NOIDA INSTITUTE OF ENGG. & TECHNOLOGY, GREATER NOIDA, GAUTAM BUDDH NAGAR
(AN AUTONOMOUS INSTITUTE)

Affiliated to

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY UTTAR PRADESH, LUCKNOW

Evaluation Scheme & Syllabus

For

Bachelor of Technology

Electronics and Communication Engineering

Fourth Year

(Effective from the Session: 2023-24)

NOIDA INSTITUTE OF ENGG. & TECHNOLOGY, GREATER NOIDA, GAUTAM BUDDH NAGAR
(AN AUTONOMOUS INSTITUTE)

Bachelor of Technology
Electronics and Communication Engineering
EVALUATION SCHEME
SEMESTER-VII

Sl. No.	Subject Codes	Subject Name	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	TOTAL	PS	TE	PE		
WEEKS COMPULSORY INDUCTION PROGRAM													
1	AEC0701	Optical Communication and Network	3	0	0	30	20	50		100		150	3
2		Departmental Elective-V	3	0	0	30	20	50		100		150	3
3		Open Elective - II	3	0	0	30	20	50		100		150	3
4		Open Elective - III	3	0	0	30	20	50		100		150	3
5	AEC0751	Optical Communication & Networking Lab	0	0	2				25		25	50	1
6	AEC0759	Industrial Assessment-III	0	0	2				50			50	1
7		MOOCs (For B.Tech. Hons. Degree)											
		GRAND TOTAL										**700**	**14**

List of MOOCs (Coursera) Based Recommended Courses for Fourth Year (Semester-VII) B. Tech Students

S. No.	Subject Code	Course Name (IoT)	University / Industry Partner Name	No of Hours	Credits
1.		Software Architecture for the IoT	EIT Digital	27	2
2.		Introduction to Architecting smart IoT Devices	EIT Digital	17	1

OR

S. No.	Subject Code	Course Name (AI)	University / Industry Partner Name	No of Hours	Credits
1		Python for Data Science, AI & Development	IBM Skills Network	21	1.5
2		Getting Started with Go	University of California, Irvine	11	0.5

OR

S. No.	Subject Code	Course Name (Embedded & Robotics)	University / Industry Partner Name	No of Hours	Credits
1		Real-Time Project for Embedded Systems	University of Colorado Boulder	49	4
2		Getting Started with Go	University of California, Irvine	11	0.5

PLEASE NOTE:-

- **Internship (3-4 weeks) shall be conducted during summer break after semester-VI and will be assessed during semester-VII.**

Abbreviation Used: -

L: Lecture, T: Tutorial, P: Practical, CT: Class Test, TA: Teacher Assessment,
PS: Practical Sessional, TE: Theory End Semester Exam.,
PE: Practical End Semester Exam.

List of Departmental Electives- V

Sl. No.	Departmental Electives	Subject Codes	Subject Name	Bucket Name	Branch	Semester
1.	Elective-V	AEC0711	Big Data Analytics For IoT and Internet of Everything	Internet of Things	ECE	7
2.	Elective-V	AEC0712	Industrial Automation and Programming	Embedded& Robotics	ECE	7
3.	Elective-V	AEC0713	Data Analytics	Artificial Intelligence	ECE	7

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Bachelor of Technology

Electronics and Communication Engineering

EVALUATION SCHEME

SEMESTER-VIII

Sl. No.	Subject Codes	Subject Name	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	TOTAL	PS	TE	PE		
1		Open Elective - IV	2	0	0	30	20	50		100		150	2
2	AEC0858/ AEC0859	Industrial Internship/ Capstone Project	0	0	20				200		300	500	10
3		MOOCs (For B.Tech. Hons. Degree)			2								
4		**TOTAL**										**650**	**12**

List of MOOCs (Coursera) Based Recommended Courses for Fourth Year (Semester-VIII) B. Tech Students

S. No.	Subject Code	Course Name (IoT)	University / Industry Partner Name	No of Hours	Credits
1.		Ethical Hacking Essentials	EC Council	31	2.5
2.		Cyber security Roles, Processes & Operating System Security	IBM	15	1

OR

S. No.	Subject Code	Course Name (AI)	University / Industry Partner Name	No of Hours	Credits
1		Supervised Machine Learning: Regression	IBM Skills Network	21	1.5
2		Introduction to Computer Vision and Image Processing	IBM Skills Network	22	1.5

OR

S. No.	Subject Code	Course Name (Embedded & Robotics)	University / Industry Partner Name	No of Hours	Credits
1		RPA Lifecycle: Development and Testing	Automation Anywhere	10	0.5
2		RPA Basics and Introduction to UiPath	UiPath	7	0.5

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AICTE Guidelines in Model Curriculum:

A student will be eligible to get Under Graduate degree with Honors only, if he/she completes the additional MOOCs courses such as Coursera certifications, or any other online courses recommended by the Institute (Equivalent to 20 credits). During Complete B.Tech. Program Guidelines for credit calculations are as follows.

1. For 6 to 12 Hours =0.5 Credit
2. For 13 to18 =1 Credit
3. For 19 to 24 =1.5 Credit
4. For 25 to 30 =2 Credit
5. For 31 to 35 =2.5 Credit
6. For 36 to 41 =3 Credit
7. For 42 to 47 =3.5 Credit
8. For 48 and above =4 Credit

For registration to MOOCs Courses, the students shall follow Coursera registration details as per the assigned login and password by the Institute these courses may be cleared during the B. Tech degree program (as per the list provided). After successful completion of these MOOCs courses, the students shall provide their successful completion status/certificates to the Controller of Examination (COE) of the Institute through their coordinators/Mentors only.

