Jabalpur Engineering College, Jabalpur

(Declared Autonomous by MP Govt., Affiliated to RGPV, Bhopal)

(AICTE Model Curriculum Based Scheme)

Bachelor of Technology (B.Tech.) VIII Semester (Electronics & Tele Communication Engineering)

w.e.f. July 2023

S.No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
				Theory			Practical			L	T	P	
				End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work					
1	EC81	PEC/DLC	Professional Elective Course-IV	70	20	10	-	-	100	3	1	-	4
2	EC82	OEC/DLC	Open Elective Course-III	70	20	10	-	-	100	3	1	-	4
3	EC83	PI	Major Project / Internship	-	-	-	150	100	250	-	-	16	8
			Total	140	40	20	150	100	450	**6**	**2**	**16**	**16**

Note: 1. Departmental BOS will decide list of three/four optional subjects those are available in MOOC/NPTEL, PEC as well for OEC.

Professional Elective Course-IV		
S.No.	**Subject Code**	**Subject Name**
1	EC81A	Advanced Mobile Communication
2	EC81B	Adaptive Signal Processing
3	EC81C	Sensor Technology

Open Elective Course-III		
S.No.	**Subject Code**	**Subject Name**
1	EC82A	Economics & Social Issues
2	EC82B	Sustainable Engineering
3	EC82C	AI & Machine Learning

Note: 2. Students going for internship would have to opt MOOC/NPTEL subjects decided / listed by the HOD / Coordinator.

Professional Elective Course-IV		
S.No.	**Subject Code**	**Subject Name**
1	EC81D	NPTEL-1
2	EC81E	NPTEL-2
3	EC81F	NPTEL-3

Open Elective Course-III		
S.No.	**Subject Code**	**Subject Name**
1	EC82D	NPTEL-4
2	EC82E	NPTEL-5
3	EC82F	NPTEL-6

Note: 3. For Major Project/ Internship, evaluation is based on work done, quality of report, presentation and performance in viva-voce through department project supervisor / Industry Project Coordinator.

1 hour lecture (L) = 1 credit	1 hour Tutorial (T) = 1 credit	2 hour Practical (P) = 1 credit

PEC: Professional Elective Course, OEC: Open Elective Course, PI: Project and Internship, DLC: Distance Learning Course

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		Theory			Practical						
		End Sem.	Mid-Sem. Exam	Quiz/ Assignment	End Sem.	Lab work		L	T	P	
EC81A	Advanced Mobile Communication	70	20	10	-	-	100	3	1	-	4

Module I:

Mobile Communications Overview: Evolution from 1G to 5G, Analog voice systems in 1G, digital radio systems in 2G, voice and messaging services, TDMA based GSM, CDMA, 2.5G (GPRS),2.75G (EDGE); IMT2000, 3GUMTS, W-CDMA, HSPA, HSPA+, 3G services and data rates, IMT Advanced, 4G, LTE, VoLTE, OFDM, MIMO, LTE Advanced Pro (3GPP Release 13+), IMT2020, enhancements in comparison to IMT Advanced.

Module II:

Introduction to 5G Communication: 5G potential and applications, Usage scenarios, enhanced mobile broad band (eMBB), ultra reliable low latency communications (URLLC), and massive machine type communications (MMTC), D2D communications, V2X communications.

Module III:

5G Radio access technologies: Spectrum for 5G, spectrum access/sharing, millimeter Wave communication, channels and signals/waveforms in 5G, carrier aggregation, small cells, dual connectivity. New Radio (NR), Standalone and non-standalone mode, non-orthogonal multiple access (NOMA).

Module IV:

5G Network: Massive MIMO, beam formation, PHY API Specification, flexible frame structure, Service Data Adaptation Protocol (SDAP), centralized RAN, open RAN, multi-access edge computing (MEC); Introduction to software defined networking (SDN), network function virtualization (NFV), network slicing; restful API for service-based interface, private networks.

Module V:

Current state and Challenges ahead: 5G penetration in developed countries; deployment challenges in low-middle income countries, stronger backhaul requirements, dynamic spectrum access and usage of unlicensed spectrum, contrasting radio resource requirements, large cell usage, LMLC, possible solutions for connectivity in rural areas (BharatNet, TVWS, Long-range WiFi, FSO); non-terrestrial fronthaul / backhaul solutions: LEOs, HAP/UAV.

