Course structure and syllabus 4th sem B.Tech-CE 3
Course structure and syllabus 4th sem B.Tech-CSE 23
Course structure and syllabus 4th sem B.Tech-ECE 33
Course structure and syllabus 4th sem B.Tech-FET 51
Course structure and syllabus 4th sem B.Tech-IE 75
Course structure and syllabus 4th sem B.Des 89
Common courses for 4th sem Mathematics (UM401) 105
Common courses for 4th sem HSS (Course UHS401) 107

Department of Civil Engineering
Draft Syllabus for 4th Semester

COURSE STRUCTURE

4th Semester / 2nd Year							
Name of the Programme		**B.Tech in Civil Engineering**					
Name of the Department		**Civil Engineering**					
A.		**Theory Courses**					
Sl No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	**Coordinating Department**
1	UHS401	Engineering Economics	3	0	0	3	HSS
2	UCE401	Surveying and Geomatics	3	0	0	3	CE
3	UCE402	Transportation Engineering-I	3	1	0	4	CE
4	UCE403	Geotechnical Engineering	3	1	0	4	CE
5	UCE404	Structural Analysis-I	3	1	0	4	CE
Total of A			**15**	**3**	**0**	**18**	
B.		**Laboratory/Project/Seminar Courses**					
Sl No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	**Coordinating Department**
1	UCE471	Surveying and Geomatics Lab	0	0	2	1	CE
2	UCE472	Geotechnical Engineering -I Lab	0	0	2	1	CE
Total of B			**0**	**0**	**4**	**2**	
C.		**Audit/Non-credit Courses**					
Sl No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	**Coordinating Department**
1	UCE405	Civil Engineering - Societal & Global Impact	2	0	0	0	CE
Total of C			**2**	**0**	**0**	**0**	
Grand Total (A+B+C)			**17**	**3**	**4**	**20**	

Course Code:	UHS401
Course Title:	Engineering Economics
Course Credit:	03
L-T-P:	3-0-0
Total contact hours:	40

Course objective:	• To introduce the fundamental concepts and principles of economics and their applications in engineering and management decisions. • To develop an understanding of consumer behaviour, utility, demand–supply mechanisms, production and cost analysis, profit estimation, and break-even analysis for effective decision-making. • To analyze different market structures, price–output determination, and key macroeconomic • To introduce the concepts such as national income, taxation, inflation, and banking. • To familiarize students with economic reforms and current situation in India—as well as international trade, global financial institutions, and capital markets.
Pre-requisites:	As this paper is introductory in nature, no prerequisite knowledge is required.
Course outcomes:	After completion of this course, students will be able to 1. Comprehend and apply the fundamental concepts and principles of economics in engineering and managerial decision-making. 2. Analyse consumer behaviour and producer behaviour, demand–supply dynamics, and production–cost relationships to support efficient resource utilization and planning. 3. Evaluate market structures and differentiate among various market forms. 4. Understand macroeconomic variables influencing business operations and national economic performance. 5. Assess the impact of economic reforms, international trade, and global financial institutions on the Indian and world economies. 6. Demonstrate awareness of the stock exchange and the regulatory roles of SEBI and IRDA.

Unit/ Module no.	**Topic**	**Nos. of contact hours**

1	**Key Economic Concepts**: Definition of Economics and concept of Engineering Economics. Consumer behaviour, Utility analysis and demand analysis, Types of Demand, Law of Demand, Concept of supply and Law of Supply, Elasticity of Demand and supply: Types and Measurement Concept of Production function and Revenue function, Cost Analysis, Profit and Break-Even Analysis.	12
2	**Market Forms**: Perfect and Imperfect markets, Features of Perfect competition, Monopoly and Monopolistic competition. Price and output determination under Perfect Competition, Monopoly, Monopolistic and Oligopoly market, etc.	10
3	**Key Macroeconomic Concepts**: National Income and various methods of measuring it, Source of Public Revenue-Tax Revenue and Non-Tax Revenue, Direct and Indirect Tax. Inflation and Deflation. Banking-Definition - Types of Banks and their various functions.	10
4	**Reforms and Regulatory Institutions and Global Financial Institutions**: Economic Reforms in India - Concept and Implications, Overview of the Current Indian Economic Scenario. Concept of Stock Exchange Market, Role of SEBI and IRDA. International Trade, Gains from International Trade, Role and Function of IMF, World Bank and WTO.	8

Textbooks:

1. Koutsoyiannis, A. (1993). Modern Microeconomics (3rdEd.). Macmillan Education
2. Salvatore, D. (2005). Principles of Microeconomics (5thEd.).Oxford University Press
3. Uma Kapila (ed.) (2024).Indian Economy since Independence: A Comprehensive and Critical Analysis of India's Economy, 1947- 2023. Academic Foundation
4. Mankiw, N. Gregory (2017). Macroeconomics (11thEd.). Macmillan Learning

Course Code:	UCE401
Course Title:	Surveying and Geomatics
Course Credit:	03
L-T-P:	3-0-0
Total contact hours:	36

Course objectives:	The course is designed to achieve the following objectives: • Apply the knowledge, techniques, skills, and applicable tools of the discipline to engineering and surveying activities • Translate the knowledge gained for the implementation of Civil infrastructure facilities • Relate the knowledge on Surveying to the new frontiers of science like Electronic Distance Measurement, Global Positioning System, Photogrammetry and Remote Sensing.
Pre-requisites:	Basic knowledge of engineering mathematics.
Course outcomes:	After completion of this course students will be able to: 1. Describe the function of surveying in civil engineering construction, Work with survey observations, and perform calculations. 2. Identify the sources of measurement errors and mistakes; understand the difference between accuracy and precision as it relates to distance, differential leveling, and angular measurements. 3. Operate an automatic level to perform various methods of levelling, operate a total station to measure distance, angles, and to calculate differences in elevation. Calculate, design and layout horizontal and vertical curves, Understand, interpret, and prepare plan, profile, and cross-section drawings. 4. To understand the importance and application of advanced surveying methods such as EDM, Photogrammetric surveying, Remote Sensing, GIS and GPS.

Module no.	**Topic**	**Nos. of contact hours**
1	**Introduction to Surveying**: Principles, Linear measurement, Survey stations, Survey lines; ranging, Bearing of survey lines, Levelling: Principles of levelling, booking and reducing levels; differential, reciprocal leveling, profile levelling and cross sectioning. Digital and Auto Level, Errors in levelling; Contouring; Characteristics, methods, uses; areas and volumes.	8

2	**Triangulation and Trilateration**: Theodolite survey: Instruments, Measurement of horizontal and vertical angle; Horizontal and vertical control, methods, triangulation, network, Signals. Baseline, choices, instruments and accessories, extension of base lines, corrections. Satellite station, reduction to center, Intervisibility of height and distances, Trigonometric leveling.	7
3	**Modern Field Survey Systems**: Principle of Electronic Distance Measurement, Total station; Parts of a Total Station, Accessories. Advantages and Applications, Field Procedure, Errors in Total Station Survey; Introduction to GPS; Segments, GPS measurements, errors and biases, Co-ordinate transformation, accuracy considerations. Introduction to GIS and UAV.	7
4	**Photogrammetry Surveying:** Introduction, Basic concepts, perspective geometry of aerial photograph, relief and tilt displacements, terrestrial photogrammetry, flight planning; Stereoscopy, ground control extension for photographic mapping- aerial triangulation, radial triangulation, methods; photographic mapping.	7
5	**Remote Sensing**: Introduction, Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation; digital image processing.	7

Textbooks:

1. Bhavikatti, S.S., Surveying and Levelling, Vol. I and II, I.K. International, 2010
2. Punmia, B.C., Surveying, Vol-I, II and III, Laxmi Publications, 2016.
3. Madhu, N, Sathikumar, R and Satheesh Gobi, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson India, 2006.
4. Anji Reddy, M., Remote sensing and Geographical information system, B.S. Publications, 2001.

References:

1. J.V. Sickle, GPS for Land Surveyors, CRC Press, 2008
2. G. Joseph, Fundamentals of Remote Sensing, Universities Press, 2003
3. R.C. Brinker and R. Minnick, The Surveying Handbook, Springer Science+ Business Media, B.V., 1995
4. Garg, P.K., Principles and Theory of Geoinformatics, Khanna Publishing House, 2019.
5. T.M. Lillesand, and R.W. Kiefer, Remote Sensing and Image Interpretation, John Wiley & Sons, 1994
6. E.M. Mikhail and J.M. Anderson, Surveying: Theory and Practice, McGraw Hill, 2013
7. Manoj, K. Arora and Badjatia, Geomatics Engineering, Nem Chand & Bros, 2011.
8. Chandra, A.M., Higher Surveying, Third Edition, New Age International (P) Limited, 2002.

Course Code:	UCE402
Course Title:	Transportation Engineering-I
Course Credit:	03
L-T-P:	3-0-0
Total Contact Hour:	36

Course objective:	The course is designed to achieve the following objectives: • To learn the principles of highway planning and development for efficient road networks. • To understand and apply the concepts of geometric design for safe and smooth traffic flow. • To identify, test, and utilize various highway construction materials. • To design both flexible and rigid pavements. • To learn about maintenance of highways
Pre-requisites:	Basic concepts of force, equilibrium, and simple stresses. Basic knowledge of rocks, soils, and geological formations. Fundamentals of levelling, traversing, and contouring.
Course outcomes:	After completion of this course students will be able to: 1. Carry out surveys required for highway alignment 2. Design the geometric elements of highways 3. Implement various highway maintenance measures 4. Characterize pavement materials 5. Design flexible and rigid pavements as per IRC

Module no.	**Topic**	**Nos. of contact hours**
1.	**Highway Development and Planning:** Different modes of transportation, Characteristics of Road transportation, Highway development in world and India, Classification of Roads, Network patterns. Highway alignment –requirements and controlling factors. Engineering surveys for alignment. Typical cross sections of Urban and Rural roads -cross sectional elements. Introduction to IRC code and MORTH guidelines.	6
2.	**Highway Geometric Design:** Factors affecting geometric design. Sight distance -stopping sight distance, overtaking sight distance, sight distance at intersections. Design of horizontal alignment -super elevation,	10

	widening of pavements, transition curves, Set back distance, Curve resistance. Design of vertical alignment -gradients, Grade compensation, summit and valley curves. Accessibility to Differently Abled Publics.	
3.	**Highway Materials:** Desirable properties, various tests and specifications of subgrade soil, road aggregates and bituminous materials. Marshall Mix Design.	4
4.	**Pavement Design:** Pavement components and their functions -Factors influencing the design of pavements -Design principles -Design of flexible and rigid pavements as per IRC.	8
5.	**Pavement Construction:** Construction of gravel, WBM, bituminous and cement concrete roads. Pavement failures -Types and causes of failures in flexible and rigid pavements.	4
6.	**Pavement Maintenance:** Maintenance of highway pavements, Highway drainage, road side development and arboriculture	4

Textbooks:

1. Veeraragavan. A, Khanna. K and Justo. C.E.G. Highway Engineering, Nem Chand & Bros Publishers.
2. Sharma. S. K Principles, Practices and Design of Highway Engineering, S. Chand and Company Ltd.

References:

1. Partha Chakroborty and Animesh Das Principles of Transportation Engineering, PHI Learning Pvt. Ltd.
2. Kadiyali. L. R. Principles and Practice of Highway Engineering, Khanna Technical Publications, Delhi.
3. Indian Road Congress (IRC), Guidelines and Special Publications on Planning and Design of Highways.
4. R. Srinivasa Kumar., Textbook of Highway Engineering, Universities Press (India).
5. Subhash C Saxena, Textbook of Highway and Traffic Engineering. CBS Publishers.
6. C. Venkatramaiah., Transportation Engineering-Highway Engineering, Universities Press
7. IRC 037: Guidelines for the Design of Flexible Pavements
8. IRC 058: Guidelines for the Design of Rigid Pavements

Course Code:	UCE403
Course Title:	Geotechnical Engineering
Course Credit:	04
L-T-P:	3-1-0
Total contact hours:	48

Course objectives:	The course is designed to achieve the following objectives: • Understanding the Basic Soil Properties and Classification a. Learn about different types of soils. b. Study physical and engineering properties of soil (e.g., texture, density, moisture content, Atterberg limits). c. Classify soil based on grain size and plasticity. • Basics of Soil Mechanics a. Understand the principles of effective stress. b. Learn about permeability, seepage, and flow through soil. • Soil Compaction and Consolidation a. Understand the process of compaction and its importance in construction. b. Study the settlement behaviour of soil due to consolidation.
Pre-requisites:	Basics of Mechanics of Materials and fluid mechanics
Course outcomes:	After completion of this course students will be able to: 1. Understand and apply soil classification. 2. Analyze physical properties through laboratory tests. 3. Evaluate permeability, compaction, and shear strength through lab and field tests. 4. Interpret results to assess soil behavior under various loading conditions. 5. Analyze seepage and flow through soil. 6. Calculate vertical stress due to surface loads and Analyze time rate and magnitude of settlement using consolidation theory.

