimation of π using Monte Carlo method; Simulation of random processes (coin toss, dice throw); Applications in physics and computational research	

ELE-842: Research (Thesis) 150 marks (6 credits)