The students shall be awarded Honors Degree as per following criterion.

i. If he / she secures 7.50 as above CGPA.
ii. Passed each subject of that degree program in the single attempt without any grace.
iii. Successful completion of MOOCs based 20 credit

Bachelor of Technology Fourth Year			
Course Code	**AEC0701**	**L T P**	**Credits**
Course Title	**Optical Communication and Network**	**3 0 0**	**3**

Course Objectives: The student will learn about

1	The basic concepts of optical communication.
2	The different types of signal losses and dispersion mechanism occurring inside the optical fiber cable.
3	The optical sources used in optical communication with their comparative study.
4	Different multiplexing techniques, second generation optical networks, optical layer, and optical packet switching
5	Different types of optical network technologies

Pre-requisites: Analog and Digital Communication

Course Contents / Syllabus

UNIT-I	**Introduction to Optical Communication**	**8 hours**

Optical Spectral Band with Operating Windows, General Communication System, Optical Communication System with its advantages.

Optical Fiber Waveguides: Ray Theory of Transmission with TIR, Acceptance Angle, Numerical Aperture and Skew Rays, Electromagnetic Mode Theory for Optical Propagation, Modes in a Planar Guide, Phase and Group Velocity, Phase Shift with Total Internal Reflection, Evanescent Field, Goos-Haenchen Shift, Cylindrical Fiber Modes, Mode Coupling, Step Index fibers Vs Graded Index fibers, Single Mode Fibers- Cut off wavelength, MFD & Spot Size.

UNIT-II	**Signal Loss in Optical Fibers**	**8 hours**

Attenuation, Material Absorption Losses (Intrinsic and Extrinsic absorption), types of Linear and Non-Linear Scattering Losses, Fiber Bending Losses, Kerr Effect.

Dispersion: Introduction with its types: Chromatic / Intramodal Dispersion (Material and Waveguide Dispersion), Intermodal dispersion (for MSI and MGI fibers), Overall (Total) FiberDispersion in Multimode and Singe Mode Fiber, Dispersion Modified Single Mode Fibers, Polarization & Fiber Birefringence.

UNIT-III	**Optical Sources**	**8 hours**

LEDs-Introduction to LEDs & Materials used for fabrication, LED Power and Efficiency, LED Structures, LED Characteristics, Modulation Bandwidth, Laser Diodes and Photo Detector-Introduction, Optical Feedback & Laser Oscillations, Resonant Frequencies, Physical Principles of Photodiodes: The PIN Photo Detector, Avalanche Photodiodes, Temperature Effect on Avalanche Gain, Detector Response Time.

UNIT-IV	**Introduction to Optical Network**	**8 hours**

Optical Networks: multiplexing techniques, second generation optical networks. The optical layer, optical packet switching. Transmission Basics: wavelength, frequencies and channel spacing, wavelength standards. Nonlinear Effects: Effective length and area, stimulated Brillouin scattering, stimulated Raman scattering, Propagation in a nonlinear medium, self-phase modulation, cross phase modulation Four wave mixing.

UNIT-V	**Optical Networks Technologies**	**8 hours**

SONET/SDH: Multiplexing, SONET/SDH layers, SONET Frame structure, SONET/SDH physical layer, Elements of a SONET/SDH infrastructure. ATM: Function of ATM, Adaptation layers, Quality of service. IP: Routing and forwarding, QOS, WDM Network elements: Optical line terminals, Optical line amplifiers, Optical add/Drop multiplexers: Architecture, reconfigurable OADMS, Optical cross connects: All optical OXC configuration.

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

CO 1	Define and explain the basic concepts of optical communication.	K1, K2
CO 2	Describe the signal losses and dispersion mechanism occurring inside the optical fiber cable.	K1, K2
CO 3	Compare the optical sources used in optical communication with their comparative study.	K1, K4

CO 4	Different multiplexing techniques, second generation optical networks, optical layer, and optical packet switching.	K1, K3
CO 5	Analyze the working of Different types of optical network technologies.	K1, K4

Text books

1. John M. Senior, "Optical Fiber Communications", PEARSON, 3rd
2. R. Ramaswami, & K. N. Siva rajan, "Optical Networks a Practical perspective", Morgan Kaufmann Publishers, 3Ed.
3. U. Black, "Optical Networks: Third Generation Transport Systems"/ Pearson Educations

Reference Books

1. Biswanath Mukherjee "Optical WDM Networks" Springer Pub 2006.
2. Govind P. Agrawal, "Fiber Optic Communication Systems", John Wiley, 3rd Edition, 2004.

NPTEL/ Youtube/ Faculty Video Link:

Unit I	https://www.youtube.com/watch?v=PnBxq0-FisA&list=PLbMVogVj5nJQxs7jmzJkGENCYYL-WnP_F&index=4
Unit II	https://www.youtube.com/watch?v=BGUhTDWkwx8&list=PLbMVogVj5nJQxs7jmzJkGENCYYL-WnP_F&index=9
Unit III	https://www.youtube.com/watch?v=wwdtDcu5yAE&list=PLbMVogVj5nJQxs7jmzJkGENCYYL-WnP_F&index=12
Unit IV	https://www.youtube.com/watch?v=4W7hieXDAmc&list=PLHj96QRJ0kOhH8xoXXrOgkMf9ZOvjhqYl&index=114
Unit V	https://www.youtube.com/watch?v=f5EmFoXlYyQ&list=PLHj96QRJ0kOhH8xoXXrOgkMf9ZOvjhqYl&index=115

Bachelor of Technology Fourth Year			
Course Code	AEC0751	**L T P**	**Credit**
Course Title	**Optical Communication & Networking Lab**	**0 0 2**	**1**

Course Objectives: The student will learn

1.	The concept of optical fiber communication and setup of the link.
2.	Applications of Time-Division Multiplexing and Line Coding schemes in optical communication
3.	The effect of electromagnetic interference on the optical fiber medium.
4.	The implementation of Memory management & I/O management in optical communication.