Module no.	Topic	Nos. of contact hours
1	**Introduction:** Historical development of soil engineering, Origin and types of soil, regional soil deposits of India, fields of geotechnical engineering.	**6**
2	**Elementary Properties:** Identification and classification of soils, phase relationship, index properties, consistency, sensitivity, clay mineralogy.	**6**
3	**Compaction:** Principle of compaction, Light and heavy compaction, field compaction control, factors affecting compaction.	**6**
4	**Effective stress, capillarity and Permeability:** Principle and physical meaning of effective stress, soil-water capillary phenomena, Darcy's law of permeability, determination of Co-efficient of permeability, Equivalent permeability for stratified soil, seepage force, downward flow, upward flow and quick sand condition.	**6**
5	**Seepage through soil:** Two-dimensional flow-Laplace's Equation, Flow nets – principles, confined flow, unconfined flow, Determination of pore water pressure, piping and exit gradient.	**8**
6	**Compressibility and Consolidation of soil:** Compressibility, Terzaghi's theory of one-dimensional consolidation, Secondary Consolidation, estimation of consolidation settlement.	**8**
7	**Shear strength of soils:** Mohr Circle of stress, mechanism of shear resistance, Mohr-Coulomb failure criterion, measurement of shear strength, shear strength of clay and sand, drainage conditions and strength parameters.	**8**

Textbooks:

1. Basic and Applied Soil Mechanics by Gopal Ranjan & Rao, New Age International Publishers.
2. Geotechnical Engineering by SK Gulhati & M Dutta, Tata McGraw-Hill Publishers.
3. Soil Mechanics by Whitman & Lambe, John Willey.
4. Soil Mechanics and Foundation by B.C. Punmia, Ashok Kr. Jain & Arun Kr. Jain.

References:

1. Introduction to Soil Mechanics by BM Das, Galgotia Publication.
2. Soil Mechanics by Whitman &Lambe, John Willey.
3. Soil Mechanics & Foundation Engg by VNS Murthy, Dhanpat Rai & Sons.

Course Code:	UCE404
Course Title:	Structural Analysis-I
Course Credit:	4 (L: 3 T: 1 P: 0)
L-T-P	3-1-0
Total Contact hours	48

Course objective:	The objective of this course is to impart knowledge on: • To introduce the fundamental concepts of structural systems, types of structures, and conditions of equilibrium. • To enable students to analyze determinate structures and calculate reactions, internal forces, slopes, and deflections. • To develop understanding of energy principles and the application of strain energy and virtual work methods. • To impart knowledge on the analysis of pin-jointed trusses, arches, and cables using analytical and graphical methods. • To familiarize students with influence lines and their applications in analyzing statically determinate structures subjected to moving loads.
Pre-requisites:	Basic knowledge of Strength of Materials
Course outcomes:	After completion of this course students will be able to 1. Classify different structural systems and determine support reactions and internal forces in determinate structures. 2. Compute slope and deflection in beams using double integration, moment-area, and conjugate beam methods. 3. Apply strain energy and Castigliano's theorem for determining deflection and redundant forces. 4. Analyze trusses, arches, and cables under various loading conditions, including statically determinate cases.

Module no.	Topic	Nos. of contact hours
1	**Introduction to Structural analysis:** Forms of structures, Loads and Forces, Free body diagram, conditions of equilibrium of forces, support and connections – reactions, Difference between determinate and indeterminate structures.	4

2	**Deflection of statically determinate structures:** Computation of slope and deflection by double integration, moment area method, conjugate beam method, applications to simply supported, overhang and cantilever beams.	11
3	**Strain Energy and Virtual work:** Strain energy for axial force, bending, shear and torsion. Castigliano's theorems and their applications to find deflection and redundant forces in simple cases.	09
4	**Analysis of Pin-Jointed Structure:** Method of joints and sections, Graphical method, Deflection of joints, Truss with single redundancy, Maxwell's reciprocal theorem, Betti's theorem and their applications.	11
5	**Arches, cables & Influence lines for statically determinate structures:** Three hinge and Two hinge arch. Cables, Three hinge stiffening Girder. Normal thrust, shear force and bending moment for segmental three hinged arches. Influence lines for cantilever beam, simply supported beam, overhanging beam and pin jointed trusses. Criteria for maximum shear force and bending moment under moving loads for simply supported beams, absolute maximum bending moment.	13

Textbooks:

1. S.S. Bhavikatti, Structural Analysis Volume – I, Vikas Publishers, 3rd edition, 2011. (ISBN: 9788125942696/8125942696).
2. D. Menon, Structural Analysis Volume – I and II Narosa Publication, 2010. (ISBN- 978-1842653371/1842653377).
3. C.S. Reddy, Basic Structural Analysis, Publisher: Tata McGraw Hill, 2010. (ISBN-1283187140/978-1283187145).

References

1. C.K. Wang, Intermediate Structural Analysis, McGraw Hill, 1984. (ISBN-10:0070666237/978-0070666238).
2. B.G. Neal, Structural theorems and their application, Pergaman Press, 1972. (ISBN:978-1483139029).
3. S. Timoshenko and Young, Theory of Structures, Publisher: Tata McGraw Hill, 1965. (ISBN-9780070648685/978-0070648685).
4. Norries and Wilbur, Elementary Structural Analysis, Publisher: McGraw Hill, 1990. (ISBN-0071008365/978-0071008365).
5. H I Laursen, Structural Analysis, Publisher: McGraw Hill, 1988. (ISBN-0070366454/978-0070366459).

6. B.N. Thadani and J.P. Desai, Modern Methods in structural Analysis, Weinall Book Corporation, 1998. (ISBN-021026957X/978-0210269572)
7. Pandit and Gupta, Matrix Method in Structural Analysis, Tata McGraw Hill, 2008. (ISBN-0070667357/978-0070667358)
8. L.S. Negi and R.S. Jangid, Structural Analysis, Tata McGraw Hill, 2008.
9. Gupta and Pandit, Structural Analysis Vol. I & II, Tata McGraw Hill,2008. (ISBN-0070667357/978-0070667358)
10. Gare and Weaver, Analysis of Framed Structure, CBS Publication, 2nd Edition, 2004. (ISBN:978- 8123911519/8123911513).

Laboratory Courses

Course Code:	UCE471
Course Title:	Surveying and Geomatics Lab
Course Credit:	01
L-T-P:	0-0-2
Total Contact Hour:	24

Course objective:	The objectives of this course are: • To understand the concept of plane and geodetic surveying to understand maps. • To understand meridian, bearing and traverse using compass. • To understand levelling and apply different methods of levelling. • To learn total station and its uses in different surveying applications and to understand and lay out curves.
Pre-requisites:	Basic theoretical knowledge of Surveying
Course outcomes:	After completion of this course students will be able to: 1. Understand the concept of surveying and apply suitable methods to carry out surveying works. 2. Use a compass and establish traverse for mapping. 3. Carry out different methods (differential leveling, reciprocal leveling, profile leveling and cross-sectioning) of leveling using automatic level. 4. Use a total station for mapping. 5. Lay out a simple circular curve.

Module no.	**Topic**	**Nos. of contact hours**
1	Compass surveying: Finding included angles and local attraction of a traverse.	24
2	Levelling: Measuring elevation differences between points by different methods.	
3	Profile levelling and cross-sectioning using automatic level	
4	Total Station survey and computation.	
5	Digital mapping and processing.	
6	Contour map of a given area.	
7	Digital land surveying and mapping.	

8	Layout of simple circular curve	
9	GPS surveying	
10	DGPS Surveying	

Textbooks:

1. Bhavikatti, S.S., Surveying and Levelling, Vol. I and II, I.K. International, 2010
2. Garg, P.K., Principles and Theory of Geoinformatics, Khanna Publishing House, 2019.
3. Chandra, A.M., Higher Surveying, Third Edition, New Age International (P) Limited, 2002.

References:

1. Arora, K.R., Surveying, Vol-I, II and III, Standard Book House, 2015.
2. Punmia, B.C., Surveying, Vol-I, II and III, Laxmi Publications, 2016.
3. Madhu, N, Sathikumar, R and Satheesh Gobi, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson India, 2006.
4. Anji Reddy, M., Remote sensing and Geographical information system, B.S. Publications, 2001.
5. Manoj, K. Arora and Badjatia, Geomatics Engineering, Nem Chand & Bros, 2011.

Course Code:	UCE472
Course Title:	Geotechnical Engineering Lab
Course Credit:	01
L-T-P:	0-0-2
Total Contact Hours:	24

Course objectives:	Objectives of the Geotechnical Engineering Laboratory are to provide: • Hands-on experience in evaluating the physical properties of soil and • Practical experience in applying theoretical concepts from geotechnical engineering to real-world problems.
Pre-requisites:	Basic theoretical knowledge of Geotechnical Engineering
Course outcomes:	After completion of this course students will be able to: 1. Classify soils using systems like the Unified Soil Classification System (USCS) or AASHTO classification based on test data. 2. Experimentally determine important soil properties. 3. Familiar with the use, calibration, and maintenance of geotechnical testing equipment. 4. Develop competency in collecting, recording, analyzing, and presenting geotechnical data in technical reports.

Module no.	**Topic**	**Nos. of contact hours**
1	Determination of moisture content (by oven drying) and specific gravity of soil.	**24**
2	Particle size analysis of soil using dry and wet sieving.	
3	Particle size analysis soil using hydrometer.	
4	Determination of relative density of sand.	

5	Determination of filed density using and core cutter method.	
6	Determination of filed density using sand replacement.	
7	Determination of MDD and OMC using Standard Proctor Test.	
8	Determination of MDD and OMC using Modified Proctor Test.	
9	Determination of coefficient of permeability using constant head and falling head test.	
10	Determination of shear parameters using direct shear test.	
11	Determination of shear parameters using unconfined compression test.	
12	Determination of consolidation parameters of soil using Consolidometer test.	

Textbooks:

1. Basic and Applied Soil Mechanics by Gopal Ranjan & Rao, New Age International Publishers.
2. Geotechnical Engineering by SK Gulhati & M Dutta, Tata McGraw-Hill Publishers.

References:

1. Geotechnical testing Lab manual, Indian Institute of Technology Gandhinagar, https://research.iitgn.ac.in/stl/wp/labmanual/

Audit Course

Course Code:	UCE405
Course Title:	Civil Engineering-Societal & Global Impact
Course Credit:	0
L-T-P:	2-0-0
Total Contact Hours:	24

Course objective:	The objective of this course is to impart: • awareness on the importance of civil engineering and the impacts it has on society and at global levels • awareness on the impacts of civil Engineering in the various specific fields of human endeavour • the ability to think innovatively to ensure sustainability
Pre-requisites:	Basic knowledge of environmental science
Course outcomes:	After completion of this course students will be able to understand 1. the impact of civil engineering projects on society, 2. the extent of infrastructure, its requirements, and how they are met: past, present and future, 3. the sustainability of the environment

Module no.	Topic	Nos. of contact hours
1	**Introduction: understanding the past to look into the future :** Overview of civil engineering and roles of civil engineers; Present-day world and future projections, Ecosystems in society and nature; Erosion in sustainability; Global warming, its impact; Evaluating future requirements for various resources; Applications of GIS.	6
2	**Infrastructure - Traditional & futuristic methods:** Habitats, Megacities, Smart Cities, futuristic visions, Transportation; Electric energy generation; Water provisioning; Telecommunication needs; Solid waste management, Water purification, Wastewater treatment & Recycling, Hazardous waste treatment; Flood control structures, multi-purpose water projects; Codes & Standards.	6

3	**Built environment:** Facilities management; Energy efficient and sustainable built environments, Recycling, Intelligent/Smart Buildings; Aesthetics of built environment; Conservation, Repairs & Rehabilitation of Structures & Heritage structures; Innovations and methodologies for ensuring Sustainability.	6
4	**Civil Engineering Projects:** Environmental Impact Analysis procedures; Project appraisal to stakeholders; Forest and Environmental clearance; Wastage avoidance; Increasing efficiency in project implementation; Advanced construction techniques for better sustainability; New project management paradigms & Systems, Contributions to employment generation and GDP, Quality; Safety, Health & Environment.	6

Textbooks:

1. Prithaliya, R.P., Prithaliya, M.R., (2020), Civil Engineering-Societal And Global Impact, 1st ed., Atul Prakashan, ASIN: B0848NPZGJ.
2. Kumar, A., Kumar, S., Suman S.K. (2024), Civil Engineering-Societal And Global Impact, 1st ed., Rook Rivers, ISBN: 9789358428209, 260 pages.

