COURSE SCHEME AND SYLLABUS

FOR

B.E. Electronics (Instrumentation and Control) Engineering

THAPAR INSTITUTE
OF ENGINEERING & TECHNOLOGY
(Deemed to be University)

2023

Approved in 109 th meeting of the Senate held on March 16, 2023. Revised in 112 th meeting of the Senate held on March 11, 2024.

SEMESTER-I

S. No.	Course Code	Course Name	CODE**	L	T	P	Cr
1.	UPH013	PHYSICS	BSC	3	1	2	**4.5**
2.	UES101	ENGINEERING DRAWING	ESC	2	4	0	**4.0**
3.	UHU003	PROFESSIONAL COMMUNICATION	HSS	2	0	2	**3.0**
4.	UES102	MANUFACTURING PROCESSES	ESC	2	0	2	**3.0**
5.	UMA010	MATHEMATICS–I	BSC	3	1	0	**3.5**
		TOTAL		11	6	6	**18.0**

CODE** For filling code in this column refer to the table titled "**Nature of course and code**" given below (on next page)

SEMESTER-II

S. No.	Course Code	Course Name	CODE**	L	T	P	Cr
1.	UCB009	CHEMISTRY	BSC	3	0	2	**4.0**
2.	UES103	PROGRAMMING FOR PROBLEM SOLVING	ESC	3	0	2	**4.0**
3.	UES013	ELECTRICAL & ELECTRONICS ENGINEERING	ESC	3	1	2	**4.5**
4.	UEN008	ENERGY AND ENVIRONMENT	HSS	2	0	0	**2.0**
5.	UMA004	MATHEMATICS–II	BSC	3	1	0	**3.5**
		TOTAL		14	2	6	**18.0**

SEMESTER-III

S. No.	Course Code	Course Name	CODE**	L	T	P	Cr
1.	UES034	MEASUREMENT SCIENCE AND TECHNIQUES	ESC	3	1	2	**4.5**
2.	UMA302	MATHEMATICS FOR SIGNALS	BSC	3	1	0	**3.5**
3.	UEI408	ANALOG DEVICES & CIRCUITS	PCC	3	1	2	**4.5**
4.	UTA030	ENGINEERING DESIGN PROJECT (BUGGY)	PRJ	1	0	4	**3.0**
5.	UEI301	DIGITAL ELECTRONICS	PCC	3	1	2	**4.5**
6.	UTD002	EMPLOYABILITY DEVELOPMENT SKILLS	HSS	2	0	0	2.0
7.	UEI306	NETWORK ANALYSIS	PCC	2	1	0	**2.5**
		TOTAL		18	4	10	**24.5**

SEMESTER-IV

S. No.	Course Code	Course Name	CODE**	L	T	P	Cr
1.	UEE410	DATA STRUCTURE AND ALGORITHMS	ESC	3	0	2	**4.0**
2.	UMA028	MATHEMATICS FOR DATA SCIENCE	BSC	3	0	2	**4.0**
3.	UEI403	ELECTRICAL AND ELECTRONIC MEASUREMENTS	PCC	3	1	2	**4.5**
4.	UEI501	CONTROL SYSTEMS	PCC	3	1	2	**4.5**
5.	UTA018	OBJECT-ORIENTED PROGRAMMING	ESC	3	0	2	**4.0**
6.	UMA035	OPTIMIZATION TECHNIQUES	BSC	3	0	2	**4.0**
7.	UHU050	EVOLUTIONARY PSYCHOLOGY (1 SELF EFFORT HOUR)	HSS	1*	0	0	1.0
		TOTAL		14	3	12	**26**

SEMESTER-V

S. No.	Course Code	Course Name	CODE**	L	T	P	Cr
1.	UEI610	FUNDAMENTALS OF MICROPROCESSORS AND MICROCONTROLLERS	PCC	3	0	2	**4.0**

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2.	UEI510	BIO-MEDICAL INSTRUMENTATION	PCC	2	0	2	**3.0**
3.	UEI722	INDUSTRIAL INSTRUMENTATION	PCC	2	1	2	**3.5**
4.	UEI518	ARTIFICIAL INTELLIGENCE AND APPLICATIONS	PCC	3	1	2	**4.5**
5.	UEI607	DIGITAL SIGNAL PROCESSING AND APPLICATIONS	PCC	3	1	2	**4.5**
6	UTA025	INNOVATION & ENTREPRENEURSHIP	OTH	1	0	2*	**2.0**
7.	UEI519	INSTRUMENT DESIGN PROJECT	PRJ	1	0	2	**2.0**
		TOTAL		15	3	14	**23.5**

SEMESTER-VI

S. No.	Course Code	Course Name	CODE**	L	T	P	Cr
1.	UEI844	VIRTUAL INSTRUMENTATION	PCC	2	0	3	**3.5**
2.	UEI701	DATA ACQUISITION AND SYSTEM DESIGN	PCC	3	0	2	**4.0**
3.	UEI604	PROCESS DYNAMICS AND CONTROL	PCC	3	1	2	**4.5**
4.		ELECTIVE-1					**3.0**
5.		ELECTIVE-II					**3.0**
6.	UEI793	CAPSTONE PROJECT (START)	PRJ	1*	0	2	---
7	UHU005	HUMANITIES FOR ENGINEERS	HSS	2	0	2	3.0
		TOTAL					**23 .0**

*****Alternate week

SEMESTER-VII

S. No.	Course Code	Course Name	CODE**	L	T	P	Cr
1.	UEI801	ADVANCED PROCESS CONTROL	PCC	3	1	2	**4.5**
2.		ELECTIVE-III					**4.0**
3.		ELECTIVE-IV					**3.0**
4.		GENERIC ELECTIVE		2	0	0	**2.0**
5.	UEI793	CAPSTONE PROJECT	PRJ	1*	0	2	**8.0**
		TOTAL					**21.5**

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SEMESTER-VIII

S. No.	Course Code	Course Name	CODE**	L	T	P	Cr
1.	UEI896	PROJECT SEMESTER	PRJ				**15**
OR							
1.	UEI897	DESIGN PROJECT	PRJ				**8.0**
2.	UEI852	LINEAR INTEGRATED CIRCUITS	PCC	3	0	2	**4.0**
3.	UEI805	ENVIRONMENTAL INSTRUMENTATION	PCC	3	0	0	**3.0**
OR							
1.	UEI898	Start-up Semester	PRJ				15.0
		TOTAL					**15.0**

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Total Credits: 164.5

Total Credit Score for specific Nature of course/s

Nature of the course	CODE	Total Credits	Semester and Course Name
Basic Science Courses	BSC	27	Semester-I, Physics Semester-I, Mathematics-I Semester-II,Chemistry Semester-II, Mathematics-II Semester-III, Mathematics for Signals Semester-III, Optimization Techniques Semester-IV, Mathematics for Data Science
Engineering Science Courses	ESC	28	Semester-I, Engineering Drawing Semester-I, Manufacturing Processes Semester-II, Programming for Problem Solving Semester-II, Electrical & Electronics Engineering Semester-III, Measurement Science and Techniques Semester-IV, Object Oriented Programming Semester-IV, Data Structures and Algorithms
Humanities and Social Science Courses	HSS	11	Semester-I, Professional Communication Semester II, Energy and Environment Semester-III, Employability development skills Semester IV, Evolutionary Psychology Semester-VI, Humanities for Engineers
Professional Core Courses	PCC	56.5	Semester-III, Digital Electronics Semester-III, Analog Devices and Circuits Semester-III, NETWORK ANALYSIS Semester-IV, Electrical and Electronic Measurement Semester-IV, Control Systems Semester-V, Fundamentals of Microprocessors and Microcontrollers Semester-V, Bio-medical Instrumentation

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Nature of the course	CODE	Total Credits	Semester and Course Name
			Semester-V, Industrial Instrumentation Semester-V, Artificial Intelligence and Applications Semester-V, Digital Signal Processing and Applications Semester-VI, Virtual Instrumentation Semester-VI, Data Acquisition and System Design Semester-VI, Process Dynamics and Control Semester-VII, Advanced Process Control
Open Elective Courses	OEC	15	Semester-VI, Elective-I, Semester-VI, Elective-II Semester-VII, Elective-III Semester-VII, Elective-IV Semester-VII, Generic Elective
Project	PRJ	28	Semester-III, Engineering Design Project (BUGGY) Semester-V, Instrument Design Project Semester-VII, Capstone Project Semester-VIII, Project Semester
Others	OTH	2.0	Semester-V, Innovation and Entrepreneurship

Table: Nature of course and code

Nature of the course	CODE**
Basic Science Courses	BSC
Engineering Science Courses	ESC
Humanities and Social Science Courses	HSS
Professional Core Courses	PCC
Open Elective Courses	OEC
Project	PRJ
Others	OTH

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Baskets:

S.No.	**Industrial Automation**	**Biomedical Instrumentation**	**Smart Systems**	**Computer Systems**
1	Robotics	Biometrics	IoT Systems	Data Base Management Systems
2	Advanced Control systems	Prosthetics and rehabilitation	Data Analytics	Computer Networks
3	Power Electronics for Automation	Biomedical devices and signal analysis	Embedded system design	Operating Systems
4	Robust and Real Time Control Systems	Deep Learning in Health Care Applications	Smart Sensor Networks	Deep Learning and Computer Vision

List of Electives:

Elective-I:

S. No.	**COURSE NO.**	**TITLE**	**L**	**T**	**P**	**CR**
1	UEI612	ROBOTICS **(basket 1)**	2	0	2	3.0
2	UEI613	BIOMETRICS **(basket 2)**	2	0	2	3.0
3	UEI514	IOT BASED SYSTEMS **(basket 3)**	2	0	2	3.0
4	UEI515	ANALOG AND DIGITAL COMMUNICATION	3	0	0	3.0
5	UEI516	ANALYTICAL INSTRUMENTATION	3	0	0	3.0
6	UEI615	DATA BASE MANAGEMENT SYSTEM (basket-4)	2	0	2	3.0
7	UEI616	CLOUD COMPUTING	2	0	2	3.0
8	UEI617	NETWORK PROGRAMMING	2	0	2	3.0