Pre-requisites: Basics of Communication Lab & Networking

List of Experiments

Sr. No.	Name of Experiment	CO
1.	Setting up fiber optic analog link using ST-2502 Fiber Optics Trainer and Digital Multimeter.	CO1
2.	Study of a 650nm fiber optic analog link in this experiment and establish the relation between the input signal and received signal.	CO1
3.	Study and perform time division multiplexing (digital) through optical fiber link with help of ST-2502 Fiber	CO2
4.	Manchester coding and decoding by using ST-2502 Fiber Optics Trainer and CRO/DSO	CO2
5.	Measure the characteristics offiber optic LED's and photodetector. Study and draw I-V Characteristics of Fiber optic LED and Photodetector.	CO2
6.	To compare the effect of Electromagnetic Interference on a copper medium and on an optical fibre medium and Measurement of bending loss and propagation loss in the fiber.	CO3
7.	Identify Cat5 cable, RJ 45 Connector, Crimping Tool , Wire Stripper	CO3
8.	Use Wire Stripper for Cutting wire shield and Understanding of Internal Structure of Cat 5 Cable	CO4
9.	Finding Pin No-1 on RJ 45 Connector and Inserting Wires in connector	CO4
10.	Working of a router & method to access the router via console or using telnet, different types of cables used for connectivity	CO4
11.	Internet Information Services tool and its installation	CO4
12.	To implement a simple file transfer protocol (FTP) using connection-oriented and connectionless sockets	CO4

Course Outcome: After successful completion of this Lab students will be able to		**Blooms Level**
CO 1	Perform Multiplexing in optical fiber communication.	K2,K3
CO 2	Demonstrates the concept of Electromagnetic Interference on an optical fibre medium.	K3,K4
CO 3	Implement File transfer protocol Configuration in optical networking .	K1,K2, K4
CO 4	Design optical communication system.	K1,K5, K6

Course Code	AEC0711	L T P	Credits
Course Title	**Big Data Analytics for IoT and Internet of Everything**	**3 0 0**	**3**

Course objective: Student will learn about

1	The concepts of big data platforms for IoT.
2	The concepts of Sustainability Data and Analytics.
3	YARN and HDFS in data management system.
4	The Hadoop and Map reduce and its uses in features extraction.
5	The various types of Google and AWS data analytics tools.

Pre-requisites:

Basic Knowledge of IoT and IoT Protocols

Course Contents / Syllabus

UNIT-I	**Big data platforms for the internet of things**	**8 hours**

Big Data Platforms for the Internet of Things: network protocol, data dissemination, current state of art Improving Data and Service Interoperability with Structure, Compliance, Conformance and Context Awareness, interoperability problem in the IoT context, Big Data Management Systems for the Exploitation of Pervasive Environments, Big Data challenges and its requirements, Types of data

UNIT-II	**Sustainability Data and Analytics**	**8 hours**

Sustainability Data and Analytics: Sustainability Data and Analytics in Cloud-Based M2M Systems, Potential stakeholders and their complex relationships to data and analytics applications, Social Networking Analysis, Building a useful understanding of a social network, Leveraging Social Media and IoT to Bootstrap Smart Environments, Lightweight Cyber Physical Social Systems, Citizen actuation

UNIT-III	**Hadoop Architecture**	**8 hours**

Hadoop Eco System and YARN: Hadoop ecosystem components, schedulers, fair and capacity, Hadoop 3.x, New Features – Name Node high availability, HDFS federation, MRv2, YARN, Running MRv1 in YARN.
HDFS (Hadoop Distributed File System): Design of HDFS, HDFS concepts, benefits and challenges, file sizes, block sizes and block abstraction in HDFS, data replication, how does HDFS store, read, and write files, Java Interfaces to HDFS, command-line interface, Hadoop file system interfaces, data flow, data ingest with Flume and Scoop, Hadoop archives, Hadoop I/O: compression, serialization, Avro and file-based data structures.

UNIT-IV	**Hadoop and Map Reduce**	**8 hours**

Hadoop: History of Hadoop, Apache Hadoop, the Hadoop Distributed File System, components of Hadoop, data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, Hadoop Echo System.
Map Reduce: Map Reduce framework and basics, how Map Reduce works, developing a Map Reduce application, unit tests with MR unit, test data and local tests, anatomy of a Map Reduce job run, failures, job scheduling, shuffle and sort, task execution, Map Reduce types, input formats, output formats, Map Reduce features, Real-world Map Reduce

UNIT-V	**Google and AWS Data Analytics Tools**	**8 hours**

Google Data Analytics Tools: Google Analytics, Google Search Console, Looker, Google Ads, Google Data Studio, Google Optimize, Google Surveys, Google tag manager, Google Big Query
AWS Data Analytics Tools: Amazon Athena, Amazon EMR, Amazon Redshift, Amazon Kinesis, Amazon Open Search Service, Amazon Quick sight, AWS Glue Data Brew

Course Outcomes: After completion of this course students will be able to

CO 1	Identify the concept of big data platforms for IoT.	K1,K2
CO 2	lyze the concept of Sustainability Data and Analytics in Cloud-Based M2M Systems.	K2,K3
CO 3	Explain the YARN and HDFS in Data management.	K1,K2

CO 4	Analyze Map Reduce framework and demonstrate its use in features extraction.	K2, K3
CO 5	Describe the various types of Google and AWS data analytics tools.	K1,K2

Text books

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013. 2. Big-Data Black Book, DT Editorial Services, Wily India
2. Tom White, "Hadoop: The Definitive Guide", Third Edition, O' Reilley, 2012. 5. Eric Sammer, "Hadoop Operations", O' Reilley, 2012.

Reference Books

1. Stackowiak R, Licht A, Mantha V, Nagode L" Big Data and The Internet of Things Enterprise Information Architecture for A New Age", A press, 2015.
2. Dr. John Bates, "Thingalytics - Smart Big Data Analytics for the Internet of Things", John Bates, 2015.