References:

1. Acharya, S. (2023), Civil Engineering-Societal And Global Impact, All India Council of Technical Education, ISBN: 978-81-963773-7-3, (PDF) Civil Engineering- Societal & Global Impact
2. *Žiga* Turk (2014), Global Challenges and the Role of Civil Engineering, Chapter 3 in: Fischinger M. (eds)
3. Brito, Ciampi, Vasconcelos, Amarol, Barros (2013) Engineering impacting Social, Economical and Working Environment, 120th ASEE Annual Conference and Exposition
4. Ashley R M., Nowell R., Gersonius B., Walker L. (2011). Surface Water Management and Urban Green Infrastructure. Review of Current Knowledge. Foundation for Water Research FR/R0014; RoCK-FR-R0014-Surface-Water-Management.pdf
5. Centre for Water Sensitive Cities (2012) Blueprint for a water sensitive city. Monash University.
6. Sustainable Building Design Manual – Volume II, The Energy Research Institute, New Delhi, 2004.
7. Sustainable Construction: Green Building Design and Delivery. C. J. Kibert. John Wiley & Sons, 2013.
8. Sustainable Construction. Sandy Halliday, Routledge, Taylor & Francis Group, 2013.
9. A Handbook of Sustainable Building Design and Engineering. Dejan Mumovic and Mat Santamouris (Ed), Earthscan Publishing, 2009.
10. Green Architecture: Advanced Technologies and Materials. Osman Attmann, McGraw Hill, 2010.

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Dept. of CSE, UG, New Syllabus

Semester IV

Sl. No	Code No.	Course Title	L	T	P	Credits
1.	UMA4XX	Discrete Mathematics	3	0	0	3
2.	UCS401	Computer Organization & Architecture	3	0	0	3
3.	UCS471	Computer Organization & Architecture -Lab	0	0	2	1
4.	UCS402	Design & Analysis of Algorithms	3	1	0	4
5.	UCS472	Design & Analysis of Algorithms - Lab	0	0	4	2
6.	UCS403	Advanced Programming using Java	3	0	0	3
7.	UCS473	Advanced Programming using Java Lab	0	0	2	1
8.	UHS4XX	Engineering Economics	3	0	0	3
		Total				20
MINOR						
1	**UCS4M1**	Introduction to AI, Machine Learning & Data Analytics	4	1	0	5
2	**UCS4ML1**	Introduction to AI, Machine Learning & Data Analytics Lab	0	0	4	2

Course Code	Course Title	L	T	P	C
UMA4XX	Discrete Mathematics	3	0	0	3

Contents to be updated from Mathematics department

Course Code	Course Title	L	T	P	C
UCS401	Computer Organization & Architecture	3	0	0	3

Total Contact Hours: 30

Prerequisites: UECE306: Digital Electronics and Logic Design

Module –I: Introduction (5L)
Generations of computers, Stored programmed Architecture, Basic Components and their interconnection in a computer System, different abstraction levels of computation from problem definition to circuit level implementation, review of digital circuits and digital components.

Module-II: Arithmetic (8L)
Data representation – signed bit, 2's complement, fixed point and floating-point representation (single precision and double precision), different arithmetic algorithms – signed multiplication, restoring and non-restoring division, systolic array multiplication, floating point arithmetic algorithms basic ALU organization.

Module III: CPU Design (6L)
Instruction Set Architecture (ISA): Von Neumann vs. Data Flow. Instruction set, Instruction format, Instruction mode: ISA design trade off, addressing modes, Register Transfer Language and micro operation, design of control unit: microprogrammed and hardwired control unit.

Module IV: Memory (6L)
Memory hierarchy, design of semiconductor memories – SRAM, DRAM, different ROMs, Cache memory – cache mapping techniques, cache replacement algorithms, virtual memory, optical disk – data read/write techniques, magnetic disk -read/write techniques.

Module V: I/O (5L)
Programmed I/O, Concept of handshaking, Polled and Interrupt driven I/O, DMA data transfer; I/O subsystems: I/O interfacing

Module VI: Pipelining and Parallelism (5L)
Basic concepts of pipelining, speedup computation, different pipelining – arithmetic, instruction, stalls in pipelining, remedy from stall, introduction to parallel Processing.

Text Books:

1. M. M. Mano, "Computer System Architecture", Pearson, 3rd Ed., 2007.
2. Stallings, "Computer Organization & Architecture", 8th Ed., Pearson Education, 2009.
3. Hamacher, Zaky, Vranesic, "Computer Organization", TMG, 5th Ed., 2011.

Reference Books:

1. Hennessey and Patterson, "Computer Architecture: A quantitative Approach", 5th Ed., Morgan Kaufman Publication, 2012.

Course Code	Course Title	L	T	P	C
UCS471	Computer Organization & Architecture - Lab	0	0	2	1

HDL: Verilog/VHDL

List of experiments:

1. Realization of basic digital circuits: Half adder, Full Adder, Ripple Carry Adder, Adder/Subtractor, Multiplexer/Demultiplexer.
2. Complex Arithmetic Units: Carry Lookahead Adder, Unsigned Multiplication, Signed Multiplication, Systolic Array Multiplication, Division
3. Realization of Logic Units: 16 bits greater than, 16 bits less than, 16 bit equals to
4. Development of a 16-bit ALU

Books:

The Verilog® Hardware Description Language 5th Edition by Donald E. Thomas , Philip R. Moorby

Course Code	Course Title	L	T	P	C
UCS402	Design & Analysis of Algorithms	3	1	0	4

Prerequisites:

UCSE201 Programming for Problem Solving and UCSE301 Data Structures and Algorithms

Detailed Syllabus:

Module 1: Introduction [3L]:
Introduction to the RAM machine of computers, asymptotic notations and their mathematical importance, Time and Space Complexity, best, average and worst case. Introduction to the algorithm paradigms – recursion, divide and conquer, greedy, dynamic programming etc.

Module 2: [3L] Recursion:
Definition, time and space complexity evaluation of different recursive algorithms – factorial, tower of Hanoi etc.

Module 3: [5L] Divide and Conquer:
Basic idea, design and complexity evaluations of different algorithms – binary search, merge sort, quick sort etc.

Module 4: [5L] Greedy Method:
Basic idea, design and complexity evaluations of different algorithms- knapsack problem (fractional), Minimum Spanning Tree etc.

Module 5: [5L] Dynamic Programming:
Basic idea, design and complexity evaluations of different algorithms- Rod cutting problem, matrix chain multiplication etc.

Module 6: [4L] Branch and Bound and Backtracking:
Basic concepts, concepts of lower bound, Traveling Salesperson problem, 8 queens' problem etc.

Module 7: [4L] Graph:
Definition, Graph traversal algorithms – BFS and DFS, graph colouring algorithm, Hamiltonian path and cycle, Shortest path algorithm.

Module 8: [5L] NP completeness:
Basic concepts of reduction, reduction problems – Hamiltonian path to Hamiltonian Cycle and vice versa, classes – P, NP, NP hard, NP Complete, SAT problem, Cook's Theorem and applications

Text Book:

1. Introduction to Algorithms, by Cormen, Leiserson, Rivest, and Stein, MIT Press, Third Edition, 2009. 2. A. Aho, J.Hopcroft and J.Ullman "The Design and Analysis of Algorithms"

Reference Books:

1. Computer Algorithms, by Horowitz, Sahni, and Rajasekaran, Silicon Press, 2007.

2. Design And Analysis Of Algorithms 2nd Edition by Dave and Himanshu, Pearson India,2013.

Course Code	Course Title	L	T	P	C
UCS472	Design & Analysis of Algorithms lab	0	0	4	2

Lab Experiments:

 # 1: Recursion: factorial, tower of Hanoi etc.

#2: Divide and Conquer: binary search, merge sort, quick sort etc.

#3: Greedy Method: knapsack problem (fractional), Minimum Spanning Tree etc.

#4: Dynamic Programming: Rod cutting problem, matrix chain multiplication etc.

#5: Branch and Bound and Backtracking: Traveling Salesperson problem, 8 queens' problem etc.

#6: Graph: BFS and DFS, graph colouring Shortest path.

Course Code	Course Title	L	T	P	C
UCS403	Advanced Programming using Java	3	0	0	3

Module 1 – Object-Oriented Concepts in Java **Contact hours: 10**

- Features of Java, JVM architecture, and JDK structure.
- Review of OOP concepts (Encapsulation, Inheritance, Polymorphism, Abstraction).
- Classes, objects, constructors, method overloading, this and static.
- Nested classes, inner classes, and anonymous inner classes.
- Abstract classes and interfaces.

Module 2 – Advanced Language Features **Contact hours: 8**

- Packages and access control modifiers.
- Generics and type parameters.
- Collections Framework: List, Set, Map, and iteration techniques.
- Lambda expressions and Functional Interfaces.
- Stream API (map, filter, reduce operations).

Module 3 – Exception Handling and Multithreading **Contact hours: 8**

- Exception hierarchy, checked vs. unchecked exceptions.
- Use of try, catch, throw, throws, and finally.
- Custom exceptions.
- Thread creation using Thread and Runnable.
- Thread lifecycle, synchronization, inter-thread communication, and deadlock.
- Executor framework and thread pools (intro).

Module 4 – File and I/O Programming **Contact hours: 5**

Streams: byte and character streams.

- Classes: FileInputStream, FileOutputStream, FileReader, FileWriter, BufferedReader.
- Serialization and deserialization.

Module 5 – GUI and Event-Driven Programming **Contact hours: 7**

AWT and Swing components, containers, layout managers.

- Event handling model, listeners, and adapters.
- JavaFX basics

Module 6 – Database and Network Programming **Contact hours: 7**

JDBC architecture and drivers.

- Connecting to databases (MySQL/PostgreSQL).
- Executing queries and handling ResultSet.
- Network programming: TCP and UDP sockets, URL, and HttpURLConnection.
- Building a simple client–server chat or database application.

Books/References

1. Herbert Schildt, Java: The Complete Reference, McGraw-Hill.
2. E. Balagurusamy, Programming with Java – A Primer, McGraw-Hill.
3. Joshua Bloch, Effective Java, Addison-Wesley.
4. Cay S. Horstmann, Core Java Volume I & II, Pearson Education.
5. Bruce Eckel, Thinking in Java, Pearson.
6. Kathy Sierra & Bert Bates, Head First Java, O'Reilly.

Course Code	Course Title	L	T	P	C
UCS473	Advanced Programming using Java Lab	0	0	2	2

Unit 1: Object-Oriented Programming in Java

1. Write Java programs to demonstrate class, object, constructor, and method overloading.
2. Implement inheritance (single, multilevel) and method overriding.
3. Demonstrate the use of abstract classes and interfaces.
4. Implement inner classes and anonymous inner classes.

Unit 2: Advanced Language Features

5. Implement programs using Generics (generic class, generic method).
6. Demonstrate the use of Collections Framework – ArrayList, HashSet, HashMap.
7. Implement data processing using Stream API with lambda expressions and method references.

Unit 3: Exception Handling and Multithreading

8. Write Java programs demonstrating try–catch–finally, throw, and throws.
9. Implement a custom exception class.
10. Create a program with multiple threads showing synchronization and inter-thread communication.
11. Implement a producer–consumer problem using threads.