Elective-II

S. No.	**COURSE NO.**	**TITLE**	**L**	**T**	**P**	**CR**
1	UEI731	ADVANCED CONTROL SYSTEMS **(basket 1)**	3	0	0	3.0
2	UEI626	PROSTHETICS AND REHABILITATION **(basket 2)**	3	0	0	3.0
3	UEI627	DATA ANALYTICS **(basket 3)**	3	0	0	3.0
4	UEI628	OPTICAL INSTRUMENTATION	3	0	0	3.0
5	UEI629	COMPUTER NETWORKS (basket-4)	2	0	2	3.0

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6	UEI630	SECURE CODING	2	0	2	3.0
7	UEI631	SOURCE CODE MANAGEMENT	2	0	2	3.0

Elective-III

S. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UEI735	Power Electronics for Automation	3	0	2	4.0
2	UEI736	Biomedical devices and signal analysis (basket 2)	3	0	2	4.0
3	UEI733	EMBEDDED SYSTEM DESIGN **(basket 3)**	3	0	2	4.0
4	UEI734	DIGITAL IMAGE PROCESSING	3	0	2	4.0
5	UEI726	NETWORK SYNTHESIS	3	0	2	4.0
5	UEI711	OPERATING SYSTEMS (basket 4)	3	0	2	4.0
6	UEI712	SOFTWARE ENGINEERING	3	0	2	4.0
7	UEI713	COMPUTER GRAPHICS	3	0	2	4.0

Elective-IV

S. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UEI744	ROBUST AND REAL TIME CONTROL SYSTEMS	3	0	0	3.0
2	UEI745	Deep Learning in Health Care Applications	3	0	0	3.0
3	UEI742	SMART SENSOR NETWORKS **(basket 3)**	3	0	0	3.0
4	UEI743	BIOSENSORS AND MEMS	3	0	0	3.0
5	UEI727	DEEP LEARNING AND COMPUTER VISION (basket 4)	2	0	2	3.0
6	UEI728	COMPUTER & NETWORK SECURITY	2	0	2	3.0
7	UEI729	BLOCKCHAIN TECHNOLOGY AND APPLICATIONS	2	0	2	3.0

Generic Electives

S. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UHU016	INTRODUCTORY COURSE IN FRENCH	2	0	0	2.0
2	UCS002	INTRODUCTION TO CYBER SECURITY	2	0	0	2.0
3.	UTD002	EMPLOYABILITY DEVELOPMENT SKILL	2	0	0	2.0
4.	UHU017	INTRODUCTION TO COGNITIVE SCIENCE	2	0	0	2.0
5.	UHU018	INTRODUCTION TO CORPORATE FINANCE	2	0	0	2.0
6.	UEN006	TECHNOLOGIES FOR SUSTAINABLE DEVELOPMENT	2	0	0	2.0
7.	UPH064	NANO SCIENCE AND NANO-MATERIALS	2	0	0	2.0
8.	UMA069	GRAPH THEORY AND APPLICATIONS	2	0	0	2.0
9.	UMA070	ADVANCED NUMERICAL METHODS	2	0	0	2.0
10.	UBT510	BIOLOGY FOR ENGINEERS	2	0	0	2.0

UPH013: Physics

L	T	P	Cr
3	1	2	4.5

Course Objectives: To introduce the student to the basic physical laws of oscillators, acoustics of buildings, ultrasonics, electromagnetic waves, wave optics, lasers, and quantum mechanics and demonstrate their applications in technology. To introduce the student to measurement principles and their application to investigate physical phenomena.

Syllabus

Oscillations and Waves: Oscillatory motion and damping, Applications - Electromagnetic damping – eddy current; Acoustics: Reverberation time, absorption coefficient, Sabine's and Eyring's formulae (Qualitative idea), Applications - Designing of hall for speech, concert, and opera; Ultrasonics: Production and Detection of Ultrasonic waves, Applications - green energy, sound signaling, dispersion of fog, remote sensing, Car's airbag sensor.

Electromagnetic Waves: Scalar and vector fields; Gradient, divergence, and curl; Stokes' and Green's theorems; Concept of Displacement current; Maxwell's equations; Electromagnetic wave equations in free space and conducting media, Application - skin depth.

Optics: Interference: Parallel and wedge-shaped thin films, Newton rings, Applications as Non-reflecting coatings, Measurement of wavelength and refractive index. **Diffraction:** Single and Double slit diffraction, and Diffraction grating, Applications - Dispersive and Resolving Pow- ers. **Polarization:** Production, detection, Applications – Anti-glare automobile headlights, Ad- justable tint windows. **Lasers:** Basic concepts, Laser properties, Ruby, HeNe, and Semiconductor lasers, Applications – Optical communication and Optical alignment.

Quantum Mechanics: Wave function, Steady State Schrodinger wave equation, Expectation value, Infinite potential well, Tunneling effect (Qualitative idea), Application - Quantum comput- ing.

Laboratory Work :

1. Determination of damping effect on oscillatory motion due to various media.
2. Determination of velocity of ultrasonic waves in liquids by stationary wave method.
3. Determination of wavelength of sodium light using Newton's rings method.
4. Determination of dispersive power of sodium-D lines using diffraction grating.
5. Determination of specific rotation of cane sugar solution.
6. Study and proof of Malus' law in polarization.
7. Determination of beam divergence and beam intensity of a given laser.
8. Determination of displacement and conducting currents through a dielectric.
9. Determination of Planck's constant.

Micro Project: Students will be given physics-based projects/assignments using computer simu-

Course Learning Outcomes (CLOs) /Course Objectives (COs):On completion of this course, the students will be able to:

1. Understand damped and simple harmonic motion, the role of reverberation in designing a hall and generation and detection of ultrasonic waves.
2. use Maxwell's equations to describe propagation of EM waves in a medium.
3. demonstrate interference, diffraction and polarization of light.
4. explain the working principle of Lasers.
5. use the concept of wave function to find probability of a particle confined in a box.
6. perform an experiment, collect data, tabulate and report them and interpret the results with error analysis.

Text Books:

1. Beiser, A., Concept of Modern Physics, Tata McGraw Hill (2007) 6th ed.
2. Griffiths, D.J., Introduction to Electrodynamics, Prentice Hall of India (1999) 3rd ed.
3. Jenkins, F.A. and White, H.E., Fundamentals of Optics, McGraw Hill (2001) 4th ed.

Reference Books:

1. Wehr, M.R, Richards, J.A., Adair, T.W., Physics of The Atom, Narosa Publishing House (1990) 4th ed.
2. Verma, N.K., Physics for Engineers, Prentice Hall of India (2014)1st ed.
3. Pedrotti, Frank L., Pedrotti, Leno S., and Pedrotti, Leno M., Introduction to Optics, Pearson Prentice HallTM (2008) 3rd ed.

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

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UES101: Engineering Drawing

L	T	P	Cr
2	4	0	4.0

Course Objectives: This module is dedicated to graphics and includes two sections: 2D drafting and 3D modelling of solid objects. This course is aimed at making the student understand the concepts of projection systems, learn how to create projections of solid objects using first and third angle orthographic projection as well as isometric and auxiliary projection, concept of sectioning, to interpret the meaning and intent of toleranced dimensions and to create/edit drawings using drafting software. In addition, this course shall give an insight on the basic 3D modelling concepts like extrude, revolve, sweep, construction of complex solids.

Syllabus

Engineering Drawing Concepts

1. Introduction to Engineering Drawing
2. Projection systems: First angle and third angle projection system
3. Orthographic Projection: Points, Lines, Solid objects
4. Isometric Projections
5. Auxiliary Projections
6. Development of surfaces
7. Section of solids
8. Limits, fits and tolerances

2D Drafting

1. Management of screen menus commands
2. Creating basic drawing entities
3. Co-ordinate systems: Cartesian, polar and relative coordinates
4. Drawing limits, units of measurement and scale
5. Layering: organizing and maintaining the integrity of drawings
6. Design of prototype drawings as templates.
7. Editing/modifying drawing entities: selection of objects, object snap modes, editing commands,
8. Dimensioning: use of annotations, dimension types, properties and placement, adding text to drawing

3D Modelling

1. Management of screen menus commands
2. Introduction to basic 3D modelling commands such as extrude, revolve, sweep etc.
3. Creation of 2D drawings from a 3D model

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Micro Projects /Assignments:

1. Completing the views - Identification and drawing of missing lines and views in the projection of objects
2. Projects related to orthographic and isometric projections Using wax blocks/soap bars/any soft material to develop three dimensional object from given orthographic projections
3. a. 3D modelling of complex machine components
   b. Development of production drawings of individual components from the model

Course Learning Outcomes (CLOs) /Course Objectives (COs):

On completion of this course, the students will be able to:

1. Creatively comprehend the geometrical details of common engineering objects
2. Draw dimensioned orthographic and isometric projections of simple engineering objects
3. Interpret the meaning and intent of limits, fits and tolerances in the drawing
4. create/edit the engineering drawings for simple engineering objects using 2D drafting software
5. create/edit 3D models of engineering components using 3D modelling software

Text Books:

1. Jolhe, D.A., Engineering Drawing, Tata McGraw Hill, 2008
2. Davies, B. L., Yarwood, A., Engineering Drawing and Computer Graphics, Van Nostrand Reinhold (UK), 1986

Reference Books:

1. Gill, P.S., Geometrical Drawings, S.K. Kataria & Sons, Delhi (2008).
2. Gill, P.S., Machine Drawings, S.K. Kataria & Sons, Delhi (2013).
3. Mohan, K.R., Engineering Graphics, Dhanpat Rai Publishing Company (P) Ltd, Delhi (2002).
4. French, T. E., Vierck, C. J. and Foster, R. J., Fundamental of Engineering Drawing &Graphics Technology, McGraw Hill Book Company, New Delhi (1986).
5. Rowan, J. and Sidwell , E. H., Graphics for Engineers, Edward Arnold, London (1968).
6. Mastering AutoCAD 2021 and AutoCAD LT 2021, Brian C. Benton, George Omura, Sybex
   - John Wiley and Sons, Indiana (2021).