NPTEL Links

Unit 1	**https://www.youtube.com/live/e3D0gNqfnzo?feature=share**
Unit 2	**https://youtu.be/CDgtvl4c9Pg**
Unit 3	**https://youtu.be/FispS3Jx_3g**
Unit 4	**https://www.youtube.com/watch?v=mNP44rZYiAU**
Unit 5	**https://youtu.be/K-FhMegdlJo**

Course Code	AEC0713	L T P	Credits
Course Title	**Data Analytics**	**3 0 0**	**3**

Course Objective: In this course, the student will learn about

1	Various basic concepts & fundamentals of Data analytics	
2	Various types of data formats and their manipulations.	
3	Exploratory data analysis and visualization techniques	
4	R/Python/Tableau programming language.	

Pre-requisites: Basic Knowledge of Statistics and Probability

Course Contents / Syllabus		Hours
UNIT-I	**Introduction To Data Science**	**8**

Introduction to Data Science, Evolution of Data Science, Datafication, Skillsets needed, Data Science Lifecycle, types of Data Analysis, Data Science Tools and technologies, Need for Data Science, Analysis Vs Analytics Vs Reporting, Data classification, Future of Data Science, Applications of Data Science in various fields, Use cases of Data science-Facebook, Netflix, Amazon, Uber, AirBnB.

UNIT-II	**Data Handling & Statistical Analysis**	**8**

Types of Data: structured, semi-structured, unstructured data, Numeric, Categorical, Graphical, High Dimensional Data, Transactional Data, Spatial Data, Social Network Data, standard datasets, Data Classification, Sources of Data, Data manipulation in various formats, for example, CSV file, import and export data in R/Python. Measure of central tendency (Mean, Median, Mode), Central limit theorem, Skewness, Variance, SD, Covariance, Correlation, Histogram Analysis, Normal distribution, Students T distribution, Margin of Error

UNIT-III	**Data Pre-processing & Data Analysis**	**8**

Form of Data Pre-processing, data Attribute and its types, understanding and extracting useful variables, KDD, process, Data Cleaning: Missing Values, Noisy Data, Discretization and Concept hierarchy generation (Binning, Clustering, Histogram), Inconsistent Data, Data Integration and Transformation. Data Reduction: Data Cube, Aggregation, Data Compression, Numerosity Reduction, R-Square, Adjusted R-Square, Significance of p-value, Introduction to data visualization and various graphical ways of data representation.

UNIT-IV	**Exploratory Data Analysis**	**8**

Handling Missing data, Removing Redundant variables, variable Selection, identifying outliers, Removing Outliers, Time series Analysis, Data transformation and dimensionality reduction techniques such as Principal Component Analysis (PCA), Factor Analysis (FA) and Linear Discriminant Analysis (LDA), Univariate and Multivariate Exploratory Data Analysis. Data Munging, Data Wrangling- APIs and other tools for scrapping data from the web/ internet using R/Python**.**

UNIT-V	**Data Visualization**	**8**

Introductions and overview, Debug and troubleshoot installation and configuration of the Tableau. Creating Your First visualization: Getting started with Tableau Software, Using Data file formats, connecting your Data to Tableau, creating basic charts (line, bar charts, Tree maps), Using the Show me panel.

Tableau Calculations: Overview of SUM, AVR, and Aggregate Features Creating custom calculations and fields, Applying new data calculations to your visualization. Manipulating Data in Tableau: Cleaning-up the data with the Data Interpreter, structuring your data, Sorting, and
filtering Tableau data, Pivoting Tableau data. Advanced Visualization Tools: Using Filters, Using the Detail panel Using the Size panels, customizing filters, Using and Customizing tooltips, formatting your data with colors, Creating Dashboards & Stories, Distributing & Publishing Your Visualization

Course Outcomes: After completion of this course, the students will be able to

CO1	Understand the fundamental concepts of data analytics in the areas that plays major role within the realm of data science.	K1
CO2	Explain and exemplify the most common forms of data and its representations.	K2
CO3	Apply data pre-processing techniques on heterogenous datasets.	K3
CO4	Analyze data using exploratory data analysis.	K4
CO5	Apply visualization tool to analyze and draw inference from different types of data sets w.r.t different application scenarios.	K3

Textbooks:

1. Glenn J. Myatt, Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, John Wiley Publishers, 2007.
2. Data Analysis and Data Mining, 2nd Edition, John Wiley & Sons Publication, 2014.

Reference Books:

1. Data Mining Concepts and Techniques, Third Edition, Jiawei Han, Micheline Kamber, Jian Pei, Morgan Kaufmann, 2012.
2. The Data Science Handbook, Field Cady, John Wiley & Sons, Inc, 2017

NPTEL/ Youtube/ Faculty Video Link:

Unit 1	https://www.youtube.com/watch?v=3Bh_viwz6_0&ab_channel=NPTELIITGuwahati
Unit 2	https://www.youtube.com/watch?v=eo2tOPV3AoE&ab_channel=nptelhrd
Unit 3	https://www.youtube.com/watch?v=WwMz2fJwUCg&ab_channel=MITOpenCourseWare
Unit 4	https://www.youtube.com/watch?v=ARU0BEVxasQ&ab_channel=ConstrainedandUnconstrainedOptimization https://www.youtube.com/watch?v=bZMRHWu7hvg&list=PLIgDtce9BR0dZv1aZwVTmuWXc_vJPbB3q&index=34&ab_channel=ConstrainedandUnconstrainedOptimization
Unit 5	https://www.youtube.com/watch?v=3-NiZPbkr7A&ab_channel=KimiaLab

Course Code	AEC0712	L T P	Credits
Course Title	**Industrial Automation and Programming**	**3 0 0**	**3**

Course objective: Student will learn about

1	The basic concepts of automation.
2	Different types of circuits & cylinders in pneumatics.
3	The basic concepts of Electro pneumatics.
4	Different types of circuits in Electro pneumatics.
5	Discrete control using PLC and ladder programming.