Unit 4: File and I/O Programming

12. Perform file read/write operations using both byte and character streams.
13. Demonstrate serialization and deserialization of objects.
14. Implement file copying and merging using BufferedReader and BufferedWriter.

Unit 5: GUI Programming and Event Handling

15. Design a GUI-based calculator or student record manager using AWT/Swing components.
16. Implement event handling using listeners (ActionListener, ItemListener, MouseListener).

Unit 6: Database and Networking Applications

17. Connect Java to a database (e.g., MySQL) using JDBC.
    Insert, update, delete, and display records using SQL queries.
18. Create a client–server chat application using TCP sockets.
19. Build a simple HTTP client using HttpURLConnection or Java Sockets.

Course Code	Course Title	L	T	P	C
UHS4XX	Engineering Economics	3	0	0	3

Contents to be updated from HSS

MINOR

Course Code	Course Title	L	T	P	C
UCS4M1	Introduction to AI, Machine Learning & Data Analytics	4	1	0	5

Total Lectures: 45

Module 1: Introduction to AI [6L]: Introduction to Artificial Intelligence, Predicate Logic, Representing Knowledge as Rules, Representing simple facts in logic, Logic Programming.

Module 2: Mathematics for Machine Learning [6L]: Mathematical foundations: Matrix Theory, Statistics, Probability for Machine Learning.

Module 3: Introduction to Data Analytics [6L]:
Data Analytics Process, Knowledge Check, Exploratory Data Analysis (EDA), EDA-Quantitative technique, EDA-Graphical Technique.

Module 4: Data Visualization [5L]: Data Visualization: Basic principles, ideas, and tools for data visualization, Examples of inspiring (industry) projects, Exercise: create your own visualization of a complex dataset.

Module 5: Supervised Machine Learning [10L]: Introduction, Classification - binary, multiclass, Naive-Bayes classifier, Support Vector Machine, Decision Tree, Regression - Linear, non-linear. [mathematical derivations of all the models]

Module 6: Unsupervised Machine Learning [5L]: Clustering - K Means, Hierarchical Clustering.

Module 7: Hypothesis Testing [4L]: Null and alternative hypotheses, Paired t-test, Analysis of Variance.

Module 8: Applications of Data Science [3L]: Data Science and Ethical Issues - Discussions on privacy, security, ethics.

Text Books:

1. Saroj Kaushik, Artificial Intelligence, Cengage Learning, 1st Edition, 2011.
2. Anindita Das Bhattacharjee, Practical Workbook Artificial Intelligence and Soft Computing for Beginners, Shroff Publisher-X team Publisher.
3. M.C. Trivedi, A Classical Approach to Artificial Intelligence, Khanna Publishing House, Delhi.
4. Jeeva Jose, Introduction to Machine Learning, Khanna Publishing House, Delhi.
5. Yuxi (Hayden)Liu, Python Machine Learning by Example", PacketPublishing Limited, 2017.
6. Tom Mitchell, Machine Learning, McGraw-Hill, 2017.
7. Christopher M.Bishop, Pattern Recognition and Machine Learning, Springer, 2011.
8. V. K. Jain, Data Sciences & Analytics, Khanna Publishing House.
9. Annalyn Ng, Kenneth Soo, Data Science for the Layman, Shroff Publisher

Course Code	Course Title	L	T	P	C
UCS4ML1	Introduction to AI, Machine Learning & Data Analytics Lab	0	0	4	2

1. Python Environment Setup and Essentials.
2. Mathematical Computing with Python (NumPy).
3. Scientific Computing with Python (SciPy).
4. Data Manipulation with Pandas.
5. Data Visualization in python using matplotlib
6. Using any dataset, apply the concept of:
   a.Classification - Naive-Bayes, SVM, Decision Tree
   b. Linear regression, Non-linear regression,
   c. Implementation of different clustering algorithms.

COURSE STRUCTURE

AND

SYLLABUS FOR

B. TECH PROGRAMME

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

SEMESTER IV

(APPLICABLE FROM AY 2024-2025 ADMITTED BATCH ONWARDS)

COURSE STRUCTURE							
4th Semester / 2nd Year							
Name of the Programme		**B.Tech**					
Name of the Department		**ECE**					
A.		**Theory Courses**					
Sl No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	**Coordinating Department**
1	UEC401	Analog Circuits	3	1	0	4	ECE
2	UEC402	Microcontrollers	3	0	0	3	ECE
3	UEC403	Analog Communication	3	1	0	4	ECE
4	UEC404	Control Systems	3	0	0	3	ECE
5	UEC491	Mini Project	0	0	2	1	ECE
6	UHS401	Engineering Economics	3	0	0	3	
Total of A						**18**	
B.		**Laboratory/Project/Seminar Courses**					
Sl No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	**Coordinating Department**
7	UEC471	Analog Circuits Lab	0	0	2	1	ECE
8	UEC472	Microcontrollers Lab	0	0	2	1	ECE
Total of B						**2**	
Grand Total (A+B)						**20**	

Name of the Programme:	B. Tech in **Electronics & Communication Engineering**
Semester:	**4**

Course Code:	**UEC401**
Course Title:	**Analog Circuits**
Course Credit:	4 (L: 3 T: 1 P: 0)

Course objective:	1. Understand the fundamentals of analog components 2. Analyze and design analog electronic circuits 3. Explore frequency response and oscillator fundamentals 4. Study of Single stage and Multistage transistor amplifier models.
Pre-requisites:	Basics of Semiconductor devices, Network theory.
Course outcomes:	After completion of this course students will 1. Understand the applications of diodes. 2. Able to analyze various rectifier circuits & design circuits for managing power supply. 3. To be able to analyze, design amplifier circuits for different applications. 4. Understand the functioning of multistage and high-performance amplifiers. 5. Able to study the feedback and employ it to design sinusoidal and non-sinusoidal oscillators.

Unit/ Module no.	**Topic**	**Nos. of contact hours**	**Distribution of marks (out of 100)**
1	Diode Circuits: Switching applications, Rectifier circuits (uncontrolled), clipping & clamping circuits, Zener diode characteristics, Application in Voltage regulators (Series & Shunt)	6	
2	Single stage Transistor Amplifier models: Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, In- Band Small signal model for BJT and FET. Small signal analysis ofAmplifiers, estimation of voltage gain, input resistance, output resistance etc. HF model of BJT and FET. Frequency response of amplifiers.	10	
3	Power Amplifiers & Multistage Amplifier: Various classes of operation (Class A, B, AB, C etc.); their Voltage transfer characteristics, power efficiency and distortion issues. Cascaded	10	

	Amplifiers, Feedback Amplifiers, Feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth, stability etc., calculation gain, Rin, Rout with feedback. Basic concepts of stability.		
4	Current mirror: Basic topology and its variants, V-I characteristics, output resistance and minimum sustainable voltage (VON), maximum usable load. Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR.	8	
5	OP-AMP applications: Ideal parameters of Op-Amp, Op-Amp as Buffer, use of Op-Amp in inverting and non-inverting amplifiers, summing amplifier, difference amplifiers	6	
6	Sinusoidal and Non-sinusoidal Oscillators: Review of Oscillation mechanism, Barkhausen criterion, types of oscillators, Oscillatory Tank circuit, complete classification of oscillator- RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, etc.).	8	

Text Books:

1.B. Razavi, "Microelectronics", 3rd Ed., Wiley, 2020.
2. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
3. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, 4th Ed.

Reference Books:

1.J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992.
2. Paul R. Gray and Robert G. Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley, 3rd Edition.
3. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
4. D. A. Neamen, "Microelectronics: Circuit Analysis and Design", McGraw Hill, 4th Ed., 2021.

Course Code:	**UEC471**
Course Title:	**Analog Circuits Lab**

Course Credit:	1 (L: 0 T: 0 P: 2)
Course objective:	1. Understand the fundamentals of analog components 2. Analyze and design analog electronic circuits 3. Explore frequency response and oscillator fundamentals 4. Utilize simulation and practical tools for circuit evaluation
Pre-requisites:	Basics of Semiconductor devices, Network theory
Course outcomes:	After completion of this course students will 1. Understand the characteristics of diodes and transistors 2. Design and analyze various rectifier and amplifier circuits 3. Understand sinusoidal oscillators and generate waves at a specified frequency. 4. Understand the functioning of OP-AMP and design OP-AMP based circuits

Unit/ Module no.	**Topic**	**Nos. of contact hours**	**Distribution of marks (out of 100)**
1	Study and explore half-wave type rectifier (load and line regulation).	2	
2	Study and explore full-wave bridge type rectifier (load and line regulation).	2	
3	Design and study the use of Zener diode for voltage regulation	2	
4	Design and study drain and transfer characteristics of JFETs.	2	
5	Design and study the characteristics of CE amplifier circuit.	2	
6	Design and study the frequency response of CE amplifier circuit.	2	
7	Design and study of the characteristics of CC amplifier circuit.	2	
8	Design and explore sinusoidal oscillator.	2	
9	Design and explore non-sinusoidal oscillator	2	
10	Design adder, subtractor, voltage bufferOp-Amp based circuits and study its characteristics.	2	
11	Practice/Make-up lab.	4	

Text Books:

1. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, Edition 4.
2. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.

Reference Books:

1. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992.
2. Paul R. Gray and Robert G. Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley, 3rd Edition.
3. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.

Course Code:	**UEC402**
Course Title:	**Microcontrollers**

Course Credit:	3 (L: 3 T: 0 P: 0)
Course objective:	1. Understand microcontroller architecture and registers. 2. Apply programming skills for control of several I/O devices. 3. Learn effective use of serial communication protocol. 4. Employ the programming and hardware knowledge to design small scale embedded systems.
Pre-requisites:	Basic digital electronics and digital arithmetic
Course outcomes:	After completion of this course students will 1. Be affluent with assembly language & C programming 2. Know how to interfacing the peripherals: Sensors, A/D, D/A, Relay, LCD, LED, switches etc. 3.Develop small scale systems with 8-bit microcontrollers 4.Understand instruction sets used for RISC processors.

Unit/ Module no.	**Topic**	**Nos. of contact hours**	**Distribution of marks (out of 100)**
1	Overview of microcomputer systems and their building blocks, memory interfacing, concepts of interrupts and Direct Memory Access, instruction sets of microprocessors (with examples of 8085 and 8086)	4	
2	Introduction to single chip microcontrollers: Intel MCS-51 family features - 8051/8031 architecture - pin configuration - basic assembly language programming & application examples.	5	
3	8051 Instruction Set: Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instructions. Simple examples of assembly language program (without loops) to use these instructions.	6	
4	8051 Stack, I/O Port Interfacing and Programming: 8051 Stack, Stack and Subroutine instructions. Assembly language program examples on subroutine and involving loops - Delay subroutine, Factorial of an 8-bit number (result maximum 8 bit), Block move without overlap, Addition of N 8-bit numbers, Picking smallest/largest of N 8-bit numbers. Interfacing simple switch and LED to I/O ports to switch on/off LED with respect to switch status.	8	

Text Books:

5	8051 Timers and Serial Port: 8051 Timers and Counters – Operation and Assembly language programming to generate a pulse using Mode-1 and a square wave using Mode-2 on a port pin. 8051 Serial Communication- Basics of Serial Data Communication, RS-232 standard, 9 pin RS232 signals, Simple Serial Port programming in Assembly and C to transmit a message and to receive data serially.	7	
6	8051 Interrupts and Interfacing Applications: 8051 Interrupts. 8051 Assembly language programming to generate an external interrupt using a 73 switch, 8051 C programming to generate a square waveform on a port pin using a Timer interrupt. Interfacing 8051 to ADC-0804; LCD and stepper motor and their 8051-assembly languageinterfacingprogramming.	6	

1. R. S. Gaonkar, "Microprocessor Architecture: Programming and Applications with the 8085/8080A", Penram International Publishing, 1996
2. Douglas Hall, "Microprocessors Interfacing", Tata McGraw Hill, 1991.

Reference Books:

1. D A Patterson and J H Hennessy, "Computer Organization and Design The hardware and software interface", Morgan Kaufman Publishers.
2. Kenneth J. Ayala, "The 8051 Microcontroller", Penram International Publishing, 1996.
3. M. Mazidi, "The 8051 Microcontroller and Embedded Systems Using Assembly & C", 2nd Ed, Pearson.