Text and References Books:

1. Mobile Communications by Jochen Schiller Pub: Financial Times / Imprint ofPearson
2. Mobile Communications Design Fundamentals by William Lee, Pub: Wiley India Pvt.Ltd.
3. Wireless Communications: Principles and Practice by Theodore S. Rappaport, Pub:Pearson
4. Fundamentals of 5G Mobile Networks Jonathan Rodriguez Wiley First Edition.
5. 5G NR: The Next Generation Wireless Access Technology Erik Dahlman, Stefan Parkvall, Johan Skold Elsevier

Course Outcomes:
At the end of this course students will demonstrate the ability to:

CO1	Understand the evolution of mobile communication standards developed over the years.
CO2	Evaluate the use of advanced techniques in cellular communications and understand D2D, MMTC,V2X communication and standardization
CO3	Study the in-depth functioning of 5G radio access technologies.
CO4	Draw and explain 5G architecture, its components and functional criteria
CO5	Understand current issues and future challenges in 5G

Prof. & Head

Dr. BHAVANA JHARIA
~~Reader~~, Dept. of Electronics
& Telecommunications Engg.
Jabalpur Engineering College
Jabalpur - 482 011 (M.P.)

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Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/ Week			Total Credits
		Theory			Practical						
		End Sem.	Mid-Sem. Exam	Quiz/ Assignment	End Sem.	Lab work		L	T	P	
EC81B	Adaptive Signal Processing	70	20	10	-	-	100	3	1	-	4

MODULE-I
General concept of adaptive filtering and estimation: Applications and motivation, Review of probability, random variables and stationary random processes, Correlation structures, properties of correlation matrices.

MODULE-II
Adaptive Filters: Optimal FIR (Wiener) filter, Method of steepest descent, extension to complex valued LMS algorithm (real, complex), convergence analysis, weight error correlation matrix, excess mean square error and mis-adjustment
Variants of the LMS algorithm: the sign LMS family, normalized LMS algorithm, block LMS and FFT based realization, frequency domain adaptive filters, Sub-band adaptive filtering.

MODULE-III
Signal space concepts: Introduction to finite dimensional vector space theory, subspace, basis, dimension, linear operators, rank and nullity, inner product space, orthogonality, Gram-Schmidt orthogonalization, concepts of orthogonal projection, orthogonal decomposition of vector spaces, vector space of random variables, correlation as inner product, forward and backward projections, Stochastic lattice filters, recursive updating of forward and backward prediction errors, relationship with AR modeling, joint process estimator, gradient adaptive lattice.

MODULE-IV
RLS: Introduction to recursive least squares (RLS), vector space formulation of RLS estimation, pseudo-inverse of a matrix, time updating of inner products, development of RLS lattice filters, RLS transversal adaptive filters.

MODULE-V
Advanced topics : Affine projection and sub-spaced based adaptive filters, partial update algorithms, QR decomposition and systolic array.

Text/Reference Books:

1. S. Haykin, Adaptive filter theory, Prentice Hall, 1986.
2. Bernard Widrow and Samuel D. Stearns, Adaptive signa processing, Prentice Hall, 1984.
   by Tulay Adali and Simon Haykin, Adaptive Signal Processing: Next Generation Solutions; Pub: Wiley

Course Outcomes:
At the end of this course students will demonstrate the ability to

CO1	Understand the general concepts of adaptive filtering and estimation.
CO2	Analyze different types of adaptive filters used in signal processing.
CO3	Solve numerical problems on correlation, convergence and filtering aspects.
CO4	Evaluate and compare different adaptive signal processing techniques.
CO5	Understand the advanced concepts of adaptive filtering

Dr. BHAVANA JHARIA
Prof. & Head Reader, Dept. of Electronics & Telecommunications Engg.
Jabalpur Engineering College
Jabalpur - 482 011 (M.P.)

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		Theory			Practical						
		End Sem.	Mid-Sem. Exam	Quiz/ Assignment	End Sem.	Lab work		L	T	P	
EC81C	Sensor Technology	70	20	10	-	-	100	3	1	-	4

MODULE-I

Sensors Fundamentals and Characteristics, Sensors. Signals and Systems; Sensor Classification; Units of Measurements: Sensor Characteristics

MODULE-II

Physical Principles of Sensing, Electric Charges, Fields, and Potentials; Capacitance; Magnetism; Induction; Resistance; Piezoelectric Effect; Hall Effect; Temperature and Thermal Properties of Material: Heat Transfer; Light; Dynamic Models of Sensor Elements

MODULE-III

Interface Electronic Circuits, Input Characteristics of Interface Circuits, Amplifiers, Excitation Circuits, Analog to Digital Converters, Direct Digitization and Processing, Bridge Circuits, Data Transmission, Batteries for Low Power Sensors

MODULE-IV

Sensors in Different Application Area, Occupancy and Motion Detectors; Position, Displacement, and Level: Velocity and Acceleration; Force, Strain, and Tactile Sensors; Pressure Sensors, Temperature Sensors

MODULE-V

Sensor Materials and Technologies, Materials, Surface Processing, Nano-Technology

Reference Books:

1. J. Fraden, Handbook of Modern Sensors:Physical, Designs, and Applications, AIP Press Springer.
2. D. Patranabis, Sensors and Transducers, PHI Publication, New Delhi.
3. Mechatronics-Ganesh S. Hegde, Published by University Science Press (An imprint of Laxmi Publication Private Limited).