Pre-requisites:

Basic Electronics & Basics of mechanical system

Course Contents / Syllabus

UNIT-I **Introduction to Automation** **8 hours**

Review and Definitions: Robots & its Kinds, Definition of Levels, Manipulators, Structure of Automatic Industrial Systems, Non-industrial Representatives of the Robot Family, Relationship between the Level of Robot "Intelligence" and the Product

Concepts and Layouts: Processing Layout, Concept of an Automatic Manufacturing Process, Productivity of a Manufacturing Process, The Kinematic Layout, Rapid Prototyping

UNIT-II **Pneumatics Automation** **8 hours**

Pneumatic Devices: Different types of valves, Actuators and auxiliary elements in Pneumatics & hydraulics, their applications and use of their ISO symbols Synthesis and design of circuits (up to 3 cylinders).

Introduction to Material storage: Handling and transport systems and its automation using AS/RS, AGVS and conveyors etc.

UNIT-III **Electro Pneumatics Automation** **8 hours**

Introduction to Electro Pneumatics, Classification Of Electro-Pneumatic Elements, Fundamentals of Electrical Technology, Electrical Symbols, Solenoid Valves, Switches, Sensors and Relays, Electro - Pneumatics Circuits, Rules for creating Relay logic diagram

UNIT-IV **Electro Pneumatics** **8 hours**

Timer, Counter, Design of Electro-Pneumatic Circuits using single solenoid and double solenoid valves with and without grouping.

Industrial control systems: Process industries versus discrete manufacturing industries, Continuous verses discrete control, Computer process control, Forms of computer process control.

UNIT-V **PLC** **8 hours**

Introduction, Definition, Advantages of PLC, Structures of PLC, Modes of Operation, Resources of PLC, PLC Programming Languages, Communication: Need for Communication, Data Transmission Commissioning: Types of Commissioning, Ladder digs, Ladder Logic, Programming for different types of logic gates, Latching, Timers, Counter, Practical Examples of Ladder Programming

Course Outcomes: After completion of this course students will be able to

CO 1	Apply the knowledge of basic concepts of industrial automation and explore the direction of flow in components.	K_1, K_3
CO 2	Design different types of circuits with pneumatics elements.	K_4
CO 3	Analyze the use of different types of circuits with the help of Electro pneumatics elements.	K_4
CO 4	Analyze the Industrial control systems using electro-pneumatics technique.	K_4
CO 5	Implement Discrete control using PLC and ladder programming.	K_4

Text books

1. "Automation, Production Systems and Computer Integrated Manufacturing"- M.P. Grover, Pearson Education.

Reference Books

1. "Computer Based Industrial Control" – Krishna Kant, EEE-PHI	
2. Principles and Applications of PLC – Webb John, Mcmillan 1992	
3. "An Introduction to Automated Process Planning Systems" – Tiess Chiu Chang & Richard A. Wysk.	
4. "Anatomy of Automation" – Amber G.H & P.S. Amber, PrenticeHall.	
NPTEL Links	
Unit 1	https://www.youtube.com/watch?v=br-ezdmEq7A
Unit 2	https://www.youtube.com/watch?v=se9XxkpXP74
Unit 3	https://www.youtube.com/watch?v=jKb-KLVzCtw
Unit 4	https://slideplayer.com/slide/3374651/
Unit 5	https://slideplayer.com/slide/3374651/

List of Open Electives(II) /(III) for VII semester

S.No.	Subject Code	Name of open elective Subjects	Subject offered to programme	Sem
1	AOE0761	Project Management	All Programs	7
2	AOE0762	Biology for Engineers	All Programs except BT	7
3	AOE0763	Object Oriented Programming	EC, ME,BT	7
4	AOE0764	Cloud computing	EC, ME,BT	7
5	AOE0765	Human Psychology and Organizational Behaviour	All Programs	7
6	AOE0766	Sensor Technologies	All Programs	7
7	AOE0767	Nano Technology	All Programs except BT	7
8	AOE0768	Web Technologies	EC, ME,BT	7
9	AOE0769	Data Base Technologies	EC, ME,BT	7
10	AOE0770	Finance for Engineers	All Programs	7
11	AOE0771	Entrepreneurship Development and IPR	All Programs	7
12	AOE0772	Wireless communication	All Programs except EC,ME,BT, IOT	7
13	AOE0773	Digital Image Processing	ME,BT,IOT	7

Open Elective

Courses Offered by EC

1. Sensor Technology
2. Wireless Communication
3. Real Time System
4. Digital Image Processing
5. Robotics & Automation

Sr. No	Name of open elective	Subject offered to program	Subject offered by program	Category (OE, 1(6)/2(7)/3(7)/4(8)
1	Sensor Technologies	ALL Programs except EC,IOT,BT	EC	**2**
2	Wireless communication	all the programs except EC,ME,BT	EC	**3**
3	REAL TIME SYSTEMS	ME,BT	EC	**4**
4	Digital Image Processing	ME,BT	EC	**3**
5	Robotics and Automation	ALL Programs except EC,BT,ME	EC/ME	**2**
Category :		(1) Technical/Engineering Science: 1/2 (2) Management / Entrepreneurship / Human Values / Applied Science (3) MooCs Based OE		

Open Elective – Courses offered to EC

Course code	AOE0766	L T P 3 0 0	Credits 3
Course title	Sensor Technology		

Course Objectives: Student will learn about

1	The concept of sensors and it's characteristics.
2	Various sensor materials and technology used in designing sensors.
3	Commonly used sensors in industry for measurement of temperature, position, accelerometer, vibration sensor, flow and level.
4	The use of basic electronics circuits and intelligent sensors for industrial automation.
5	The fundamentals of mechanical terms like pressure, position, force, strain and sensor application in different areas.

Pre-requisites: Basic Electronics and Electrical Engineering

Course Contents / Syllabus

UNIT-I	Sensors Fundamentals	8 hours

Sensors & Transducers: Definition, Classification & selection of sensors, Sensor Characteristics, Measurement of displacement using Potentiometer, Measurement of position using Hall effect sensors

UNIT-II	Sensor Materials and Technologies	8 hours

Materials: Passive Materials, Active Materials, Silicon, Polysilicon, semiconductors, Plastics, and Ceramics, Sensor Fabrication, Sensor Technologies: Surface Processing, Nano-Technology, IoT sensors. Pollution sensors, RFID sensors, image sensors, biometric sensors, MEMS and NEMS sensors.