Course Code:	**UEC472**

Course Title:	**Microcontrollers Lab**
Course Credit:	1 (L: 0 T: 0 P: 2)
Course objective:	1. Understanding the effective use of internal registers and I/O Ports of an MCU. 2. Applying programming skills for managing the hardware in a small-scale embedded system. 3. Get acquainted with the tools for firmware design for 8-bit MCU from different vendors. 4. Analyzing and troubleshooting microcontroller-based circuits.
Pre-requisites:	Digital electronics and Digital arithmetic
Course outcomes:	After completion of this course students will 1. Be able to do assembly language and C programming 2. Have hands on knowledge on interfacing of peripherals and their control through programming. 3. Develop small scale embedded systems using 8-bit microcontrollers 4. Be able to solve real world problems with MCU.

Unit/ Module no.	Topic	Nos. of contact hours	Distribution of marks (out of 100)
1	Blinking of LED at a given frequency (MCU Board)	2	
2	Arithmetic Data Manipulation between registers and sending to the output port.	2	
3	Logical Data Manipulation between registers and sending to output port.	2	
4	Data read and manipulation between LUT and RAM	2	
5	Data read and manipulation between RAM and External ROM.	2	
6	Use timers for square wave generation at an output port.	2	
7	Serial data transmission and reception.	2	
8	Use of Interrupts for performing two different tasks.	2	
9	Interfacing 16x2 LCD with 8bit MCU (MCU Board).	2	
10	Interfacing 8-bit ADC with the 8-bit MCU and display at the LCD (MCU Board)	2	
11	Practice/Make-up lab.	4	

Text Books:

1. M. Mazidi, “The 8051 Microcontroller and Embedded Systems Using Assembly & C”, 2nd Ed, Pearson.

2. Elecia White, “Making Embedded Systems: Design Patterns for Great Software”, O’ Reilly.

Reference Books:

1. The 8051 Microcontroller Based Embedded Systems, Manish K. Patel, McGraw Hill

2. Kenneth J. Ayala, The 8051 Microcontroller, Penram International Publishing, 1996.

3. Douglas Hall, Microprocessors Interfacing, Tata McGraw Hill, 1991.

Course Code:	**UEC403**
Course Title:	**Analog Communication**

Course Credit:	4 (L: 3 T: 1 P: 0)
Course objective:	1. **Understanding** fundamental principles of analog communication 2. **Understanding**modulation/demodulation schemes 3. **Analyzing** system performance under noise and channel constraints
Pre-requisites:	Signals and systems, Network theory
Course outcomes:	After completion of this course students will 1. Analyse and compare different analog modulation schemes for their efficiency and bandwidth 2. Analyse the behaviour of a communication system in presence of noise 3. Investigate pulsed modulation system and analyse their system performance 4. Analyse different analog modulation schemes and their system performance

Unit/ Module no.	**Topic**	**Nos. of contact hours**	**Distribution of marks (out of 100)**
1	***Introduction to communication system***: Need for modulation, Frequency Division Multiplexing, Amplitude Modulation, Definition, Time domain and frequency domain description, single tone modulation, power relations in AM waves, Generation of AM waves, square law Modulator, Switching modulator, Detection of AM Waves; Square law detector, Envelope detector.	5	
2	***DSB Modulation***: Double side band suppressed carrier modulators, time domain and frequency domain description, Generation of DSBSC Waves, Balanced Modulators, Ring Modulator, Coherent detection of DSB-SC Modulated waves, COSTAS Loop.	4	
3	***SSB and VSB Modulation***: Frequency domain description, Generation of AM SSB Modulated Wave, Time domain description, Phase discrimination method for generating AM SSB Modulated waves. Demodulation of SSB Waves, Vestigial side band modulation: Frequency description, Generation of VSB Modulated wave, Time domain description, Envelope detection of a VSB Wave, Comparison of AM Techniques, Applications of different AM Systems.	5	
4	***Angle Modulation***: Basic concepts, Frequency Modulation: Single tone frequency modulation, Spectrum Analysis of Sinusoidal FM Wave, Narrow band FM, Wide band FM, Constant Average Power, Transmission bandwidth of FM Wave - Generation of FM Waves, Direct FM, Detection of FM Waves: Balanced/Dual slope Frequency	6	

	discriminator (Foster-Seeley), zero crossing detector (ZCD), Phase locked loop, Comparison of FM & AM.		
5	***Transmitters***: Radio Transmitter - Classification of Transmitter, AM Transmitter, Effect of feedback on performance of AM Transmitter, FM Transmitter – Variable reactance type and phase modulated FM Transmitter, frequency stability in FM Transmitter. ***Receivers***: Radio Receiver - Receiver Types - Tuned radio frequency receiver, Super-heterodyne receiver, RF section and Characteristics - Frequency changing and tracking, Intermediate frequency, AGC, FM Receiver, Comparison with AM Receiver.	6	
6	***Pulse Modulation***: Time Division Multiplexing, Types of Pulse modulation, PAM (Single polarity, double polarity). PWM: Generation & demodulation of PWM. PPM: Generation and demodulation of PPM.	3	
7	***Noise in communication systems***:Model for linear modulation system, Destination SNR of a baseband system, Figure of merit, Pre-detection SNR, Destination SNR for: SSB-SC, DSB-SC, DSB-FC. Noise performance of angle modulated systems- Destination SNR. Comparison of linear and angle modulation systems.	7	

Text Books:

1. H. Taub and D.L.Schilling and G. Saha, "Principles of Communication Systems", McGraw Hill, 4th Ed, 2017.
2. B.P. Lathi, Zhi Ding, "Modern Digital and Analog Communication Systems", Oxford University Press, 2017.

Reference Books:

1. S. Haykin, "Communications Systems", Wiley, 4th Ed, 2006.
2. J. G. Proakis and M. Salehi, "Communication Systems Engineering", Pearson Education, 2018.
3. J. M. Wozencraft and I. M., Jacobs I. M., "Principles of Communication Engineering", John Wiley, 1965.
4. A. Bruce Carlson, Paul B. Crilly, "Communication Systems", McGraw-Hill Education, 5th edition, 2009.
5. R. E. Ziemer, W. H. Tranter, "Principlesof Communications: Systems, Modulation and Noise", Wiley, 6th Ed., 2009.

Course Code:	**UEC404**

Course Title:	**Control Systems**
Course Credit:	3 (L: 3 T: 0 P: 0)
Course objective:	1. Understand fundamental conceptsincluding system modeling, feedback mechanisms, and stability analysis. 2. Apply mathematical tools like Laplace transforms, transfer functions, and state-space representations to analyze and design control systems across various engineering domains. 3. Design and analyze controllerssuch as PID, lead-lag compensators, and state feedback systems, and evaluate their performance using time and frequency domain techniques.
Pre-requisites:	Network theory
Course outcomes:	1. Learn about closed loop control systems 2. Know time domain response analysis of control systems 3. Analyze the stability of control systems 4. Understand state variable analysis, controllability and observability.

Unit/ Module no.	**Topic**	**Nos. of contact hours**	**Distribution of marks (out of 100)**
1	**Introduction and mathematical modelling:** Motivation, examples of control systems, feedback control systems. Mathematical modelling of: electrical systems, mechanical systems, electro-mechanical systems. Laplace transforms, transfer functions, electrical analogues of other dynamical systems. State-space modelling of dynamical systems. Block diagrams, block diagram reductions. Signal flow graph, Mason's gain formula. Linearity, time-invariance versus nonlinearity and time-variance. Linearization. Distributed parameter systems	7	
2	**Time response of dynamical systems:** Obtaining solutions from mathematical models. Poles and zeros and their effects on solutions. Step response of standard second order systems, time-domain specifications and their formulae. Basic idea of feedback control systems. Error analysis. P, PI, PD, PID controllers.	7	
3	**Design of controller and stability:** Definition of stability. Routh-Hurwitz test. Lyapunov theory.The root-locus technique, steps in obtaining a root-locus. Design of controllers using root-locus. Pole placement with state feedback, controllability.	6	
4	**Frequency domain analysis:** Bode plot, Nyquist plot, Nyquist stability criterion, gain and phase margins, and robustness.	6	

5	**Design of compensators:** Lead compensator, lag compensator, lead-lag/lag-lead compensators, and their design.	4	
6	**Introduction to State space Analysis:** Concept of State-space representation, Transfer function decomposition, Direct decomposition, Cascade decomposition, Parallel decomposition, Solution of state equation, Determination of State transition matrix: Laplace transform method, Caley-Hamilton Theorem, Controllability and Observability.	6	

Text Books:

1. B. C. Kuo, Automatic Control Systems, Prentice-Hall of India Pvt Ltd., New Delhi, 6th edition, 1991.
2. B.S Manke, Linear Control Systems with MATLAB Applications, Khanna Publishers, New Delhi, 11thedition, 2012.

Reference Books:

1. Franklin G.F., Powell J.D., Emami-Naeini A., Feedback Control of Dynamic Systems, Pearson, Upper Saddle River, New Jersey, 5th edition, 2006.
2. Ogata K., Modern Control Engineering, Prentice-Hall of India Pvt Ltd., New Delhi, 3rd edition, 2000.

Course Code:	**UEC491**
Course Title:	**Mini Project**
Course Credit:	1 (L: 0 T: 0 P: 2)
Course objective:	1. Apply electronic circuit design principles to develop a functional hardware-based electronic system or product. 2. Use appropriate simulation tools, laboratory instruments, and engineering methodologies for circuit analysis, prototyping, and testing. 3. Integrate hardware and software (as applicable) to perform the intended functionality of the designed system.
Pre-requisites:	Analog Electronics, Digital Electronics
Course outcomes:	After completion of this course students will 1. Conceive a problem statement either from rigorous literature survey or from the requirements raised from need analysis. 2. Design, implement and test the prototype/algorithm in order to solve the conceived problem. 3. Write comprehensive report on mini project work.

Guidelines:

1. The mini-project is a group activity having 3-4 students in a group. The final outcome after the mini-project should be an electronic product with emphasis of electronic circuit design.
This is electronic product design work with a focus on electronic circuit design.
2. The mini project may be a complete hardware or a combination of hardware and software. The software part in mini project should be less than 50% of the total work.
3. Mini Project should cater to a small system required in laboratory or real life.
4. It should encompass components, devices, analog or digital ICs, micro controller with which functional familiarity is introduced.
5. After interactions with course coordinator and based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of mini project.
6. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
7. The student is expected to exert on design, development and testing of the proposed work as per the schedule.
8. Art work and Layout should be made using CAD based PCB simulation software. Due considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design.
9. Completed mini project and documentation in the form of mini project report is to be submitted at the end of semester.
10. The lab sessions should be used for discussion on standard practices used for electronic circuits/product design, converting the circuit design into a complete electronic product, PCB design using suitable simulation software, estimation of power budget analysis of the product, front panel design and mechanical aspects of the product, and guidelines for documentation /report writing.

Course Code:	**UHS401**
Course Title:	**Engineering Economics**
Course Credit:	3 (L: 3 T: 0 P: 0)
Course objective:	1. To introduce the fundamental concepts and principles of economics and their applications in engineering and management decisions. 2. To develop an understanding of consumer behavior, utility, demand–supply mechanisms, production and cost analysis, profit estimation, and break-even analysis for effective decision-making. 3. To analyze different market structures, price–output determination, and key macroeconomic 4. To introduce the concepts such as national income, taxation, inflation, and banking. 5. To familiarize students with economic reforms and current situation in India—as well as international trade, global financial institutions, and capital markets.
Pre-requisites:	As this paper is introductory in nature, no prerequisite knowledge is required.
Course outcomes:	After completion of this course, students will be able to 1.Comprehend and apply the fundamental concepts and principles of economics in engineering and managerial decision-making. 2.Analyse consumer behaviour and producer behaviour, demand–supply dynamics, and production–cost relationships to support efficient resource utilization and planning. 3.Evaluate market structures and differentiate among various market forms. 4.Understand macroeconomic variables influencing business operations and national economic performance. 5.Assess the impact of economic reforms, international trade, and global financial institutions on the Indian and world economies. 6.Demonstrate awareness of the stock exchange and the regulatory roles of SEBI and IRDA.