Evaluation Scheme

Evaluation Elements	**Weightage %**
MST (1.5 hours-CAD based) (MST)	**20**
EST (2 hours-CAD based) (ESE)**	**45**
AutoCAD tutorials/SolidWorks/Project work*	**35**

* Students are required to bring their personal computers for the tutorial work.

* Availability of institute server resources for sharing the software licenses with the student community.

**Institute computational resources in collaboration with other academic units / departments for conducting the mid semester and end semester test.

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UHU003: Professional Communication

L	T	P	Cr
2	0	2	3.0

Course Objectives: The course is designed to develop the interpersonal, written, and oral as well as the non- verbal communication skills of the students. The course begins by building up on the theoretical concepts and then practicing on the applicability of the various elements. Since the course has very high applicability content, the students are advised to practice in class as well as off class. A very high level of interaction is expected of the students in the class.

Syllabus

Fundamentals of Communication: Meaning, Types and Characteristics of communication, Applicability of Transactional Analysis and Johari Window for enhancing interpersonal communication skills. Seven Cs of Effective Communication, Barriers to Effective Communication.

Effective Oral Communication: Understanding Principles of Oral communication, Formal and Informal Oral Communication, Oral Communication and Behavioral Patterns, Advantages and Disadvantages of Oral Communication.

Effective Listening: Listening vs Hearing, Active Listening techniques, Barriers to Listening.

Effective non-verbal communication: Meaning and Importance of Non-Verbal Communication, Different Types of Non-verbal Communication, Interpretation of Non-verbal Cues.

Effective written Communication: Characteristics of Good Writing, Choice of Words, Sentence Construction, Paragraph development, Forms of writing.

Business Communication: Technical Report Writing, Designing Resumes and Cover Letters for effective job application, E-mail writing and e-mail etiquette.

Organizational Communication: Directional communication: Downward, Upward and Horizontal Communication, Grapevine.

Reading: The following texts (one from each of the two categories listed below) are required to be read by the students in the semester:

Category 1: Animal Farm by George Orwell, Lord of the Flies by William Golding, Life of Pi by Yann Martel

Category 2: The Namesake by Jhumpa Lahiri, The God of Small Things by Arundhati Roy, Q&A by Vikas Swarup

Laboratory Work :

1. Needs-assessment of spoken and written communication with feedback.
2. Training for Group Discussions through simulations and role plays.
3. Technical report writing on survey-based projects.
4. Project-based team presentations.

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Course Learning Outcomes (CLOs) /Course Objectives (COs):On completion of this course, the students will be able to:

1. Apply communication concepts for effective interpersonal communication.
2. Speak assertively and effectively.
3. Interpret non-verbal cues in professional communication.
4. Write objectively, purposefully and effectively.
5. Design effective resumes and reports.

Text Books:

1. Mukherjee H.S..Business Communication: Connecting at Work. Oxford University Press.(2013)
2. Lesikar R.V, and Flately M.E., Basic Business Communication Skills for empowering the internet generation.(2006)
3. Raman, M.,and Singh ,P, Business Communication . Oxford . University Press (2008).

Reference Books:

1. Riordan, G.R. Technical Communication. Cengage Learning India Private Ltd. (2012)
2. Butterfield, Jeff., Soft Skills for everyone, Cengage Learning New Delhi, (2013).
3. Robbins, S.P., & Hunsaker, P.L., Training in Interpersonal Skills, Prentice Hall of India, New Delhi, (2008).
4. Orwell, G., Animal Farm, Fingerprint Publishing, New Delhi, (2017).
5. Golding, W, Lord of the Flies, Faber & Faber; Export edition (1999)
6. Martel,Y., Life of Pi, RHC, New Delhi, (2012).
7. Lahiri,J., The Namesake, Harpercollins (2007)
8. Arundhati Roy,A., The God of Small Things, Penguin India, (2002).
9. Swarup,V., Q&A, Black Swan,(2009).

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

UES102: Manufacturing Processes

L	T	P	Cr
2	0	2	3.0

Course Objectives: This course introduces the basic concepts of manufacturing via machining, forming, casting and joining, enabling the students to develop a basic knowledge of the mechanics, operation and limitations of basic machining tools along with metrology and measurement of parts. The course also introduces the concept of smart manufacturing.

Syllabus

Machining Processes: Principles of metal cutting, Cutting tools, Cutting tool materials and applications, Geometry of single point cutting tool, Introduction to computerized numerical control (CNC) machines, G and M code programming for simple turning and milling operations, introduction of canned cycles.

Metal Casting: Introduction & Principles of sand casting, Requisites of a sound casting, Permanent mold casting processes, casting defects

Metal Forming: Hot & cold metal working, Forging, Rolling, Sheet Metal operations.

Joining Processes: Method of joining, type of electric arc welding processes, Methods of shielding, Power source characteristics, Resistance welding, Soldering, Brazing.

Smart Manufacturing: IoT and ML in manufacturing, Introduction to Additive Manufacturing, Robotics and Automation in manufacturing.

Laboratory Work :

Relevant shop floor exercises involving practices in Sand casting, Machining, Welding, Sheet metal fabrication techniques, CNC turning and milling exercises, Experiments on basic engineering metrology and measurements to include measurements for circularity, ovality, linear dimensions, profiles, radius, angular measurements, measurement of threads, surface roughness.

Basic knowledge and derivations related to above measurements, uncertainties, statistical approaches to estimate uncertainties, Line fitting, static and dynamic characteristics of instruments will be discussed in laboratory classes.

Assignments: Assignments for this course will include the topics: Manufacturing of micro-chips used in IT and electronics industry and use of touch screens. Another assignment will be given to practice numerical exercises on topics listed in the syllabus. Case study related to smart manufacturing.

Micro Project: Fabrication of multi-operational jobs using the above processes as per requirement by teams consisting of 4 -6 members. Quality check should be using the equipment available in metrology lab.

Course Learning Outcomes (CLOs) /Course Objectives (COs):On completion of this course, the students will be able to:

1. identify & analyse various machining processes/operations for manufacturing of industrial components
2. apply the basic principle of bulk and sheet metal forming operations
3. apply the knowledge of metal casting for different requirements.
4. identify and analyse the requirements to for achieving a sound welded joint apply the concept of smart manufacturing

Text Books:

1. Degarmo, E. P., Kohser, Ronald A. and Black, J. T., Materials and Processes in Manufac- turing, Prentice Hall of India (2008) 8th ed.
2. Kalpakjian, S. and Schmid, S. R., Manufacturing Processes for Engineering Materials, Dor- ling Kingsley (2006) 4th ed.

Reference Books:

1. Martin, S.I., Chapman, W.A.J., Workshop Technology, Vol.1 & II, Viva Books (2006) 4th ed.
2. Zimmer, E.W. and Groover, M.P., CAD/CAM - Computer Aided Designing and Manufac- turing, Dorling Kingsley (2008).
3. Pandey, P.C. and Shan, H. S., Modern Machining Processes, Tata McGraw Hill (2008).
4. Mishra, P. K., Non-Conventional Machining, Narosa Publications (2006).
5. Campbell, J.S., Principles of Manufacturing, Materials and Processes, Tata McGraw Hill Company (1999).
6. Lindberg, Roy A., Processes and Materials of Manufacture, Prentice Hall of India (2008) 4th ed.

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

UMA010: Mathematics-I

L	T	P	Cr
3	1	0	3.5

Course Objectives: To provide students with skills and knowledge in sequence and series, advanced calculus, calculus of several variables and complex analysis which would enable them to devise solutions for given situations they may encounter in their engineering profession.

Syllabus

Sequences and Series: Introduction to sequences and infinite series, Tests for convergence/divergence, Limit comparison test, Ratio test, Root test, Cauchy integral test, Alternating series, Absolute convergence, and conditional convergence.

Series Expansions: Power series, Taylor series, Convergence of Taylor series, Error estimates, Term by term differentiation and integration.

Partial Differentiation: Functions of several variables, Limits and continuity, Chain rule, Change of variables, Partial differentiation of implicit functions, Directional derivatives and its properties, Maxima and minima by using second order derivatives.

Multiple Integrals: Double integral (Cartesian), Change of order of integration in double integral, Polar coordinates, Graphing of polar curves, Change of variables (Cartesian to polar), Applications of double integrals to areas and volumes, Evaluation of triple integral (Cartesian).

Complex analysis: Introduction to complex numbers, Geometrical interpretation, Functions of complex variables, Examples of elementary functions like exponential, trigonometric and hyperbolic functions, Elementary calculus on the complex plane (limits, continuity, differentiability), Cauchy – Riemann equations, Analytic functions, Harmonic functions.

Course Learning Outcomes (CLOs) /Course Objectives (COs):On completion of this course, the students will be able to:

1. determine the convergence/divergence of infinite series, approximation of functions using power and Taylor's series expansion and error estimation.
2. examine functions of several variables, define and compute partial derivatives, directional derivatives, and their use in finding maxima and minima in some engineering problems.
3. evaluate multiple integrals in Cartesian and Polar coordinates, and their applications to engineering problems.
4. represent complex numbers in Cartesian and Polar forms and test the analyticity of complex functions by using Cauchy – Riemann equations.