UNIT-III	Measurement of Physical parameters	8 hours

Measurement of temperature using Thermistors, Thermocouple & RTD, Concept of thermal imaging, Proximity sensors: Capacitive, Use of proximity sensor as accelerometer and vibration sensor, Flow Sensors: Ultrasonic & Laser, Level Sensors: Ultrasonic & Capacitive.

UNIT-IV	Interface Electronic Circuits & Intelligent Sensors	8 hours

Input Characteristics of Interface Circuits, Excitation Circuits, Analog to Digital Converters, Direct Digitization and Processing, Bridge Circuits, Data Transmission.
Intelligent Sensors: General Structure of smart sensors & its components, Characteristic of smart sensors: Self calibration, Self-testing & self-communicating, Application of smart sensors: Automatic robot control & automobile engine control.

UNIT-V	Sensor application in Different Areas	8 hours

Velocity and Acceleration; Force, Strain, Pressure Sensors. Batteries for Low Power Sensors, LVDT & Optical Encoder, Measurement of force using strain gauge, Measurement of pressure using LVDT based diaphragm & piezoelectric sensor.

Course outcome: After successful completion of this course, students will be able to

CO1	Explain the concept of sensors and its characteristics.	K_1
CO2	Explain the different materials and technologies used in designing sensors.	K1, K2
CO3	Explain and apply sensors in industry for measurement of temperature, position, accelerometer, vibration sensor, flow and level.	K2 , K3
CO4	Apply the basic electronics circuits and intelligent sensors for industrial automation.	K2, K3
CO5	Explain the basic fundamentals of mechanical terms like position, strain, and apply sensor for measurement of parameters in different areas.	K2, K3

Text books:

1. DVS Murthy, Transducers and Instrumentation, PHI 2nd Edition 2013
2. S. Gupta, J.P. Gupta / PC interfacing for Data Acquisition & Process Control, 2nd ED / Instrument Society of America, 1994.
3. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press).

Reference Books:

1. Arun K. Ghosh, Introduction to measurements and Instrumentation, PHI, 4th Edition 2012.
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).

NPTEL/ YouTube /Learning Source:

https://youtu.be/1uPTyjxZzyo

https://youtu.be/q8UuRkOQ9A0

www.nptel.ac.in

Course Code	AOE0772	L T P	Credits
Course Name	**Wireless Communication**	**3 0 0**	**3**

Course Objective: Student will learn about

1	The fundamentals of mobile communication systems.	
2	The concept of cellular communication.	
3	Propagation Models and channel fading	
4	Contention free Multiple access technique (TDMA/FDMA/CDMA) and contention based (Pure ALOHA, Slotted ALOHA, CSMA).	
5	Various modern wireless technologies.	

Pre-requisites: Basic Knowledge of Digital Communication

Course Contents / Syllabus

UNIT-I	**Introduction of Wireless Communication**	**8 Hours**

History and evolution of mobile radio systems. General Model of Wireless Communication Link Types of mobile wireless services/systems-Cellular, WLL, Paging, Satellite Systems, Future trends in personal wireless systems.

UNIT-II	**Cellular Concepts and System Design Fundamentals**	**8 Hours**

Cellular Infrastructure, Cellular System Components, Antennas for Cellular Systems, Operation of Cellular Systems, frequency reuse, channel assignment, handoff strategies, Interference and system capacity.

UNIT-III	**Mobile Radio Propagation Models**	**8 Hours**

Radio wave propagation issues in personal wireless systems, Propagation models, Channel Noise and Losses, Fading in Land Mobile Systems, Multipath Fading, Fading Effects on Signal and Frequency, Shadowing; Wireless Channel Modeling: AWGN Channel, Rayleigh Channel,

UNIT- IV	**Equalization, Diversity Techniques & Multiple Access Techniques**	**8 Hours**

Equalization, Rake receiver concepts, Diversity Techniques, Linear predictive coders and channel coding. Multiplexing and Multiple Access: FDMA, TDMA, CDMA, OFDMA, Multiple Access for Radio Packet Systems: Pure ALOHA, Slotted ALOHA, CSMA and their versions; Packet and Pooling Reservation Based Multiple Access Schemes.

UNIT-V	**Wireless Systems & Standards**	**8 Hours**

GSM system for mobile Telecommunication, General Packet Radio Service, Edge Technology; CDMA 2000, IMT 2000 and UMTS, Long Term Evolution (LTE), Introduction to Mobile Adhoc Networks, Li-Fi Communication, Ultra-Wideband Communication, Mobile data networks, Introduction to 4G, 5G and concept of NGN.

Course Outcomes: After completion of this course students will be able to

CO 1	plain with various generations of mobile communications.	K1, K2
CO 2	plain concept of cellular communication.	K2
CO 3	scribe the basics of wireless communication.	K2
CO 4	plain and differentiate contention free and contention based multiple access techniques.	K2,K4
CO 5	plain Various modern wireless technologies.	K2

Text Books:

1. T.S. Rappaport, "Wireless Communication-Principles and practice", Pearson Publications, Second Edition.
2. Upena Dalal, "Wireless Communication and Networks", Oxford Press Publications.
3. T L Singal ,"Wireless Communications ", McGraw Hill Publications.