Unit/ Module no.	**Topic**	**Nos. of contact hours**	**Distribution of marks (out of 100)**
1	**Key Economic Concepts**: Definition of Economics and concept of Engineering Economics. Consumer behavior, Utility analysis and demand analysis, Types of Demand, Law of Demand, Concept of supply and Law of Supply, Elasticity of Demand and supply: Types and Measurement Concept of Production function and Revenue function, Cost Analysis, Profit and Break-Even Analysis.	12	30

2	**Market Forms**: Perfect and Imperfect markets, Features of Perfect competition, Monopoly and Monopolistic competition. Price and output determination under Perfect Competition, Monopoly, Monopolistic and Oligopoly market, etc.	10	20
3	**Key Macroeconomic Concepts**: National Income and various methods of measuring it, Source of Public Revenue-Tax Revenue and Non-Tax Revenue, Direct and Indirect Tax. Inflation and Deflation. Banking-Definition - Types of Banks and their various functions.	10	25
4	**Reforms and Regulatory Institutions and Global Financial Institutions**: Economic Reforms in India - Concept and Implications, Overview of the Current Indian Economic Scenario. Concept of Stock Exchange Market, Role of SEBI and IRDA. International Trade, Gains from International Trade, Role and Function of IMF, World Bank and WTO.	8	25

Text Books:

1. Koutsoyiannis, A. (1993). Modern Microeconomics (3rdEd.). Macmillan Education
2. Salvatore, D. (2005). Principles of Microeconomics (5thEd.). Oxford University Press
3. Uma Kapila (ed.) (2024). Indian Economy since Independence: A Comprehensive and Critical Analysis of India's Economy, 1947- 2023. Academic Foundation
4. Mankiw, N. Gregory (2017). Macroeconomics (11thEd.). Macmillan Learning.

COURSE STRUCTURE

IV SEM

A.		Theory Courses					
Sl No.	Course Code	Course Title	L	T	P	C	Coordinating Department
1	UHS401	Engineering Economics	3	0	0	3	HSS
2	UME401	Fluid Mechanics	2	1	0	3	ME
3	UFE401	Food Product Technology- I (Fruits & Vegetables)	3	0	0	3	FET
4	UFE402	Food Product Technology- II (Cereals & Pulses)	3	0	0	3	FET
5	UFE403	Food Microbiology and Biotechnology	3	0	0	3	FET
6	UFE41*	Elective – I	3	0	0	3	FET
	UFE411	Plantation of Crops and Spices					
	UFE412	Basic of Food Science and Nutrition					
	UFE413	Principles of Consumer Behaviour					
		Total of A	**17**	**1**	**0**	**18**	
B.		**Laboratory/Project/Seminar Courses**					
Sl No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	**Coordinating Department**
1	UFE471	Product Technology- I/II Lab	0	0	2	1	FET
2	UFE472	Food Microbiology Lab	0	0	2	1	FET
		Total of B	**0**	**0**	**4**	**2**	
C.		**Audit/Non-credit Courses**					
Sl No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	**Coordinating Department**
		Total of C					
		Grand Total (A+B+C)	**17**	**1**	**4**	**20**	

DETAILED SYLLABUS

Name of the Programme:	B. Tech
Semester:	4
Course Code:	UHS401
Course Title:	Engineering Economics
Course Credit:	3 (L: 3 T:0 P: 0)
Course objective:	• To introduce the fundamental concepts and principles of economics and their applications in engineering and management decisions. • To develop an understanding of consumer behaviour, utility, demand–supply mechanisms, production and cost analysis, profit estimation, and break-even analysis for effective decision-making. • To analyze different market structures, price–output determination, and key macroeconomic • To introduce the concepts such as national income, taxation, inflation, and banking. • To familiarize students with economic reforms and current situation in India—as well as international trade, global financial institutions, and capital markets.
Pre-requisites:	As this paper is introductory in nature, no prerequisite knowledge is required.
Course outcomes:*	After completion of this course, students will be able to • Comprehend and apply the fundamental concepts and principles of economics in engineering and managerial decision-making. • Analyse consumer behaviour and producer behaviour, demand–supply dynamics, and production–cost relationships to support efficient resource utilization and planning. • Evaluate market structures and differentiate among various market forms. • Understand macroeconomic variables influencing business operations and national economic performance. • Assess the impact of economic reforms, international trade, and global financial institutions on the Indian and world economies. • Demonstrate awareness of the stock exchange and the regulatory roles of SEBI and IRDA.

Unit/ Module no.	Topic	No. of contact hours
1	Key Microeconomic Concepts: Definition of Economics and concept of Engineering Economics. Consumer behaviour, Utility	12

	analysis and demand analysis, Types of Demand, Law of Demand, Concept of supply and Law of Supply, Elasticity of Demand and supply: Types and Measurement. Concept of Production function and Revenue function, Cost Analysis, Profit and Break Even Analysis.	
2	Market Forms: Perfect and Imperfect markets, Features of Perfect competition, Monopoly and Monopolistic competition. Price and output determination under Perfect Competition, Monopoly, Monopolistic and Oligopoly market, etc.	10
3	Key Macroeconomic Concepts: National Income and various methods of measuring it, Source of Public Revenue-Tax Revenue and Non-Tax Revenue, Direct and Indirect Tax. Inflation and Deflation. Banking-Definition - Types of Banks and their various functions.	10
4	Reforms and Regulatory Institutions and Global Financial Institutions: Economic Reforms in India - Concept and Implications, Overview of the Current Indian Economic Scenario. Concept of Stock Exchange Market, Role of SEBI and IRDA. International Trade, Gains from International Trade, Role and Function of IMF, World Bank and WTO.	8

Text Books:

1. *Koutsoyiannis, A. (1993). Modern Microeconomics (3rd Ed.). Macmillan Education*
2. *Salvatore, D. (2005). Principles of Microeconomics (5th Ed.).Oxford University Press*
3. *Uma Kapila (ed.) (2024).Indian Economy since Independence: A Comprehensive and Critical Analysis of India's Economy, 1947- 2023. Academic Foundation*
4. *Mankiw, N. Gregory (2017). Macroeconomics (11th Ed.). Macmillan Learning*

Name of the Programme:	B. Tech
Semester:	4
Course Code:	UME401
Course Title:	Fluid Mechanics
Course Credit:	3 (L:2 T:1 P:0)
Course objective:	The objectives of this course are • To provide fundamental knowledge on the fluid properties and the governing equations of fluid dynamics. • To understand fluid kinematics and related flow parameters. • To study the behaviour and characteristics of laminar and turbulent flows.
Pre-requisites:	Engineering Thermodynamics
Course outcomes:*	By the end of this course, students will be able to • Explain basic fluid properties. • Evaluate the kinematic parameters of fluid motion, such as velocity, acceleration, and rotational characteristics. • Apply the fundamental governing equations of fluid flow to analyse fluid motion in basic engineering systems. • Understand static and stagnation pressures and flow measurement using the Venturimeter, Pitot tube, and Orifice meter. • Solve and analyse laminar and turbulent flow problems.

Unit/ Module no.	Topic	No. of contact hours
1	Introduction and Basic Concept: Definition of Fluid, Dimension and Units, Concept of Continuum, No-slip condition of viscous fluids, Classification of fluid flow; Properties of fluids–mass, density, specific gravity, specific weight, viscosity, compressibility, surface tension and capillary effect.	3

2	Pressure Measurement and Fluid Statics: Definition of pressure, pressure at a point, variation of pressure with depth, pressure measuring devices; Hydrostatic forces on submerged plane and curved surfaces; Buoyancy, stability of floating and immersed bodies.	8
3	Kinematics of Fluid Flow: Lagrangian and Eulerian description of fluid motion, acceleration field, Flow pattern, and visualisation–streamlines, stream tubes, pathlines, streaklines, and timelines, Deformation of fluid elements, Vorticity and rotationality.	5
4	Dynamics of Fluid Flow: Reynolds Transport Theorem, Integral form of conservation laws (mass, momentum and energy) for a control volume; Euler's equation of motion, Bernoulli's equation and its applications; Concept of static, dynamic and stagnation pressures; Pitot tube, Venturimeter and Orificemeter; Differential form of conservation laws; Elementary derivation of the Navier-Stokes equations.	10
5	Laminar and Turbulent Flows: Laminar viscous flow–Reynolds number, Laminar flow in pipes, pressure drop and head loss, Darcy-Weisbach equation, Poiseuille flow and Couette flow; Basic introduction to turbulent flows; Minor losses, Flow through pipes connected in series and parallel.	10

Text Books & References:

1. *White, F.M. and Xue, H., Fluid Mechanics, McGraw-Hill, 9th Edition, 2022.*
2. *Som, S.K., Biswas, G. and Chakrabarty, S., Introduction to Fluid Mechanics and Fluid Machines, McGraw-Hill, 3rd Edition, 2017.*
3. *Cengel, Y.A. and Cimbala, J.M., Fluid Mechanics: Fundamentals and Applications, McGraw-Hill, 4th Edition, 2017.*
4. *Bansal, R.K., A Text Book of Fluid Mechanics, Laxmi Publications, 2nd Edition, 2020*
5. *Lal, J., Fluid Mechanics and Hydraulic with Computer Application, Metropolitan Book Co. (P) Ltd., 9th Edition, 2014.*

Name of the Programme:	B. Tech
Semester:	4
Course Code:	UFE401
Course Title:	Food Product Technology- I (Fruits & Vegetables)
Course Credit:	3 (L: 3 T:0 P: 0)
Course objective:	• To introduce the technology, concepts, and practices in the processing of fruits and vegetables. • To impart knowledge about the processing technologies of fruits and vegetable products. • To make students able to implement their knowledge about detailed manufacturing technologies of fruits and vegetable products consumed in daily life in food industries.
Pre-requisites:	• Fundamentals of Food Science • Introduction to Food Engineering
Course outcomes:*	After completion of this course, students will be able to • Acquaint with the proper handling technologies of fruits and vegetables to reduce post-harvest losses • Familiarize with principles and methods of preservation of fruits and vegetables into various products • Understand about the quality evaluation of fruit and vegetable products.

Unit/ Module no.	Topic	No. of contact hours
1	Current status of production and processing of fruits and vegetables. Post-harvest physiology, handling, losses and conservation of fruits and vegetables - physiological post-harvest disorders - chilling injury and disease	12
2	Techniques of extension of shelf life of unmodified produce: hypobaric storage, pre-cooling and cold storage, Zero energy cool chamber; Commodity pretreatments - chemicals, wax coating, prepackaging, VHT and irradiation.	12

3	Technology of Products: juices & pulps, concentrates & powders, squashes & cordials, nectars, fruit drinks, IQF and frozen fruits and vegetables, Fermented products.	10
4	Jam, Jelly & Marmalades; candied fruits, soup mixes; sauces & ketchups; puree & pastes; chutneys & pickles, dehydration of fruits and vegetables. Fruit powders using spray drying; Canning.	10

Text Books:

1. *Shrivastava and Kunal. (2017) India, Fruit & Vegetable Preservation: Principles and Practices (3rd ed.), CBS Publishers.*
2. *Mridula Mirajkar and Sreelata Menon (2010). India, Kanishka Publishers.*
3. *R.B.H. Will and J.B. Holding (2016) UK. Postharvest: An Introduction to the Physiology Handling Fruit and Vegetables, CABI Publishers.*

Reference Books:

1. *B.Srilakshami (2018) India, Food science (7th ed.) New Age International Publishers*
2. *R. Madambi and M.V. Rajgopal (2001) India, Fundamentals of Foods and Nutrition (4th ed.) New Age International Publishers.*
3. *D. K Salunke and S. S Kadam (1995) USA, Hand Book of Fruit Science and Technology: Production, Composition, Storage and Processing (1st ed.), CRC press.*
4. *B. Sivasankar, (2002) India, Food Processing & Preservation, Prentice Hall of India.*

Name of the Programme:	B. Tech
Semester:	4
Course Code:	UFE402
Course Title:	Food Product Technology-II (Cereals and Legumes)
Course Credit:	3 (L: 3 T:0 P: 0)
Course objective:	• Understand the importance, diversity, structure, and composition of major cereals and pulses. • Gain knowledge of engineering, physicochemical and rheological properties influencing processing behavior. • Learn various primary and secondary processing operations including milling, parboiling, cleaning, grading, and storage. • Evaluate quality characteristics related to nutritional, cooking, and storage aspects. • Understand by-product utilization and development of value-added cereal and pulse-based products.
Pre-requisites:	• Fundamentals of Food Science • Introduction to Food Engineering / Unit Operations
Course outcomes:*	After completion of this course, students will be able to • Identify and classify various cereals and pulses used in food systems. • Interpret physical, chemical, mechanical, frictional, aerodynamic, and rheological properties relevant to handling and processing. • Explain post-harvest losses and apply techniques for quality preservation. • Analyze process parameters for rice, wheat, corn and millet processing. • Assess milling quality and evaluate characteristics of cereal and pulse flours. • Recommend by-product utilization strategies for economic and environmental benefits.