Course Outcomes:

Upon successful completion of course students will be able to:

CO1	Understand sensor fundamentals
CO2	Describe physical principle of sensing
CO3	Interface various Electronic circuits
CO4	Discuss sensors in different application area
CO5	Knowledge of sensor material and technologies

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Reader, Dept. of Electronics
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		Theory			Practical						
		End Sem.	Mid-Sem. Exam	Quiz/ Assignment	End Sem.	Lab work		L	T	P	
EC82A	Economics & Social Issues	70	20	10	-	-	100	3	1	-	4

MODULE-I

Indian Economy on the eve of independence, British Rule and its impact on economy, Population growth its pattern, genders, rural urban literacy, Poverty and inequality agriculture and its productivity Green Revolution, Industrial economy pattern, small scale industries.

MODULE-II

Micro economics, Theory of consumer behavior, Law of diminishing utility. demand and supply, Demand curve, elasticity of demand, Theory of production, Theory of cast.

MODULE-III

National income, Measurement of national income, Measurement of cost of living, Consumption function, investment function, Economics fluctuations GDP, GVP.

MODULE-IV

Concept of public and private goods public budget, optimum budget, plan budget, budget procedure of India, Taxes in India.

MODULE-V

Indian economy policy, population policy antipoverty programmes, NRECA Rishtto employment, MSME, growth, structure EXIM policies.

Reference Books:

1. Mishra &Puri Indian Economy
2. Rana&Verma Macro economics
3. NavendraJadhav, Monetary Policy
4. J. Ray Chellaih, Trends and Issues in Indian Finance

Prof. & Head Dr. BHAVANA JHARIA
Reader, Dept. of Electronics
& Telecommunications Engg.
Jabalpur Engineering College
Jabalpur - 482 011 (M.P.)

Course Outcomes: Upon successful completion of course students will be able to:

CO1	Understanding Indian Economy since independence
CO2	General information about micro Economics, Demand supply Losses
CO3	Compressive Knowledge about GDP and GNP, consumption
CO4	Compressive study of private public systems functioning and taxation systems
CO5	Knowledge about polices of Indian Economy and MSME

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		End Sem.	Mid-Sem. Exam	Quiz/ Assignment	End Sem.	Lab work		L	T	P	
EC82B	Sustainable Engineering	70	20	10	-	-	100	3	1	-	4

Module I:

Introduction to Sustainable Engineering- Sustainable development, concepts of sustainable development: three pillar model, egg of sustainability model, Atkisson's pyramid model, prism model, principles of sustainable development, sustainable engineering, threats for sustainability. Environmental Ethics and Legislations – Environmental ethics and education, multilateral environmental agreements and protocols, enforcement of environmental laws in India – The Water Act, The Air Act, The Environment Act.

Module- II

Local Environmental Issues- Solid waste, impact of solid waste on natural resources, zero waste concept and three R concept, waste to energy technology: thermo-chemical conversion, biochemical conversion. Global Environmental Issues- Resource degradation: deterioration of water resources, land degradation, air pollution, climate change and global warming, ozone layer depletion, carbon footprint, carbon trading.

Module-III

Tools for Sustainability - Environmental management System (EMS), concept of ISO14000, life cycle assessment (LCA): basic components, advantages, disadvantages, case study. Environmental impact assessment (EIA), environmental auditing, bio mimicking, case studies.

Module- IV

Sustainable Habitat - Concept of green building, green building materials, green building certification and rating: green rating for integrated habitat assessment (GRIHA) , leadership in energy and environmental design (LEED) rating, energy efficient buildings, sustainable cities, sustainable transport, sustainable pavements, case studies in sustainability engineering: Green building, sustainable city, sustainable transport system. Sustainable Industrialization and Urbanization – Sustainable urbanization, industrialization, material selection, pollution prevention, industrial ecology, industrial symbiosis, poverty reduction.

Module- V

Renewable energy resources- Conventional and non- conventional forms of energy, solar energy, fuel cells, wind energy, small hydro plants, biogas systems, biofuels, energy from ocean, geothermal energy, conservation of energy. Green technology and Green Business: Sustainable business, green technology, green energy, green construction, green transportation, green chemistry, green computing

Text Book:

R. L. Rag and Lekshmi Dinachandran Remesh. Introduction to Sustainable Engineering. 2nd Edition, PHI Learning Pvt. Ltd., 2016.