Reference Books:

1. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press.	
2. S. Haykin & M. Moher, “Modern wireless communication”, Pearson, 2005.	
PTEL/ YouTube/ Faculty Video Link:	
Unit 1	https://youtu.be/JCGMP37-2EA
Unit 2	https://youtu.be/f2wlHL1Sok8 https://youtu.be/0PWILK-hqbQ
Unit 3	https://youtu.be/SFcRtZ30rqs https://youtu.be/BKf2mN9W6Nk https://youtu.be/tePZhxRLsjE
Unit 4	https://youtu.be/GLmF3YB0pQU https://youtu.be/QHqZwBoTJRY
Unit 5	https://youtu.be/t3FVP5wuG4g https://youtu.be/ixY0Cau4mBM

Course Code		L T P	Credits
Course title	**Real Time Systems**	3 0 0	3

Course Objectives: Student will learn about

1	Fundamentals of real time systems.
2	Concepts of computer control and the suitable computer hardware requirements for real-time applications.
3	Concept of operating system and techniques required for real time systems.
4	Software algorithms using suitable languages to meet real time applications.
5	Methodologies to design and develop real time Systems.

Pre-requisites:

Course Contents / Syllabus

UNIT-I	**Introduction to Real-Time Systems**	**8**

Introduction to Real-Time Systems: Historical background, Elements of a Computer Control System, RTS- Definition, Classification of Real-time Systems, Time Constraints, Classification of Programs.

Concepts of Computer Control: Introduction, Sequence Control, Loop Control, Supervisory Control, Centralized Computer Control, Hierarchical Systems.

UNIT-II	**Computer Hardware Requirements for Real-Time Applications**	**8**

Computer Hardware Requirements for Real-Time Applications: Introduction, General Purpose Computer, Single Chip Microcomputers and Microcontrollers, Specialized Processors, Process-Related Interfaces, Data Transfer Techniques, Communications, Standard Interface.

UNIT-III	**Languages for Real-Time Applications**	**8**

Languages for Real-Time Applications: Introduction, Syntax Layout and Readability, Declaration and Initialization of Variables and Constants, Cutlass, Modularity and Variables, Compilation of Modular Programs, Data types, Control Structures, Exception Handling, Low-level facilities, Co-routines, Interrupts and Device Handling, Concurrency, Real-Time Support, Overview of Real-Time Languages.

UNIT-IV	**Operating Systems:**	**8**

Operating Systems: Introduction, Real-Time Multi-Tasking OS, Scheduling Strategies, Priority Structures, Task Management, Scheduler and Real-Time Clock Interrupt Handler, Memory Management, Code Sharing, Resource Control, Task Co-Operation and Communication, Mutual Exclusion.

UNIT-V	**Design of RTS**	**8**

General Introduction, Specification Document, Preliminary Design, Single-Program Approach, Foreground/Background System.

RTS Development Methodologies: Introduction, Yow-don Methodology, Ward and Mellor Method, Hately and Pirbhai Methods.

Course Outcomes: After completion of this course students will be able to

CO 1	Describe the fundamentals of real time systems and its classifications.	K2, K3
CO 2	Understand the concepts of computer control and identify the suitable computer hardware	K2,K3

	requirements for real-time applications.	
CO 3	Describe the operating system concepts and techniques required for real time systems.	K2,K3
CO 4	Develop the software algorithms using suitable languages to meet real time applications	K3,K4
CO 5	Apply suitable methodologies to design and develop real time systems.	K3, K4

Text Books

1. Real-Time Computer Control, Stuart Bennet, 2nd Edn. Pearson Education. 2008.
2. Real-Time Systems -C. M. Krishna, Kang G. Shin, , McGraw-Hill, 2010.

Reference Books

1. Real Time Systems – Mall Rajib, Pearson Education
2. Embedded Systems, Raj Kamal, Tata McGraw Hill, India, third edition, 2005.
3. Real-Time Systems Design and Analysis -Philip A. Laplante, Seppo J. Ovaska, Wiley, 2012.

PTEL/ YouTube/ Faculty Video Link:

Unit 1	https://onlinecourses.nptel.ac.in/noc20_cs16/preview
Unit 2	https://www.youtube.com/watch?v=a5n8TMNbyrg&list=PLJ5C_6qdAvBH6gRqEfGp00gMo1-ip_6Bg&index=6
Unit 3	https://www.youtube.com/watch?v=HlU5cYqGLZE
Unit 4	https://www.youtube.com/watch?v=mx6UMgoufLw&list=PLJ5C_6qdAvBH6gRqEfGp00gMo1-ip_6Bg&index=39
Unit 5	https://www.youtube.com/watch?v=c1Ou_yqXjoo&list=PLJ5C_6qdAvBH6gRqEfGp00gMo1-ip_6Bg&index=40

Course Code		L T P	Credits
Course Title	**Robotics and Automation**	**3 0 0**	**3**

Course Objective: Student will learn about

1	The concept of robotics.
2	The mathematical relations for forward and inverse kinematic analysis.
3	The various types of actuator and drive system.
4	Use of different types of circuits & cylinders in hydraulics and electro-pneumatics.
5	Discrete control using PLC and ladder and robot programming.

Pre-requisites: Basic fundamental of microprocessor, microcontroller & Embedded System

Course Contents / Syllabus

UNIT-I	**Introduction to Robotics and Automation**	**8 Hours**

Introduction to Robot: Classification of Robots, Advantages and Disadvantages of Robots, Robot Components, Robot Degrees of Freedom, Robot Joints, Robot Coordinates, Robot Reference Frames, Programming Modes, Robot Characteristics, Robot Workspace, Robot Languages.

Introduction to Automation: Definition and fundamentals of automation, reasons for Automating, basic elements of an automated system: Power, Program and control system.

UNIT-II	**Kinematics of Robots**	**8 Hours**

Kinematics of Robots: Position Analysis – Introduction, Robots as Mechanisms, Conventions, Matrix Representation Homogeneous Transformation Matrices, Representation of Transformations Forward and Inverse Kinematics of Robots, Forward and Inverse Kinematics of Planar Parallel Robots.

UNIT-III	**Actuators and Drive Systems**	**8 Hours**

Actuators and Drive Systems: Introduction ,Characteristics of Actuating Systems, Comparison of Actuating Systems, Hydraulic Actuators, Pneumatic Devices, Electric Motors, Microprocessor Control of Electric Motors, Pulse Width Modulation, Direction Control of DC Motors with an H-Bridge, Speed Reduction

UNIT- IV	**Pneumatics and hydraulics**	**8 Hours**

Pneumatics and hydraulics: Hydraulic and pneumatic Devices-Different types of valves, Actuators and auxiliary elements in Pneumatics & hydraulics, their applications and use of their ISO symbols Synthesis and design of circuits (up to 3 cylinders).