Unit/ Module no.	Topic	No. of contact hours
1	Introduction- Global and Indian scenario of cereal and pulses production and utilization, Importance of cereals and legumes in nutrition and food security, Types and classification of cereals and pulses, Post-harvest quality and quantity losses: causes and control. Engineering properties: physical, chemical, mechanical, frictional, aerodynamic, rheological — importance in design and processing.	04
2	Fundamentals of Cereal Processing- Introduction to unit operations in cereal processing. Cleaning, screening, sorting, grading — equipment and principles. Size separation, Size Reduction.	12
3	Rice Technology-Structure, types, composition and physicochemical quality characteristics of paddy/rice. Parboiling and Milling: principles, equipment layout, process variables. Curing and aging of rice — quality changes. Processed rice products: flaked, expanded, puffed rice. By-products: husk and rice bran — extraction and utilization.	10
4	Wheat Technology- Structure, types, composition and physicochemical properties. Cleaning, tempering, conditioning and milling processes for different wheat varieties. Blending of flour, flour grades — Atta, Suji/Semolina, Dalia. Milling equipment — roller mills, sifters. By-product utilization (bran, germ)	08
5	Pulse Milling Technology- Structural, chemical composition and properties of legumes. Cleaning, grading operations. Pretreatment for difficult-to-mill legumes (urad, arhar, moong, moth). Milling of easy-to-mill legumes (chana, masoor, pea). Dal mill equipment — CFTRI improved designs. Quality evaluation of pulses and dal.	06

References and Text Books

1. *A. Chakraverty (2019), Post-Harvest Technology of Cereals, Pulses and Oilseeds, 3rd Editio, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.*

2. *Singh, K.K. & Sahay, A.K.- Unit Operations of Agricultural Processing, (Latest Edition), Vikas Publishing House, New Delhi.*

3. *D. G. Rao (2010). Fundamentals of Food Engineering. PHI Learning Pvt. Ltd., New Delhi.*

4. *Akash Pare & B. L. Mandhyan, Food Process Engineering and Technology, Daya Publishing House / Astral International Pvt. Ltd., New Delhi.*

5. *N. L. Kent; A. D. Evers (1994), Technology of Cereals: An Introduction for Students of Food Science and Agriculture, 4th Edition., Pergamon Press (an imprint of Elsevier).*

6. *R. P. Singh & D. R. Heldman – Introduction to Food Engineering (Indian edition available)*

7. *Toledo, R. T. (2018). Fundamentals of Food Process Engineering (4th Edition), Springer, Cham.*

8. *McCabe, W. L., Smith, J. C., & Harriott, P. (2005). Unit Operations of Chemical Engineering (7th Edition). McGraw-Hill International Edition, New York.*

Name of the Programme:	B. Tech
Semester:	4
Course Code:	UFE403
Course Title:	Food Microbiology and Biotechnology
Course Credit:	3 (L: 3 T: 0 P: 0)
Course objective:	• To gain a clear and extensive knowledge on the principles of applications of microbiology in food concepts on microbial cells, their structure, and functions of their different cell components • To have a comprehensive grasp on food fermentation, foodborne diseases, and microbiological analyses of foods and associated materials e.g., soil, drinking water, packaging materials, etc. • To provide a brief outline and overview on principle of biotechnology applied in food production, processing, and quality enhancement
Pre-requisites:	• Basic concepts on microbiology (eukaryotes and prokaryotes) • Primary concepts on biochemistry 10 and 10+2 level mathematics
Course outcomes:*	After completion of this course, students will be able to • possess a comprehensive understanding on applications of microbiology and biotechnology in food sector. • earn a clear concept on fermented foods, foodborne diseases, and applications of biotechnology to advance food production, processing and quality. • have a clear overview on various different aspects of applications of microbiology, and biotechnology in food, and their relevance in human society and nature.

Unit/ Module no.	Topic	No. of contact hours
I	Introduction: History and Scopes of Application of Microbiology in food; Factors affecting Microbial survival and growth in food	12

	Biochemical pathways: Lactic acid, acetic acid, ethanol, propionic acid fermentations in food	
2	Fermented food products: Fermented dairy product – yoghurt, cheese, etc.; Fermented vegetables – pickles, sauerkraut, etc.; Fermented muscle foods e.g., sausages; Fermented cereal products – beer; Fermented fruits – wine, vinegar	12
3	Foodborne diseases: Introduction to microbial safety of foods; Modes of foodborne diseases; Detail discussions on foodborne / waterborne intoxication, infection and toxicoinfection	8
4	Food biotechnology: Introduction – Transcription, translation, conjugation, transduction; rDNA technology; Applications of biotechnology for food production, quality improvement, and advancement of food processing through genetically engineered organisms	4

Text Books:

1. Jay, J.M., Loessner, M.J., and Golden, D.A. (2005). Modern Food Microbiology (7th Ed.) Springer
2. Frazier, W.C., Westhoff, D.C., and Vanitha, N.M. (2014). Food Microbiology (5th Ed). McGraw Hill Education (India) Private Limited

Reference Book:

1. Doyle, M.P., Diez-Gonzalez, F., and Hill, C. Food Microbiology: Fundamentals and Frontiers (5th Ed), American Society of Microbiology Press

Name of the Programme:	B. Tech
Semester:	4
Course Code:	UFE411
Course Title:	Plantation of Crops and Spices
Course Credit:	3 (L: 3 T:0 P: 0)
Course objective:	• To familiarize students with the classification of tea, the detailed steps in tea manufacture (including instant formulation), and the parameters used to assess tea quality. • To impart comprehensive knowledge of coffee production, including various processing techniques, the methodology of instant coffee manufacture, and the standards for quality grading. • To introduce the principles of cocoa processing and chocolate manufacturing, along with an in-depth study of the processing chemistry of principal spices. • To develop understanding of the processing technologies and chemical characteristics of spices.
Pre-requisites:	-
Course outcomes:*	After completion of this course, students will be able to • Recognize and explain different tea varieties, their manufacturing routes (including instant tea), and assess tea quality via standard parameters. • Understand the full spectrum of coffee processing (including instant coffee) and perform evaluations using established quality grading systems. • Outline the processes involved in cocoa bean transformation and chocolate production, and dissect the chemical changes in major spices during processing. • Elucidate processing strategies and chemical makeup of spices, and appraise their impact on flavor, aroma, and functionality.

Unit/ Module no.	Topic	No. of contact hours
1	Tea: Occurrence, chemistry of constituents; harvesting; types of tea – green, oolong and CTC; chemistry and technology of CTC tea; manufacturing process for green tea and black tea	7

	manufacture; instant tea manufacture; quality evaluation and grading of tea.	
2	Coffee: Processing of coffee, type of coffee, drying, fermentation, roasting and browning processes and their importance. process flow sheet for the manufacture of coffee powder; instant coffee technology; chicory chemistry; quality grading of coffee	9
3	Cocoa: Occurrence, chemistry of the cocoa bean; changes taking place during fermentation of cocoa bean; processing of cocoa bean; cocoa powder; cocoa liquor manufacture; chocolates–types, chemistry and technology of chocolate manufacture; quality control of chocolates.	8
4	Scope of spice processing in India, Types, spice qualities and specification, uses and physiological effects, components, antimicrobial and antioxidant properties, Medicinal value of condiments and spice products.	8
5	Processing and manufacturing of major Indian Spices: Pepper, cinnamon, cardamom, Nutmeg, saffron, turmeric and Ginger, minor spices- cloves, leafy spices, bay oregano, and seed spices. Spice processing machineries, packaging and handling of spices. Spice blends and extractives, essential and encapsulated oils, oleoresins – uses in processed foods	8

Text Books:

1. *B. Banerjee (2002) India, Tea Production and Processing (3rd ed.), Oxford & IBH Publishing.*
2. *B.W. Minifie BW. 1989. Chocolate, Cocoa and Confectionery Technology (3rd ed.) Aspen Publications.*
3. *NIIR Board (2010) India, Handbook on Spices, Asia Pacific Business Press Inc.*
4. *J.S. Pruthi. (2001) India, Spices and Condiments – Major Spices of India. National Book Trust, New Delhi.*

Reference Books:

1. *B. K. Hirasa and M. Takemasa. (1998) USA, Spice Science and Technology. Marcel Dekker, NY, USA.*
2. *H. Panda. (2010) India, Handbook on Spices and Condiments (Cultivation, Processing and Extraction). Asia Pacific Business Press Inc., New Delhi.*

3. *A. Chakraverty, A. S. Mujumdar, G.S. Vijaya Raghavan and H. S. Ramaswamy (2003) USA, Handbook of Post Harvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. Marcel Dekker, Inc., NY, USA.*

Name of the Programme:	B. Tech
Semester:	4
Course Code:	UFE412
Course Title:	Basic of Food Science and Nutrition
Course Credit:	3 (L: 3 T:0 P: 0)
Course objective:	• To provide foundational knowledge of food components, their functional roles, and interactions influencing sensory and nutritional quality. • To develop understanding of basic nutrition principles, energy metabolism, and methods for evaluating the energy value of foods. • To impart knowledge on the functions, requirements, and health significance of macronutrients and micronutrients in human nutrition.
Pre-requisites:	-
Course outcomes:*	After completion of this course, students will be able to • Grasp the functional role of food components and their interaction in food products in terms of colour, flavour, texture and nutrient composition and explain the significance of water in food quality, preservation and storage • Explain basic concepts of nutrition, compute energy value of foods and understand body's need for energy. • Describe the requirements and role of carbohydrates, Proteins, Lipids, micronutrients (vitamins /minerals) in human health.

Unit/ Module no.	Topic	No. of contact hours
1	An introduction to food resources and its general composition. Proximate analysis of foods, water in food systems – concept of free and bound water, water activity and its impact on food preservation and storage. Basic concept of taste, colour, flavour and texture, sensory analysis, anti-nutritional constituents in foods.	12

2	Food composition and nutrients present in foods, terminologies used in nutrition, Food pyramid, Energy value of foods, bomb calorimeter, estimation of energy value of foods from proximate composition.	8
3	Role of carbohydrates in human nutrition- nutritionally important carbohydrates, physiological functions, digestion and absorption of available carbohydrates, dietary fiber, non-digestible oligosaccharides. Role of lipids in Human Nutrition- nutritionally important lipid constituents, physiological functions, digestion and absorption of lipids, Different classes of fatty acids.	10
4	Role of proteins in Human Nutrition- essential/ non-essential amino acids, complete/ incomplete proteins, limiting amino acid, complementary proteins, physiological functions of proteins, daily protein requirements, digestion absorption and utilization of proteins, common food sources of proteins. Role of micronutrients - Vitamins– classification- water soluble and fat soluble Vitamins; Chemistry, structure and properties; physiological functions; food sources; Minerals- Nutritional and anti-nutritional mineral elements in food, their physiological role.	10

Text Books:

1. *H. D. Belitz, W. Grosch, and P. Schieberle (2005) Food Chemistry (3rd ed.) Springer, Germany*
2. *S. Damodaran, and K. L. Parkin (2017) Food Chemistry (5th ed.) CRC Press, Boca Raton.*

Reference Books:

1. *J. Velisek, R. Koplik and K. Cejpek (2020) The Chemistry of Food (2nd ed.) Wiley-Blackwell.*
2. *C. Gopalan, B. V. Rama Sastri and S. C. Balasubramanian (1989) Nutritive Value of Indian Foods, National Institute of Nutrition, Indian Council of Medical Research.*
3. *Gibney, Lahnam-New, Cassidy and Vorster (2009) Introduction to Human Nutrition, Nutrition Society Textbook Series (2nd ed.) Wiley Blackwell Publisher*
4. *M. Eastwood (2003) Principles of Human Nutrition, Blackwell Science.*

Name of the Programme:	B. Tech
Semester:	4
Course Code:	UFE413
Course Title:	Principles of Consumer Behaviour
Course Credit:	3 (L: 3 T:0 P: 0)
Course objective:	• To provide students with an understanding of how consumers make decisions regarding food, beverage and related products in the marketplace. • To examine psychological, social, cultural and economic factors influencing consumer behaviour, especially in the food industry. • To equip students with the ability to apply consumer-behaviour concepts in food product development, marketing, branding and positioning decisions. • To develop analytical skills in interpreting consumer data, segmenting markets and designing marketing strategies for food-industry applications.
Pre-requisites:	-
Course outcomes:*	After completion of this course, students will be able to • Explain key concepts of consumer behaviour and their relevance to food marketing. • Analyse psychological, social and cultural factors that influence food purchase and consumption behaviour. • Evaluate how consumer decision-making works in the food context and design strategies for different purchase types. • Segment food markets appropriately and develop target-marketing and positioning strategies aligned with consumer behaviour insights.