Text Books:

1. Thomas, G.B. and Finney, R.L., Calculus and Analytic Geometry, Pearson Education (2007), 9th ed.
2. Stewart James, Essential Calculus; Thomson Publishers (2007), 6th ed.
3. Kasana, H.S., Complex Variables: Theory and Applications, Prentice Hall India, 2005 (2nd edition).

Reference Books:

1. Wider David V, Advanced Calculus: Early Transcendentals, Cengage Learning (2007).
2. Apostol Tom M, Calculus, Vol I and II, John Wiley (2003).
3. Brown J.W and Churchill R.V, Complex variables and applications, McGraw Hill, (7th edition)

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

UCB009: Chemistry

L	T	P	Cr
3	0	2	4.0

Course Objectives: The course aims at elucidating principles of applied chemistry in industrial systems, water treatment, engineering materials, computational and analytical techniques.

Syllabus

Atomic and Molecular spectroscopy: Introduction to spectroscopy, principles of atomic absorption, flame emission spectrophotometry and ICP-AES (Inductively Coupled Plasma- Atomic Emission Spectroscopy), Quantification by calibration method, Jablonski diagram, fluorescence and phosphorescence, Beer-Lambert's Law, principle and applications of UV-Vis and IR spectroscopy.

Electrochemistry: Background of electrochemistry, Ionic mobility, Conductometric titrations, Modern Batteries: Pb-acid and Li ion battery, Corrosion and its protection.

Water Treatment and Analysis: Physiochemical parameters of water quality, External and internal methods of Softening of water: carbonate, phosphate, calgon and colloidal conditioning, Zeolite process, Ion exchange process, treatment of water for domestic use, Desalination of brackish water: Reverse osmosis & Electrodialysis.

Fuels: Classification of fuels, Calorific value, Cetane and Octane number, alternative fuels: biodiesel, Power alcohol, synthetic petrol, Fuel cells: H2 production and storage, Water splitting, Rocket propellant.

Chemistry of Polymers: Classification of polymers, tacticity of polymers, molecular weight calculations, Polymers in daily life, conducting, inorganic and biodegradable polymers.

Computers in Chemistry: Introduction to SMILES (Simplified Molecular Input Line-Entry System): Methodology and encoding rules, SMILES notation-chemical structure interconversions and its applications.

Laboratory Work : Electrochemical measurements: Experiments involving use of pH meter, conductivity meter, potentiometer, Spectroscopic technique, Volumetric titrations: Determination of mixture of bases, hardness, alkalinity, chloride and iron content, Application of polymers and SMILES Language. onducting currents through a dielectric.

Course Learning Outcomes (CLOs) /Course Objectives (COs): On completion of this course, the students will be able to:

1. recognize principles and applications of atomic and molecular spectroscopy.
2. explain the concepts of conductometric titrations, modern batteries and corrosion.
3. apply and execute water quality parameter and treatment methods.
4. discuss the concept of alternative fuels, application of polymers and SMILES.
5. execute laboratory techniques like pH metry, potentiometry, spectrophotometry, conductometry and volumetry.

Text Books:

1. Engineering Chemistry, S. Vairam and S. Ramesh, Wiley India 1st ed, 2014.
2. Engineering Chemistry, K. S. Maheswaramma, and M. Chugh. Pearson, 2016.

Reference Books:

1. Engineering Chemistry, B. Sivasankar, Tata McGraw-Hill Pub. Co. Ltd, New Delhi, 2008.
2. Engineering Chemistry, M.J. Shulz, Cengage Learnings, 2007.
3. J. Chem. Inf. Comput. Sci., D. Weininger, Vol. 28, 1988, 31-36.

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

UES103: PROGRAMMING FOR PROBLEM SOLVING

L	T	P	Cr
3	0	2	4.0

Course Objectives: This course is designed to solve and explore the problems using the art of computer programming with the help of C Language. Students will be able to apply these problem solving concepts in real life applications.

Syllabus

Introduction to Computer Fundamentals: Computer Memory Hierarchy, Types of Software Binary number system, Algorithm, Flowchart, Formulate simple algorithms for logical and arithmetic problems.

Basics of C Programming: Structure and Life cycle of a C Program, Data types, Identifiers, Variables, Keywords, Constants, input/output statements, Operators, Type conversion and type casting. Translate the algorithms to code snippets.

Decision Making and Iterative Statements: Decision making- if, if-else, Nested ifelse, Multiple if, else if, switch, Ternary Operator, Loops- (while, do-while, for), Nesting of Loops, break, continue and goto. Implement the switch () to solve the basic functions of scientific calculator.

Functions: Function prototype, Definition and Call, Type of Functions, Scope of variables in (Block, Function, Program, File), Storage classes (Auto, Register, Static and Extern), Recursion (with the introduction of Stack), Implementation of recursion to solve the problem of Tower of Hanoi.

Arrays and Strings: One-dimensional array its operations (Traversal, Linear Search, Insertion, Deletion, Bubble Sort), Two-dimensional and its operations (Addition, Transpose and Multiplication), Passing of array into a function (row and entire array), Input and output of a string, string inbuilt functions, 2-D Character array.

Pointers: Introduction to Pointers, Pointer arithmetic, Passing arguments to a function using pointer (understanding of call by value and call by reference), Accessing arrays using pointers Dynamic memory allocation (malloc(), calloc(), realloc() and free()), Pointer and Functions.

Structures and Union: Structure declaration, Initialization of structures, Structure variables, Accessing structure elements using (.) operator, Array of structure variables, Passing structure variable to a function (individual and entire structure), Structure pointer, Comparison of Structure and Union.

File Handling: Introduction of Files (streams in C), using File (Declaring, Opening and Closing), Operations on File (Reading, Writing and appending), and Random Access of a file, command line argument

Laboratory Work

To implement programs for various kinds of real life applications in C Language.

Course Learning Outcomes (CLOs) /Course Objectives (COs):On completion of this course, the students will be able to:

1. Comprehend and analyze the concepts of number system, memory, compilation and debugging of the programs in C language.
2. Analyze the control & iterative statements to solve the problems with C language source codes.
3. Design and create programs for problem solving involving arrays, strings and pointers.
4. Evaluate and analyze the programming concepts based on user define data types and file handling using C language.

Text Books:

1. C Programming Language, Brian W. Kernighan Dennis M. Ritchie, 2nd ed, 2012.
2. Programming in ANSI C, Balagurusamy G., 8th ed., 2019

Reference Books:

1. Let Us C, Kanetkar Y., 16th ed., 2017
2. Programming with C, Byron S Gottfried, McGraw Hill Education, Forth edition, 2018

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

UES013:ELECTRICAL AND ELECTRONICS ENGINEERING

L	T	P	Cr
3	1	2	4.5

Course Objectives: To introduce the basic concepts of electrical and electronics engineering.

Syllabus

DC Circuits: Introduction to circuit elements; rms and average values for different wave shapes, independent and dependent current and voltage sources; Kirchhoff's laws; mesh and node analysis; source transformations; network theorems: Superposition theorem, Thevenin's and Norton's theorem, Maximum power transfer theorem; star-delta transformation; steady state and transient response of R-L and R-C and R-L-C circuits.

AC Circuits: Concept of phasor, phasor representation of circuit elements; analysis of series and parallel AC circuits; concept of real, reactive and apparent powers; resonance in RLC series and parallel circuits; balanced three phase circuits: voltage, current and power relations for star and delta arrangement; analysis of balanced and unbalanced circuits; three phase power measurement using two-wattmeter and one-wattmeter methods.

Magnetic circuits: analogy between electric and magnetic circuits; series and parallel magnetic circuits; operating principles of electrical appliances: single-phase transformer and rotating ma- chines; tests and performance of single-phase transformer.

Digital Logic Design: Digital signals, Number systems, Positive and negative representation of numbers, Signed-number representation, Binary arithmetic, Postulates and theorems of Boolean Algebra, Algebraic simplification, Sum of products and product of sums formulations (SOP and POS), Gate primitives, Logic Gates and Universal Gates, Minimization of logic functions, Karnaugh Maps, Logic implementation using Gates, Decoder, MUX, Flip-Flops, Asynchronous up/down counters.

Electronic Devices: p- n junction diode: V-I characteristics of diode, Operation of Bipolar Junction Transistor, CB and CE configuration, Transistor as a switch, Operation of SCR, DIAC and TRIAC.

Operational Amplifier Circuits: The ideal operational amplifier, the inverting, non- inverting amplifiers, Op-Amp Characteristics, Applications of Op-amp: summing amplifier, differentiator and integrator.

Laboratory Work

Kirchhoff's laws, network theorems, ac series and parallel circuit, three phase power measurement, magnetic circuit, tests on transformer, resonance in AC circuit, combinational circuits, flip flops, shift register and binary counters, asynchronous and synchronous up/down counters, BJT characteristics.

Course Learning Outcomes (CLOs) /Course Objectives (COs):

On completion of this course, the students will be able to:

1. Apply various networks laws and theorems to solve dc circuits
2. Compute different ac quantities with phasor representation
3. Comprehend the operation in magnetic circuits, single phase transformer and rotating machines.
4. Recognize and apply the number systems and Boolean algebra.
5. Reduce and simplify Boolean expressions and implement them with logic gates.
6. Discuss and explain the working of diode, transistor and operational amplifier, their configurations and applications.

Text Books:

1. Hughes, E., Smith, I.M., Hiley, J. and Brown, K., Electrical and Electronic Technology, Prentice Hall (2008) 10th ed.
2. Nagrath, I.J. and Kothari, D.P., Basic Electrical Engineering, Tata McGraw Hill (2002).
3. Boylestad, R.L. and Nashelsky, L., Electronic Devices & Circuit Theory, Perason (2009).
4. Mano M. M. and Ciletti, M.D., Digital Design, Pearson, Prentice Hall, (2013).