Electro pneumatics and hydraulics: electro pneumatics and hydraulics, Design of Electro-Pneumatic Circuits using single solenoid and double solenoid valves; with and without grouping.

UNIT-V	**Discrete control using PLC and Programming**	**8 Hours**

Discrete control using PLC- discrete process control, Programmable logic controller, its architecture, ladder digs, Ladder Logic, Programming for different types of logic gates, Latching, Timers, Counter.

Practical Examples of Ladder Programming, Robot Programming: Welding, Cutting, Pick & Place.

Course Outcomes: After completion of this course students will be able to

CO 1	Explain and apply the concept of robotics.	K2,K3

CO 2	Formulate the mathematical relations for forward and inverse kinematic analysis.	K2
CO 3	Interpret the various types of actuator and drive system.	K4,
CO 4	Learn the use of different types of circuits & cylinders in hydraulics and electro-pneumatics	K2
CO 5	Explain Discrete control using PLC and ladder and robot programming.	K2, K4

Text Books:

1. Saeed B. Niku, " Introduction to Robotics – Analysis, Systems and Application" : PHI 2006
2. J.J. Craig, Robotics, Addison-Wesley, 1986.
3. "Automation, Production Systems and Computer Integrated Manufacturing"- M.P. Grover, Pearson Education.

Reference Books:

1. An Introduction to Robot Technology, by CoifetChirroza, Kogan Page.
2. Robotic Engineering - An Integrated Approach : Richard D. Klafter Thomas A.

PTEL/ YouTube/ Faculty Video Link:

Unit 1	https://www.youtube.com/watch?v=P_PP76flZfw&list=PLyqSpQzTE6M_XM9cvjLLO_Azt1FkgPhpH&index=2
Unit 2	https://www.youtube.com/watch?v=XOg1KT6xD04&list=PLyqSpQzTE6M_XM9cvjLLO_Azt1FkgPhpH&index=4
Unit 3	https://youtu.be/ksOgvhYdqX8
Unit 4	https://youtu.be/Gc4BiUGiV-Q
Unit 5	https://youtu.be/pSEjWxqE3R0

Course Code	AOE0773	L T P	credits
Course Title	**Digital Image Processing**	**3 0 0**	**3**

Course Objective: Student will learn about

1	Basics of digital image and various operations on it.
2	Image enhancement techniques in different domains.
3	The various noises in images and restoration methods.
4	The skills to segment a digital image with different methods.
5	The basics of color image processing and various image compression techniques.

Pre-requisites: Basic fundamental of mathematics and signal processing

Course Contents / Syllabus		Hours
UNIT-I	**Digital Image Fundamentals:**	**8**

Introduction to Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Image Sensing and Acquisition, Image Sampling and Quantization, Basic Relationship between Pixels, Applications of DIP.

UNIT-II	**Image Enhancement:**	**8**

Spatial Domain: Basic Gray Level Transformations, Histogram based Processing, Enhancement using Arithmetic/Logic Operations, Spatial Filtering, Smoothing and Sharpening by Spatial Filtering.
Frequency Domain: Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters, Selective Filtering.

UNIT-III	**Image Restoration:**	**8**

Image Degradation/Restoration process model, Noise Models, Restoration in the presence of noise only–spatial filtering, Periodic noise reduction by frequency domain filtering.

UNIT-IV	**Image Segmentation:**	**8**

Point, Line and Edge Detection, Thresholding: Otsu Method, segmentation by region growing and by region Splitting and merging, region segmentation using clustering and Super pixels, segmentation: Morphological Watershed.

UNIT-V	**Colour fundamentals and Image compression:**	**8**

Colour Fundamentals, Colour Models, Pseudocolour Image Processing. Fundamentals, Some Basic Compression Methods: Huffman Coding, Arithmetic Coding, LZW Coding, Run Length Coding.

Course Outcomes: After completion of this course students will be able to

CO 1	Apply knowledge of mathematics for image understanding and analysis.	K1
CO 2	Analyse of image enhancement techniques in different domains.	K3,K4
CO 3	Recognize various noises in images and apply restoration methods.	K3,K4
CO 4	Apply different segmentation techniques on image.	K3, K4
CO 5	Apply knowledge of mathematics for color image processing and apply different image compression techniques.	K2,K3

Text Books:

1. Rafael C. Gonzalez, Richard E. Woods,Digital Image Processing Pearson, Third Edition, 2010.", Prentice Hall of India.
2. Anil K. Jain, Fundamentals of Digital Image Processing Pearson, 2002.

Reference Books:

1. Milan Sonka, Vaclav Hlavav, Roger Boyle, ―Image Processing, Analysis and MachineVision, 2nd ed., Thomson Learning, 2001.
2. Rangaraj M. Rangayyan, ―Biomedical Image Analysis‖, CRC Press, 2005

3. Pratt W.K, ―Digital Image Processing‖, 3rd ed., John Wiley & Sons, 2007
4. Digital Image Processing, 3rd Edition, by Rafael C Gonzalez and Richard E Woods.Publisher: Pearson Education

PTEL/ Youtube/ Faculty Video Link:

Unit 1	https://youtu.be/T0bgf3V7u-E
Unit 2	https://youtu.be/bJjgyTQ-BT4 https://youtu.be/M7JxDHUW5cc https://youtu.be/JfrcMYBouJE
Unit 3	https://youtu.be/MrNafUqh860 https://youtu.be/gLTlQPYY_pw
Unit 4	https://youtu.be/j3_Ck5oP5oI https://youtu.be/q1J0VAYFkHg
Unit 5	https://youtu.be/kSzramCsHA4 https://youtu.be/nlwH07G9Efg