Reference Books:

1. D. T. Allen and D. R. Shonnard. Sustainability Engineering: Concepts, Design and Case Studies, 1st Edition, Prentice Hall, 2011.

2. A.S. Bradley, A. O. Adebayo, P.Maria. Engineering applications in sustainable design and development, 1st Edition, Cengage learning, 2016.

Course Outcomes: At the end of the course, the student will be able to

CO1: Explain sustainable development and different environmental agreements and protocols.
CO2: Discuss real time activities causing environmental issues and different methods to use renewable energy resources.
CO3: Explain local and global environmental issues.
CO4: Differentiate between carbon emissions for regular and sustainable cities and explain different practices to move industries towards sustainability.
CO5: Discuss different renewable energy resources and explain methods to implement green technology

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EC82C	AI & Machine Learning	70	20	10	-	-	100	3	1	-	4

Module - I: Introduction to Regression, Mathematics Foundations, Model Building using Least squares, Model Accuracy & Selection, Over fitting, Interpretability of regression models.

Module - II: Overview of the Classification Module, Nearest-neighbour Methods, Naïve Bayes Classifier, Logistic Regression, Decision Tree, Optimization Foundations for Support Vector Machines, Support Vector Machines, Support Vector Machines in overlapping class distributions & Kernels, Ensemble Methods.

Module - III: Introduction to Unsupervised Learning, Clustering, K-Means Algorithm, K-Means – Variations, Detecting Outliers, Math Fundamentals for EM Algorithm, EM Algorithm, Clustering for Customer Segmentation, Hierarchical Clustering, Density Based Clustering, Clustering for Anomaly Detection, Assessing Quality of Clustering, Significance of Clustering - Interpreting/ summarizing Clusters by businesses, Association Rule Mining, Apriori Algorithm, Time series Prediction and Markov Process, Hidden Markov Model.

Module - IV: Document vectorization and Parts of Speech Tagging, Introduction to Part of speech tagging, Part of speech tagging using HMM-1, Implementing POS Tagging in Python, Topic modelling using LDA, Introduction to Sentiment Analysis, Recommender Systems.

Module - V: Introduction to Deep Learning, Artificial Neural Network, Sequence Modeling in Neural Network, Deep Learning, Convolution Networks with Deep Learning, Auto-encoders with Deep Learning Generative deep learning models.

Reference Books:-

- Rich E and Knight K, Artificial Intelligence, TMH New Delhi.
- Nelsson N.J., Principles of Artificial Intelligence, Springer Verlag, Berlin.
- Barr A, Fergenbaub E.A. and Cohen PR. Artificial Intelligence, Addison Wesley,
- Reading Waterman D.A., A guide to Expertsystem, Adision - Wesley, Reading
- Artificial Intelligence Hand book, Vol. 1-2, ISA, Research Triangle
- Park. Kos Ko B, Neural Networks and Fuzzy system –PHI.
  Haykin S, Artificial Neural Networks-Comprehensive Foundation, Asea,Pearson.

Course Outcomes:

Upon successful completion of course students will be able to:

CO1	Characterize Artificial intelligence system
CO2	Describe knowledge representation in AI systems
CO3	Illustrate reasoning using fuzzy
CO4	Elaborate natural language processing
CO5	Knowledge of neural networks

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		End Sem.	Mid-Sem. Exam	Quiz/ Assignment	End Sem.	Lab work		L	T	P	
EC83	Major Project/ Internship	-	-	-	150	100	250	-	-	16	8

Guidelines: After interactions with project guides/industry experts, based on a comprehensive literature survey/ Industry requirements analysis, the student shall identify the title and define the aim and objectives of a project. The student is expected to work on details specifications, methodology, resources required, critical issues in design and implementation, and submit the project proposal within the first two weeks of semester. The student is expected to work on the design, development, and testing of the proposed project work as per the schedule. The project report is to be submitted at the end of the semester. This report includes a summary of the literature survey, detailed objectives, project specifications, design, proof of concept, developed system/Algorithm, results, contributions, and innovations in project work.

Course Outcomes:
At the end of the project work, students will demonstrate the ability to

CO1. Identify a problem statement from a rigorous literature survey or the industry requirements analysis.
CO2. Simulate and design a solution for the identified problem by applying acquired technical knowledge.
CO3. Develop and test the prototype/algorithm to solve the complex engineering problem.
CO4. Accomplish all objectives of the project in an allocated period with efficient teamwork.
CO5. Present project work orally and through a comprehensive report.

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