Reference Books:

1. Chakraborti, A., Basic Electrical Engineering, Tata McGraw-Hill (2008).
2. Del Toro, V., Electrical Engineering Fundamentals, Prentice-Hall of India Private Limited (2004).
3. David Bell, Electronics Devices and Circuits, Oxford Publications (2009).

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

UEN008: Energy and Environment

L	T	P	Cr
2	0	0	2.0

Course Objectives: The exposure to this course would facilitate the students in understanding the terms, definitions and scope of environmental and energy issues pertaining to current global scenario; understanding the need of sustainability in addressing the current environmental & energy challenges.

Syllabus

Introduction: Concept of sustainability and sustainable use of natural resources, Climate Change & its related aspects.

Air Pollution: Origin, Sources and effects of air pollution; Primary and secondary meteorological parameters; wind roses; Atmospheric stability; Source reduction and Air Pollution Control Devices for particulates and gaseous pollutants in stationary sources.

Water Pollution: Origin, Sources of water pollution, Category of water pollutants, Physico-chemical characteristics, Components of wastewater treatment systems.

Solid waste management: Introduction to solid waste management, Sources, characteristics of municipal solid waste, Solid waste management methods: Incineration, composting, landfilling.

Energy Resources: Classification of Energy Resources; Non-conventional energy resources-Biomass energy, Thermo-chemical conversion and biochemical conversion route; Solar energy-active and passive solar energy absorption systems; Type of collectors; Thermal and photo con-version applications.

Course Learning Outcomes (CLOs) /Course Objectives (COs): On completion of this course, the students will be able to:

1. comprehend the interdisciplinary context of environmental issues with reference to sustain-ability
2. assess the impact of anthropogenic activities on the various elements of environment and apply suitable techniques to mitigate their impact.
3. demonstrate the application of technology in real time assessment and control of pollutants.
4. correlate environmental concerns with the conventional energy sources associated and assess the uses and limitations of non-conventional energy technologies

Text Books:

1. Moaveni, S., Energy, Environment and Sustainability, Cengage (2018)
2. Rajagopalan, R., Environmental Studies, Oxford University Press (2018)
3. O'Callagan, P.W., Energy Management, McGraw Hill Book Co. Ltd. (1993).

Reference Books:

1. Peavy H.S., Rowe D.S., and Tchobanoglous, G. (2013) Environmental Engineering, McGraw Hill.
2. Rao, M.N. and Rao, H.V.N. (2014) Air Pollution, McGraw Hill.
3. Metcalf and Eddy. (2003) Wastewater Engineering: Treatment and Reuse, Fourth Edition, McGraw Hill.
4. Rai, G.D. (2014) Non-conventional Energy Resources, Khanna Publishers.

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

UMA004: Mathematics - II

L	T	P	Cr
3	1	0	3.5

Course Objectives: To introduce students the theory and concepts of differential equations, linear algebra, Laplace transformations and Fourier series which will equip them with adequate knowledge of mathematics to formulate and solve problems analytically.

Syllabus

Ordinary Differential Equations: Review of first order differential equations, Exact differential equations, Second and higher order differential equations, Solution techniques using one known solution, Cauchy - Euler equation, Method of undetermined coefficients, Variation of parameters method, Engineering applications of differential equations.

Laplace Transform: Definition and existence of Laplace transforms and its inverse, Properties of the Laplace transforms, Unit step function, Impulse function, Applications to solve initial and boundary value problems.

Fourier Series: Introduction, Fourier series on arbitrary intervals, Half range expansions, Applications of Fourier series to solve wave equation and heat equation.

Linear Algebra: Row reduced echelon form, Solution of system of linear equations, Matrix inversion, Linear spaces, Subspaces, Basis and dimension, Linear transformation and its matrix representation, Eigen-values, Eigen-vectors and Diagonalisation, Inner product spaces and Gram-Schmidt orthogonalisation process.

Course Learning Outcomes (CLOs) /Course Objectives (COs):On completion of this course, the students will be able to:

1. solve the differential equations of first and 2nd order and basic application problems described by these equations.
2. find the Laplace transformations and inverse Laplace transformations for various functions. Using the concept of Laplace transform students will be able to solve the initial value and boundary value problems.
3. find the Fourier series expansions of periodic functions and subsequently will be able to solve heat and wave equations.
4. solve systems of linear equations by using elementary row operations.
5. identify the vector spaces/subspaces and to compute their bases/orthonormal bases. Fur- ther, students will be able to express linear transformation in terms of matrix and find the eigenvalues and eigenvectors.

Text Books:

1. Simmons, G.F., Differential Equations (With Applications and Historical Notes), Tata Mc- Graw Hill (2009).
2. Krishnamurthy, V.K., Mainra, V.P. and Arora, J.L., An introduction to Linear Algebra, Affiliated East West Press (1976).

Reference Books:

1. Kreyszig Erwin, Advanced Engineering Mathematics, John Wiley (2006), 8th edition.
2. Jain, R.K. and Iyenger, S.R.K., Advanced Engineering Mathematics, Narosa Publishing House (2011), 4th edition.

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

Approved in 109 th meeting of the Senate held on March 16, 2023. Revised in 112 th meeting of the Senate held on March 11, 2024.

SEMESTER-III

UES034 : MEASUREMENT SCIENCE AND TECHNIQUES				
	L	T	P	Cr
	3	1	2	4.5

Course Objective: To introduce the basic concepts of instruments, errors, system characteristics, sensors, transducers, and signal conditioning.

Syllabus

Measuring Instruments: Functional elements of an Instrument, Active and Passive transducers, Analog and digital modes of operation, Null and Deflection Methods, Input-Output Configurations of Measuring Instruments and Instrument systems.

Error Analysis: Types of errors, Uncertainty analysis, Statistical analysis, Gaussian error distribution, Chi- Square test, Correlation coefficient, Student's t-test, Method of least square, Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves.

Static Characteristics: Calibration, Accuracy, Precision. Combination of errors, static sensitivity, Linearity, Threshold, Resolution, Hysteresis and dead space. Span.

Dynamic Characteristics: mathematical model of measurement system, Digital simulation methods for dynamic response analysis. Transfer Function, Zero order Instrument, First order Instrument, Step response, ramp response, frequency response, Impulse response of first and second order instruments. Dead Time elements, Logarithmic plotting of frequency- response curves, Response of general form of instrument to a periodic and transient input.

Sensors/Transducers: Basic principle and applications of Resistive, Inductive, Capacitive, Piezoelectric and their Dynamic performance, Hall-Effect, Photo emissive, Photo Diode/ Photo Transistor, Photovoltaic, LVDT, Strain Gauge.

Introduction of Signal Conditioning: Amplification, filtering, converting, range matching, isolation, linearization, attenuator, surge protection, excitation, AC coupling.

Laboratory Work: Experiments based on first order, second order and time parameters, measurement of signal, sensors and transducers.

Course Learning Objectives (CLO)

The students will be able to:

1. Explain the concepts of measurement and its analysis.
2. Exhibit the knowledge of error analysis in measurement.
3. Exhibit the knowledge of static and dynamic characteristics of various types of instruments.
4. Elucidate the working principle of various sensors, transducers and the concept of signal conditioning.

Text Books

1. Measurement systems, Doeblin, E.O., Tata McGraw Hill, 2017.
2. Nakra, B.C. and Chaudhry, K.K., Instrumentation Measurement and Analysis, Tata McGraw−Hill (2009) 3rd ed

Approved in 109 th meeting of the Senate held on March 16, 2023. Revised in 112 th meeting of the Senate held on March 11, 2024.

Reference Books

1. Transducers and Instrumentation, Murthy, D.V.S., Prentice Hall of India, 2nd edition, 2008.
2. A Course in Electrical and Electronic Measurements and Instrumentation, Sawhney, A.K. and Sawhney, P., Dhanpat Rai, 18th edition, 2008.
3. Mastering Internet of Things: Design and create your own IoT applications using Raspberry Pi, Peter Waher, Packit, 2018.

Evaluation Scheme	
Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

Approved in 109 th meeting of the Senate held on March 16, 2023. Revised in 112 th meeting of the Senate held on March 11, 2024.

UMA302 MATHEMATICS FOR SIGNALS				
	L	T	P	Cr
	3	1	0	3.5

Course Objective: To introduce the basic concepts and processing of analog and digital signals.

Syllabus

Introduction: Signals and Systems, Classification of signals, Continuous time signals and its classifications, Standard continuous time signals, Classification of continuous time systems, Discrete time signals and its classifications, Concept of frequency in discrete time signals, Standard discrete time signals, Discrete time systems, Classification of discrete time systems, Nyquist rate, Sampling theorem, Aliasing, Convolution, Correlation.

Fourier Transform: Introduction, Condition for existence of Fourier Integral, Fourier Transform and its properties, Energy density and Power Spectral Density, Nyquist Theorem, System Analysis using Fourier Transform.

Laplace Transform: Laplace and inverse transform of some common signals, Parseval's theorem, Application of Laplace Transform Properties on analog and digital signals, unilateral Laplace Transform. Analysis and characterization of LTI systems using Laplace transform: Computation of impulse response and transfer function using Laplace transform

Z-Transform: Introduction, Region of Convergence (ROC), Properties of z transform. Initial value theorem, Final Value theorem, Partial Sum, Parseval's Theorem, z transform of standard sequences, Inverse z transform, Pole Zero plot, System function of LTI system, Causality and Stability in terms of z transform.

Random Signals: Definitions, Random variables, distribution & density functions, mean values & moments, random processes, spectral densities, response of LTI systems to random inputs.

Laboratory Work (if applicable): Not applicable.

Course Learning Objectives (CLO)

The students will be able to:

1. Enlighten the concepts to analyse signals.
2. Apply Fourier transform for different applications.
3. Apply Laplace transform for different applications.
4. Apply z-transform transform for system characterization.
5. Elucidate the concepts of random signal.

Text Books

1. Signals and Systems, Oppenheim, A.V. and Willsky, A.S., Prentice Hall of India (1997).
2. Digital Signal Processing: Principles, Algorithms and Applications, Proakis, J.G. and Manolakis, D.G., Prentice Hall (2007).

Approved in 109 th meeting of the Senate held on March 16, 2023. Revised in 112 th meeting of the Senate held on March 11, 2024.

Reference Books

1. Signal Processing and Linear System, Lathi, B.P., Oxford University Press (2008).
2. Fundamentals of Signals and Systems, Roberts, M.J., McGraw Hill (2007).

Evaluation Scheme	
Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

Approved in 109 th meeting of the Senate held on March 16, 2023. Revised in 112 th meeting of the Senate held on March 11, 2024.

UEI408:Analog Devices & Circuits				
	L	T	P	Cr
	3	1	2	4.5

Course Objective: To enhance comprehension capabilities of students through understanding of analog electronic devices, BJT, FET and working of power supplies, amplifiers, oscillators and wave shaping circuits.

Syllabus

Bipolar Junction Transistors (BJT): CE configuration as two port network: h□parameters, h□parameter equivalent circuit. The Hybrid-pi (II) Common-emitter Transistor Model, Hybrid-II conductances, The Hybrid-II Capacitances, The CE short-circuit current gain, Current gain with resistive load, Single-stage CE transistor amplifier response, The gain-bandwidth product, Emitter follower at high frequencies.

Transistors Amplifier: Multistage Amplifier: Classification of amplifiers, Analysis of transistor amplifier using h – parameter, Frequency response of single stage RC coupled CE amplifier, Effect of an emitter Bypass capacitor on low-frequency response, Feedback Amplifiers: Classification of amplifiers, Positive and negative feedback, Effect of feedback on gain, input and output impedances.

Field-Effect Transistors (FET): Structure and working of JFET and MOSFET, output and transfer characteristics, FET as voltage variable resistor and MOSFET as a switch. Biasing the FET, The FET small signal model, the low-frequency common-source and common-drain amplifiers.

Oscillator Circuits: Condition for sustained oscillation, R-C phase shift, Wien Bridge, Hartley, Colpitts and Crystal Oscillators, Frequency stability, Multivibrators, High pass and low pass filters using R-C Circuits and R-L, R-L-C Circuits, Attenuators, Clamping Circuit theorem, Schmitt Trigger, Comparator.

Signal Conditioning: Operational Amplifiers: application in instrumentation, Charge amplifier, Carrier amplifier, Introduction to active filters, Classification, Butterworth, Chebyshev, Couir filters, First order, Second order and higher order filters, Voltage to frequency and frequency to voltage converters.

Laboratory Work: Transistor circuits using BJT and FET, oscillators, filters.

Course Learning Objectives (CLO)

The students will be able to:

1. Differentiate between different of diodes based on their working principle.
2. Elucidate the working principle of BJT and FET

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3. Analyse transistor amplifier using h-model and analyse the effect of feedback on amplifiers.
4. Design the oscillator circuit.
5. Elucidate the concept of active filters.

Text Books

1. Electronic Devices and Circuit Theory, Boylestad R. L., Pearson Education (2007) 9th ed.
2. Integrated Electronics, Millman, J. and Halkias, C.C., Tata McGraw Hill (2006).

Reference Books

1. Neamen, Donald A., Electronic Circuit Analysis and Design, McGraw Hill (2006) 3rd ed.
2. Sedra A. S. and Smith K. C., Microelectronic Circuits, Oxford University Press (2006) 5th ed.

Evaluation Scheme	
Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

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UEI301: DIGITAL ELECTRONICS				
	L	T	P	Cr
	3	1	2	4.5

Course Objective: To familiarize the student with the analysis and design of various digital systems.

Syllabus

Introduction: Difference between analog and digital systems, Advantages and Disadvantages of digital system. Binary codes: Weighted and non-weighted codes, Sequential codes, Self-complementing codes, Excess-3 code, Gray code, Error-detecting codes, Error-correcting codes, Hamming code.

Realization of Logic Gates Using Diodes & Transistors: AND, OR and NOT Gates using Diodes and Transistors, DCTL, RTL, DTL, TTL, CML and CMOS Logic Families and its Comparison, Classification of Integrated circuits, comparison of various logic families, standard TTL NAND GateAnalysis & characteristics, TTL open collector O/Ps, Tristate TTL, MOS & CMOS open drain and tristate outputs, CMOS transmission gate, IC interfacing- TTL driving CMOS & CMOS driving TTL.

Sequential Circuits: Basic Bistable element, Latches, SR latch, Application of SR latch, A Switch debouncer. The SR latch, The gated SR latch. The gated D Latch, The Master-Slave Flip-Flops (Pulse- Triggered Flip-Flops): The master-slave SR Flip-Flops, The master-slave JK Flip-Flop, Edge Triggered Flip-flop: The Positive Edge-Triggered D Flip-Flop, Negative-Edge Triggered D Flip-Flop. Characteristic equations, Registers, Counters-Binary Ripple Counter, Synchronous Binary counters, Counters based on Shift Registers, Design of a Synchronous counters, Design of a Synchronous Mod-N counters using clocked JK FlipFlops Design of a Synchronous Mod-N counter using clocked D, T, or SR Flip-Flops

Sequential Systems: Introduction, Mealy and Moore models, State machine notation, synchronous sequential circuit analysis and design. Construction of state Diagrams, Counters Design.

Asynchronous Sequential Logic: Analysis Procedure, Design procedure, reduction of state and flow table, race free state assignments, hazards, Design of Asynchronous sequential circuits.

Converters: Digital to Analog conversion, R-2R ladder DAC, Weighted Resistor DAC, Analog to Digital (A/D or ADC) conversion, Flash type, Counter type ADC, Dual-slope ADC, Successive approximation type ADC, sigma-delta ADC.

Memories: Memory Units, Memory Addressing, Introduction and classification of ROM, Static and Dynamic RAM, Flash memory, Memory Expansion, FIFO Memory, LIFO

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Memory.

Introduction to HDL: Introduction, A brief history of HDL, Structure of HDL Module, Operators, Data types, Types of Descriptions, Simulation and synthesis, Brief comparison of VHDL and Verilog. Data- Flow Descriptions: Highlights of Data flow descriptions, Structure of data-flow description, Data type- vectors.

Laboratory Work: To consider various important codes and the logic for converting from one to another, Understanding of ICs 74146, 7476, 7483, 7485, 7490, 7492, 7495, 74121, 74123, 74126, 74151, 74163, 74180, 74181, 74190, 74192, 74195, 74196, Shift register and binary counting using JK flip flop, asynchronous/synchronous up/down counters, Variable modulus counters, HDL and VHDL programming.

Course Learning Objectives (CLO)

The students will be able to:

1. Differentiate between different number systems and various codes
2. Design the asynchronous sequential Logic circuits
3. Exhibit the knowledge of different analog to digital converters, logic families and realization of logic gates
4. Elucidate the concept of counters and sequence generators memories and logic circuits

Text Books

1. Digital Fundamentals, Floyd, T.L. and Jain, R. P., Pearson Education (2008).
2. Digital Systems: Principles and Applications, Tocci, R. and Widmer, N., Pearson Education (2007).
3. HDL Programming (VHDL and Verilog), Nazeih M. Botros Cengage Learning 1 st Edition, 2011.

Reference Books

1. Digital Design, Mano, M. M. and Ciletti, M., Pearson Education (2008).
2. Fundamentals of Digital Circuits, Kumar, A., Prentice Hall (2007).
3. Digital Logic Design and VHDL, A.A.Phadke S.M.Deokar Wiley India 1st Edition, 2009
4. Digital Circuits and Design, D.P.Kothari, J.S.Dhillon, Pearson First Print 2015
5. Circuit Design and Simulation with VHDL, Volnei A Pedroni PHI 2nd Edition

Evaluation Scheme	
Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

Approved in 109 th meeting of the Senate held on March 16, 2023. Revised in 112 th meeting of the Senate held on March 11, 2024.

UTA024 : Engineering Design Project (Buggy)				
	L	T	P	Cr
	1	0	4	3.0

Course Objective: The project will introduce students to the challenge of electronic systems design & integration. The project is an example of 'hardware and software co-design' and the scale of the task is such that it will require teamwork as a co-ordinated effort.

Hardware overview of Arduino:

- Introduction to Arduino Board: Technical specifications, accessories and applications.
- Introduction to Eagle (PCB layout tool) software.

Sensors and selection criterion:

- Concepts of sensors, their technical specifications, selection criterion, working principle and applications such as IR sensors, ultrasonic sensors.

Active and passive components:

- Familiarization with hardware components, input and output devices, their technical specifications, selection criterion, working principle and applications such as-
  - Active and passive components: Transistor (MOSFET), diode (LED), LCD, potentiometer, capacitors, DC motor, Breadboard, general PCB etc.
  - Instruments: CRO, multimeter, Logic probe, solder iron, desolder iron
  - Serial communication: Concept of RS232 communication, Xbee
- Introduction of ATtiny microcontroller based PWM circuit programming.

Programming of Arduino:

- Introduction to Arduino: Setting up the programming environment and basic introduction to the Arduinomicro-controller
- Programming Concepts: Understanding and Using Variables, If-Else Statement, Comparison Operators and Conditions, For Loop Iteration, Arrays, Switch Case Statement and Using a Keyboard for Data Collection, While Statement, Using Buttons, Reading Analog and Digital Pins, Serial Port Communication, Introduction programming of different type of sensors and communication modules, DC Motors controlling.

Basics of C#:

- Introduction: MS.NET Framework Introduction, Visual Studio Overview and Installation
- Programming Basics: Console Programming, Variables and Expressions, Arithmetic Operators, Relational Operators, Logical Operators, Bitwise Operators, Assignment Operators, Expressions, Control Structures, Characters, Strings, String Input, serial port communication: Read and write data using serial port.
- Software code optimization, software version control.

Laboratory Work:

Schematic circuit drawing and PCB layout design on CAD tools, implementing hardware module of IR sensor, Transmitter and Receiver circuit on PCB.

Bronze Challenge: Single buggy around track twice in clockwise direction, under full

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supervisory control. Able to detect an obstacle. Parks safely. Able to communicate state of the track and buggy at each gantry stop to the console.

Silver Challenge: Two buggies, both one loop around, track in opposite directions under full supervisory, control. Able to detect an obstacle. Both park safely. Able to communicate state of the track and buggy at each gantry stop with console.

Gold Challenge: Same as silver but user must be able to enter the number of loops around the track beforehand to make the code generalized.

Course Learning Outcomes (CLO)

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

1. Recognize issues to be addressed in a combined hardware and software system design
2. Draw the schematic diagram of an electronic circuit and design its PCB layout using CAD Tools
3. Apply hands-on experience in electronic circuit implementation and its testing
4. Demonstrate programming skills by integrating coding, optimization and debugging for different challenges
5. Develop group working, including task sub-division and integration of individual contributions from the team.

Text Books

1. Michael McRoberts, Beginning Arduino, Technology in Action Publications, 2nd Edition.
2. Alan G. Smith, Introduction to Arduino: A piece of cake, Create Space Independent Publishing Platform (2011).

Reference Books

1. John Boxall, Arduino Workshop - a Hands-On Introduction with 65 Projects, No Starch Press; 1st edition (2013).

Evaluation Scheme	
Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

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UEI306: NETWORK ANALYSIS				
	L	T	P	Cr
	2	1	0	2.5

Course Objective: To make the students understand the concepts of graph theory, two port networks, filter design, attenuators, oscillator and network synthesis.

Graph Theory: Graph, Tree and link branches, Network matrices and their relations, Choice of linearly independent network variables, Topological equations for loop current and for nodal voltage, Duality.

Network Theorems: Superposition Theorem, Thevenin's theorem, Norton's theorem, and Maximum power transfer theorem as applied to A.C. circuits, Tellegen's theorem and their applications.

Two Port Networks: Two port network description in terms of open circuits impedance, Short circuit admittance, Hybrid and inverse hybrid, ABCD and inverse ABCD parameters, Inter-connection of two port network, Indefinites admittance matrix and its applications.

Network Functions: Concepts of complex frequency, Transform impedance, Networks function of one port and two port network, concepts of poles and zeros, property of driving point and transfer function.

Passive Network Synthesis: Introduction, Positive Real Functions: Definition, Necessary and sufficient conditions for a function to be positive real, Synthesis vs. analysis, Elements of circuit synthesis, Foster and Cauer forms of LC Networks, Synthesis of RC and RL networks.

Filters and Attenuators: Classification of filters, Analysis of a prototype low pass, High pass, Band pass, Band stop and M□derived filter, Attenuation, Types of attenuators: symmetrical and asymmetrical.

Active Filters: Introduction to Active filters, first and second order low pass Butterworth filter, First and second order high pass Butterworth filter, Band pass filter.

Course Learning Objectives (CLO)

After the completion of the course, the student will be able to:

1. Apply various laws and theorems to solve electric networks.
2. Analyse the behaviour of two port networks.
3. Apply graph theory concept to solve electrical networks
4. Realise one-port network parameters
5. Design different filter and attenuator configurations.

Text Books:

Approved in 109 th meeting of the Senate held on March 16, 2023. Revised in 112 th meeting of the Senate held on March 11, 2024.

1. Engineering Circuit Analysis, Hayt, W., Tata McGraw−Hill (2006).
2. Networks and Systems, Hussain, A., CBS Publications (2004).
3. Network Analysis, Valkenberg, Van, Prentice−Hall of India Private Limited (2007).
4. Op-Amps and Linear Integrated Circuits, Gayakwad, A. Prentice−Hall of India (2006).

Reference Books:

1. Circuit Theory, Chakarbarti,A., Dhanpat Rai and Co. (P) Ltd. (2006).
2. Networks and Systems, Roy Chowdhuary, D., New Age International (P) Limited, Publishers (2007).

Evaluation Scheme	
Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

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SEMESTER-IV

UEE410 : Data Structures and Algorithms				
	L	T	P	Cr
	3	0	2	4.0

Course Objective: To become familiar with different types of data structures and their applications and learn different types of algorithmic techniques and strategies.

Introduction and Overview: Basic Terminology, Elementary Data Organization, Data Structures, Control Structures, Asymptotic Notations for Algorithms, Big O notation: formal definition and use, Little o, big omega and big theta notation, Arithmetic Expressions, Polish Notations, Arrays, Records, Pointers, Storing Strings, String Operations, Pattern Matching Algorithms, Stacks, Queues, Recursion, Towers of Hanoi.

Searching and Sorting: Linear Arrays, Traversing and Searching in Linear Arrays, Inserting and Deleting, Bubble Sort, Linear Search, Binary Search, Insertion Sort, and Selection Sort.

Non-Linear Data Structures: Trees, Binary Trees, Traversing Binary Trees, Binary Search Trees, Searching and Inserting in Binary Search Trees, Deleting in a Binary Search Tree, Preorder, Postorder and Inorder Traversal, Heaps, Graph, Graph Algorithms, Breadth First Search, Depth First Search.

Linked List: Introduction, Insertion into a linked list, Deletion into a linked list. Stack, Queues, trees using linked list, Hashing, Hash Functions.

Laboratory work: Implementation of Arrays, Recursion, Stacks, Queues, Lists, Binary trees, Sorting techniques, Searching techniques. Implementation of all the algorithmic techniques.

Course Learning Outcomes (CLO)

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

1. Implement the basic data structures and solve problems using fundamental algorithms
2. Implement various search and sorting techniques
3. Analyze the complexity of algorithms, to provide justification for that selection, and to implement the algorithm in a particular context
4. Analyze, evaluate and choose appropriate data structure and algorithmic technique to solve real-world problems.

Text Books

1. Seymour Lipschutz Data Structures, TATA McGraw Hill (2016).
2. Corman, Leiserson&Rivest, Introduction to Algorithms, MIT Press (2009).
3. Narasimha Karumanchi, Data Structures and Algorithms Made Easy (2014).

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Reference Books

1. Sahni, Sartaj, Data Structures, Algorithms and Applications in C++, Universities Press (2005).

Evaluation Scheme	
Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

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UMA028: Mathematics for Data Science				
	L	T	P	Cr
	3	0	2	4.0

Course Objective: To introduce the student to the concept of Probability and Statistics that plays a vital role in computing and computational intelligence. Knowledge of these topics is critical to decision making and to the analysis of data. Using concepts of probability and statistics, individuals are able to predict the likelihood of an event occurring, organize and evaluate data.

Mathematical Foundations of Data Sciences: Matrices, Vectors, Vector Spaces, Matrix Decomposition, Singular Value Decomposition, Eigenvalues and vectors, Sets and classes, Limit of a sequence of sets, rings, sigma-rings, sigma fields, monotone classes.

Probability: Classical, relative frequency and axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Bayes' Theorem and independence, Random variable, some common discrete and continuous distributions (Binomial, Poisson, Negative binomial, Geometric, Rectangular, Exponential, Normal, Gamma).

Bi-variate Probability Distribution: Probability distribution of functions of a random variable, Joint and marginal distributions, Conditional distributions.

Correlation and Regression: Covariance, Karl-Pearson and rank Correlation coefficients; linear regression between two variables.

Estimation: Theory of Estimation, Properties of an estimator: Unbiasedness, consistency, Method of maximum likelihood, the method of moments, confidence intervals for parameters in one sample and two sample problems of normal populations, confidence intervals for proportions.

Hypothesis: Introduction to Sampling Distribution (standard normal, chi-square, T& F distributions), Critical regions, Neyman-Pearson lemma (without proofs).

Parametric & Non-parametric tests: Tests for Goodness of fit: Based on Chi-square Test, one sample and paired sample tests; Sign Test, Signed-rank Test, Kolmogorov Smirnov Test.

Data Processing: Regression, Dimensionality Reduction, Linear Discriminant Analysis Principal Component Analysis.

Laboratory Work: Lab work based on the programming in MATLAB/ Python /SPSS/R language of various statistical techniques.

Course Learning Outcomes (CLO)
After completion of this course, the students will be able to:

Approved in 109 th meeting of the Senate held on March 16, 2023. Revised in 112 th meeting of the Senate held on March 11, 2024.

1. compute probabilities of composite events along with an understanding of random
2. variables and distribution functions.
3. understand the convergence of sequence in probabilities
4. analyse the correlated data and fit the linear regression models
5. make statistical inferences using principles of hypothesis tests.

Text Books

1. Meyer P. L., Introduction to Probability and Statistical Applications, Oxford & IBH, (2007).
2. Hogg, R. V. and Craig, A.T., Introduction to Mathematical Statistics, Prentice Hall of India, (2004).
3. Ross, S.M., A First Course in Probability, 9th edition, Pearson (2012).
4. Peng, D., R., R Programming for Data Science, Lulu.com (2012).

Reference Books

1. Walpole, R. E., Myers, R. H., Myers, S. L. and Ye, K.,. Probability and statistics for engineers and scientists, Pearson, (2010).
2. Hestie Trevor, Tibshirani R., Friedman J., the elements of statistical learning, SpringerVerlag New York Inc., 2nd Ed., (2001).

Evaluation Scheme	
Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

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UEI403: ELECTRICAL AND ELECTRONIC MEASUREMENTS

L	T	P	Cr
3	1	2	4.5

Course Objective: To understand concepts of various electrical and electronic measuring instruments. To familiarize with different electromechanical and electronic instruments. To introduce instruments for power and energy measurements. To explain instrument transformers and magnetic measurements. To be able to measure different physical parameters with the help of AC bridges.

Syllabus

Electrical Standards: Types of standards, standards of E.M.F. and resistance, Frequency dependence of resistance, Inductance and Capacitance, Time and frequency standards.

Electromechanical Indicating Instruments: PMMC galvanometer, Ohmmeter, Electrodynamometer, Moving iron meter, Rectifier and thermo-instruments, Comparison of various types of indicating instruments.

Power and Energy Measurement: Electrodynamometer type of wattmeter and power factor meter, Power in poly phase system: two wattmeter method, Single-phase induction and Electronic energy meters.

Instrument Transformers: Current & Voltage transformers, Constructional features, Ratio & Phase angle errors.

Magnetic Measurements: Determination of B-H curve and hysteresis loop, Measurement of iron losses with Llyod Fisher square.

Bridge Measurements: AC bridges: Applications and conditions for balance, Maxwell's bridge, Hay's bridge, Schering Bridge, Wien's bridge, De Sauty's bridge, Anderson's Bridge, Insulation testing, Ground resistance measurement, Varley and Murray loop test.

Electronic Instruments: Electronic multimeter, Digital voltmeters, General characteristics ramp type voltmeter, Quantization error, Digital frequency meter/Timer, Q meter and its applications, Distortion meter, Wave meter and Spectrum Analyzer, Block diagram and Applications of oscilloscopes, Deflection sensitivity, Frequency measurement using Lissajous figures, Storage type digital oscilloscopes.

Laboratory Work: Experiments around sensitivity of wheat stone bridge, Comparison of various types of indicating instruments, Single-phase induction type energy meter, AC bridges, Measurement of iron losses with Llyod Fisher square, Storage type digital oscilloscopes.

Course Learning Objectives (CLO)

The students will be able to:

1. Exhibit the knowledge of working of different electromechanical indicating instruments.
2. Measure power and energy with the help of wattmeter and energy meter.
3. Exhibit the knowledge of working and applications of instrument transformers and magnetic measurements.
4. Elucidate the working and application of several AC bridges for inductance and capacitance.

Approved in 109 th meeting of the Senate held on March 16, 2023. Revised in 112 th meeting of the Senate held on March 11, 2024.

5. Exhibit the knowledge of working principle and applications of various electronic instruments.

Text Books

1 Electrical Measurements and Measuring Instruments, Golding, E.W., and Widdis, F.C., Pitman (2003).

2 Modern Electronic Instrumentation and Measurement Techniques, Helfrick, A.D., and Cooper, W.D., Prentice Hall of India (2007).

Reference Books

1. Electronic Instrumentation, Kalsi, H.S., Tata McGrawHill (2007).
2. Instrumentation Measurement and Analysis, Nakra, B.C., Chaudhry, K.K., Tata McGrawHill (2003).

Evaluation Scheme	
Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

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UEI501: CONTROL SYSTEMS

L	T	P	Cr
3	1	2	4.5

Course Objective: To understand concepts of the mathematical modelling, feedback control and stability analysis in Time and Frequency domains. The concept of time response and frequency response of the system will be studied.

Syllabus

Basic Concepts: Historical review, Definitions, Classification, Relative merits and demerits of open and closed loop systems, Linear and non-linear systems, Transfer function, Mathematical modelling of physical systems, Block diagrams and signal flow graphs.

Components: D.C. and A.C. Servomotors, D.C. and A.C. Tach generators, Potentiometers and optical encoders, Synchro and stepper motors

Analysis: Steady-state errors and error constants, Concepts and applications of P, PD, PI and PID types of control.

Stability: Definition, Routh-Hurwitz criterion, Root locus techniques, Nyquist criterion, Bode plots, Relative stability, Gain margin and phase margins.

Compensation: Lead, Lag and lag-lead compensators, Design of compensating networks for specified control system performance.

State Space Analysis: Concepts of state, State variables and state models, State space equations, Transfer function, Transfer model, State space representation of dynamic systems, State transition matrix, Decomposition of transfer function, Controllability and observability.

Laboratory Work: Linear system simulator, Compensation design, D.C. position control and speed control, Synchro characteristics, Servo demonstration, Stepper motor, Potentiometer error detector, Rate control system, Series control system, Temperature control system.

Course Learning Objectives (CLO)

The students will be able to:

1. Develop the transfer function of the physical systems.
2. Analyse the response of the closed and open loop systems.
3. Analyse the stability of the closed and open loop systems.
4. Design the various kinds of compensator.
5. Develop and analyse state space models.

Text Books

1. Digital Control System, Gopal, M., Wiley Eastern (1986).
2. Control System Engineering, Nagrath, I.J. and Gopal, M., New Age International (P) Limited, Publishers (2003).
3. Modern Control Engineering, Ogata, K., Prentice Hall of India Private Limited (2001).

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Reference Books

1. Automatic Control System, Kuo, B.C., Prentice Hall of India Private Limited (2002).
2. Control System, Sinha, N.K., New Age International (P) Limited, Publishers (2002).

Evaluation Scheme	
Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

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UTA018 : Object Oriented Programming				
	L	T	P	Cr
	3	0	2	4.0

Course Objective: To become familiar with object oriented programming concepts and be able to apply these concepts in solving diverse range of applications.

Object Oriented Programming with C++: Class declaration, creating objects, accessing objects members, nested member functions, memory allocation for class, objects, static data members and functions. Array of objects, dynamic memory allocation, pointer, nested class, functions, constructors and destructors, constructor overloading, copy constructors, operator overloading and type conversions.

Inheritance and Polymorphism: Single inheritance, multi-level inheritance, multiple inheritance, runtime polymorphism, virtual constructors and destructors.

File handling: Stream in C++, Files modes, File pointer and manipulators, type of files, accepting command line arguments.

Templates and Exception Handling: Use of templates, function templates, class templates, handling exceptions.

Introduction to Windows Programming in C++: Writing program for Windows, using COM in Windows Program, Windows Graphics, User Input.

Laboratory Work: To implement Programs for various kinds of programming constructs in C++ Language.

Course Learning Outcomes (CLO)

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

1. Write, compile and debug programs in C++, use different data types, operators and I/O function in a computer program
2. Comprehend the concepts of classes, objects and apply basics of object oriented programming, polymorphism and inheritance
3. Demonstrate use of file handling
4. Demonstrate use of templates and exception handling
5. Demonstrate use of windows programming concepts using C++.

Text Books

1. Balagurusamy, E., Object-Oriented Programming with C++, Mc Graw Hill, 8th Eds. (2020).
2. Lafore, R., Object Oriented Programming C++, Pearson, 4th Eds. (2008).

Reference Books

1. Rajaram, R., Object Oriented Programming and C++, New Age International Publishers, 2nd Eds. (2007).
2. Sahay, S., Object Oriented Programming in C++, Oxford University Press, 2nd Eds.

Approved in 109 th meeting of the Senate held on March 16, 2023. Revised in 112 th meeting of the Senate held on March 11, 2024.

(2012).

Evaluation Scheme	
Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

UMA035 : OPTIMIZATION TECHNIQUES				
	L	T	P	Cr
	3	0	2	4.0

Course Objective: The main objective of the course is to formulate mathematical models and to understand solution methods for real life optimal decision problems. The emphasis will be on basic study of linear and non-linear programming problems, Integer programming
problem, Transportation problem, Two person zero sum games with economic applications and project management techniques using CPM

Syllabus

Scope of Operations Research: Introduction to linear and non-linear programming formulation of different models.
Linear Programming: Geometry of linear programming, Graphical method, Linear programming (LP) in standard form, Solution of LP by simplex method, Exceptional cases in LP, Duality theory, Dual simplex method, Sensitivity analysis.
Integer Programming: Branch and bound technique, Gomory's Cutting plane method.
Network Models: Construction of networks, Network computations, Free Floats, Critical path method (CPM), optimal scheduling (crashing). Initial basic feasible solutions of balanced and unbalanced transportation problems, optimal solutions, assignment problem.
Multiobjective Programming: Introduction to multiobjective linear programming, efficient
solution, efficient frontier.
Nonlinear Programming:
Unconstrained Optimization: unimodal functions, Fibonacci search method, Steepest Descent method, Conjugate Gradient method.
Constrained Optimization: Concept of convexity and concavity, Maxima and minima of functions of n-variables, Lagrange multipliers, Karush-Kuhn-Tucker conditions for constrained optimization.

Laboratory Work: Lab experiments will be set in consonance with materials covered in the theory using Matlab.

Course Learning Objectives (CLO)
The students will be able to:

1. Formulate the linear and nonlinear programming problems.
2. Solve linear programming problems using Simplex method and its variants
3. Construct and optimize various network models.
4. Construct and classify multiobjective linear programming problems.
5. Solve nonlinear programming problems.

Text Books

Approved in 109 th meeting of the Senate held on March 16, 2023. Revised in 112 th meeting of the Senate held on March 11, 2024.

1. Numerical Optimization and Applications, Chandra, S., Jayadeva, Mehra, A., Narosa
   Publishing House,(2013).
2. Operations Research-An Introduction, Taha H.A., PHI(2007).

Reference Books

1. Introduction to optimization: Operations Research, Pant J. C., Jain Brothers(2004)
2. Linear Programming and Network flows, Bazaarra Mokhtar S., Jarvis John J. and ShiraliHanif D., John Wiley and Sons(1990)
3. Operations Research, Swarup, K., Gupta, P. K., Mammohan, , Sultan Chand & Sons, (2010).
4. Introductory Operations research, H.S. Kasana and K.D. Kumar, Springer publication, (2004).
5. Operations Research - Principles and Practice, Ravindran, D. T., Phillips and James J. Solberg, John Wiley & Sons, Second edn.(2005)

Evaluation Scheme	
Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

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