Unit/ Module no.	Topic	No. of contact hours
1	Introduction to Consumer Behaviour: Definition, scope and importance of consumer behaviour in the food industry, dimensions of consumer behaviour: individual, group,	8

	organizational, application of consumer behaviour knowledge in food-marketing decisions.	
2	Psychological Influences on Consumer Behaviour: Motivation, ability and opportunity; exposure, attention and perception Categorizing and comprehending information, Learning and memory: how consumers learn about food brands, recall nutrition/ ingredient information, Attitude formation and change - food beliefs, health claims, brand trust.	8
3	Decision-Making Process and Food Purchase Behaviour: Consumer decision-making models (for food purchase) – need recognition, information search, evaluation of alternatives, purchase, post-purchase behaviour, Types of food purchase behaviour: habitual, variety-seeking, complex, impulse, post-purchase behaviour: satisfaction, loyalty, brand switching, disposal of food products.	10
4	Social, Cultural and Situational Influences: Group dynamics and consumer reference groups - Family - Social class cultural and subcultural aspects - cross cultural consumer behaviour	7
5	Emerging Issues in Consumer Behaviour in Food Industry: Consumer protection - difficulties and challenges in predicting consumer behaviour - online consumer behaviour - organizational and industrial buyer behaviour - consumer behaviour in Indian context - emerging issues	7

Reference Books:

1. *David L.Loudon, Albert J Della Bitta., (2002). New Delhi: Consumer Behaviour. McGraw Hill.*
2. *Sheth Mittal., (2003). Singapore: Consumer Behaviour A Managerial Perspective, Thomson Asia (P) Ltd.*
3. *K.K.Srivastava., (2002). New Delhi: Consumer Behaviour in Indian Context, Goal Gotia Publishing Co.*
4. *S.L. Gupta and Sumitra Pal., (2001). New Delhi: Consumer Behaviour an Indian Perspective, Sultan Chand.*
5. *Ms. Raju, Dominique Xavedel., (2004). New Delhi: Consumer behaviour, Concepts Applications and Cases, Vikas publishing house (P) Ltd.*

Name of the Programme:	B. Tech
Semester:	4
Course Code:	UFE471
Course Title:	Product Technology- I /II Lab
Course Credit:	1 (L: 0 T:0 P: 2)
Course objective:	• Provide hands-on training on physicochemical analysis of fruit- and vegetable-based food products such as juices, jams, jellies, and sauces. • Familiarize students with preparation and characterization of model processed products (jam, jelly, sauce) using standard protocols. • Impart practical understanding of important physical properties of agricultural materials relevant to handling, processing and design — including size, sphericity, bulk density, and angle of repose. • Demonstrate the working and performance assessment of selected size-reduction equipment (jaw crusher, hammer mill) for food/grain materials.
Pre-requisites:	-
Course outcomes:*	After completion of this course, students will be able to • Determine pH, titratable acidity and TSS of non-alcoholic beverages, jams, jellies and sauces using standard analytical procedures. • Prepare model products (orange jelly, apple jam, tomato sauce) and evaluate their physicochemical quality attributes. • Measure key physical properties (size, sphericity, bulk density, and dynamic angle of repose) of agricultural grains/materials and interpret their processing relevance. • Operate and evaluate size-reduction equipment (jaw crusher and hammer mill) and estimate performance parameters such as crushing efficiency.

Sl. No.	Name of the Experiment	No. of contact hours
1	Determination of titratable acidity & pH of given non-alcoholic beverages.	2
2	Determination of total soluble solid (TSS) and pH of Jam, Jelly and Sauces.	2
3	Preparation of orange jelly and its physicochemical study.	2
4	Preparation of apple jam and its physicochemical study.	2
5	Preparation of tomato sauce and its physicochemical study.	2
6	Determination of size and sphericity of given agricultural materials given.	2
7	Determination of bulk density of given agricultural cereals.	2
8	Determination of Dynamic Angle of Repose of given agricultural grains.	2
9	Estimation of crushing efficiency of jaw crusher for agricultural grains.	2
10	To study the operation of Hammer mill using agricultural grain.	2

Text Books:

1. *S Rangnna. Handbook of Analysis and Quality Control for Fruits and Vegetable Products. New Delhi, Tata Megrawhill, 2007.*

Name of the Programme:	B. Tech
Semester:	4
Course Code:	UFE472
Course Title:	Food Microbiology Lab
Course Credit:	1 (L: 0 T:0 P: 2)
Course objective:	• To provide hands-on experience in sterilization techniques and preparation of different types of microbiological media used in food analysis. • To develop skills in microbial enumeration and isolation techniques such as serial dilution, pour plate, spread plate, and streak plate methods. • To enable students to assess the microbiological quality and safety of food, beverages, and water samples using standard microbiological assays. • To familiarize students with basic staining techniques for studying microbial cell morphology and Gram characteristics.
Pre-requisites:	-
Course outcomes:*	After completion of this course, students will be able to • Prepare and sterilize various culture media and laboratory apparatus following aseptic techniques. • Perform microbial enumeration and isolation using dilution and plating methods to obtain pure cultures. • Analyze and compare the microbiological quality of different food, beverage, and water samples using standard tests (e.g., MBRT, plating). • Demonstrate proficiency in microscopic observation and differentiation of microorganisms through simple and Gram staining techniques.

Sl. No.	**Name of the Experiment**	**No. of contact hours**

1	Sterilization of microbial media and necessary apparatus and utensils	2
2	Preparation of microbiological culture media. Agar media (Petri-dishes and in slants) e.g. nutrient agar, Potato Dextrose Agar ii) Liquid broth e.g. nutrient broth, and preparation of dilution blank	2
3	Differential vs. generic / universal media vs. selective media.	2
4	Serial dilution preparation technique	2
5	Pour plating method	2
6	Spread plating method.	2
7	Determination of microbiological quality of a food /beverage/water i) MBRT of raw vs pasteurized milk, ii) Serial dilution and plating of manually extracted vs processed fruit juice, iii) Serial dilution and plating of tap water vs Aqua-guard water	2
8	Streak plating technique for pure culture preparation- Isolation of a bacterial culture from a food / food waste sample	2
9	Simple staining: Determination of bacterial cell morphology	2
10	Gram staining: Determination of bacterial cell wall structure	2

Reference Books:

1. Neelima Garg, et al. Laboratory Manual of Food Microbiology. New Delhi, International Publishing House Pvt. Ltd, 2010.

Proposed Courses from 4th Semester

4th Semester								
Name of the Programme		**B.Tech.**						
Name of the Department		**Instrumentation Engineering**						
A.		**Theory /Lab Courses**						
Sl No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	**CONTACT HOURS**	**Coordinating Department**
1	UHS401	Engineering Economics	3	0	0	3	3	HSS
2	UEE401	Electrical Machines	2	0	0	2	2	EE
3	UIE401	Sensors and Transducers	3	0	0	3	3	IE
4	UIE402	Analog Circuits	3	0	0	3	3	IE
5	UIE403	Digital Electronics	3	0	0	3	3	IE
6	UIE404	Signals and Systems	3	0	0	3	3	IE
7	UEE471	Electrical Machines Lab	0	0	2	1	2	EE
8	UIE471	Sensors and Transducers Lab	0	0	2	1	2	IE
9	UIE472	Analog Circuits Lab	0	0	2	1	2	IE
10	UIE473	Digital Electronics Lab	0	0	2	1	2	IE
			17	**0**	**8**	**21**	25	

Detailed Syllabus

Paper code: UEE401 **Paper name: Electrical Machines** **Credit: 2**

Total contact hours: 24 **L-T-P: 2-0-0**

Course Objectives:

1. To provide a basic introduction to Electrical Machines.
2. To provide mathematical model of Electrical Machines

Module 1: DC Machines **Contact hours: 05**

Introduction to DC machines, study and drawing of various parts of a DC machine, magnetic circuit and flux path, DC generators, EMF equation, shunt, series and compound generators, losses and efficiency studies.

Principle of DC motor, electromagnetic torque, Back EMF, shunt, series and compound motors, speed relations, losses and efficiency studies, motor characteristics studies, speed control of DC motors, introduction to servomotor, stepper motor and DC tachomotor.

Module2: Transformers **Contact hours: 08**

Introduction, construction and working principles, Ideal transformer, EMF equation, Phasor diagram, voltage transformation ratio, practical transformer on no-load and on–load, equivalent circuits, shifting impedances, transformer's tests, open circuit and short circuit's tests, voltage regulation, losses and efficiency studies, polarity of transformer, autotransformer, applications.

Module3: Induction Motor **Contact hours: 08**

Introduction, construction, types and working principle, slip, induction motor and transformer comparison, equivalent circuit, torque under starting and running conditions, torque-speed characteristics, torque-slip curve, losses and efficiency studies, effect of change in supply voltage, starting methods, speed control, no-load and blocked rotor characteristics, industrial applications in different areas.

Module 4: Single Phase Motors **Contact hours: 03**

Introduction, conditions at starting, Double Revolving Field Theory, circuit model, cross-field theory, making single- phase IM self-starting, split-phase motor, capacitor start motor.

Books/References:

1. B.L. Theraja and A.K. Theraja , A Text Book of Electrical Technology (Vol. 2) by, S.

Chand Publishing, 2005.
2. D. P. Kothari and I. J. Nagrath, Electric Machines, McGraw Hill Education, 5th Edition, 2017.
3. Dr. P.S. Bimbhra, Electrical Machinery, Khanna Publishing, 1st Edition, 2021.

Course Outcomes:

1. Students can have a basic knowledge of Electrical Machines.
2. Students can analyse the mathematical model of Electrical Machines

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Course Title: Sensors and Transducers
Course Code: UIE401 **Credit: 03**
Total contact hours: 36 **L-T-P: 3-0-0**

Course Objective:

1. To introduce students with the role of transducers in an instrumentation system.
2. To familiarize students with the basic principle of operation and other essential features of all important transducers used in industrial and laboratory applications.
3. To acquaint students about selection and design of signal conditioning circuit for a particular transducer application.

Course Outcome:

1. Students will know about the role of transducer and signal conditioning in an instrumentation system.
2. Students will know about the basic principle of working and other essential features of a transducer.
3. Students will able to select and design signal conditioning circuit for a particular transducer.

Module 1 **Contact hours: 4**

Definition, classification and selection of transducers. Elastic elements: diaphragm, cantilever, bellows and bourdon tube.

Module 2 **Contact hours: 6**

Resistive transducers: basic principle of working of resistive transducer, potentiometers, strain gauges, load cell, resistive accelerometer, RTD, thermistor and LDR.
Signal conditioning circuits for resistive transducer

Module 3 **Contact hours: 7**

Capacitive transducers: basic principle of working of capacitive transducer, different types of capacitive transducer (variable area, variable distance and variable dielectric constants), capacitor microphone and capacitive proximity sensor.
Signal conditioning circuits for capacitive transducer.

Module 4 **Contact hours: 7**

Inductive transducers: basic principle of working of inductive transducer, variable reluctance transducers, self and mutual inductance transducers, LVDT, RVDT, eddy current transducers, inductive proximity transducer, synchros and resolvers.
Signal conditioning circuits for inductive transducer.

Module 5 **Contact hours: 6**

Optical transducers: photoconductive, photovoltaic, photodiode, photo transistor and pyrometers.
Piezo electric transducers: basic principle of working of piezoelectric transducers, materials and properties, and modes of deformation
Signal condition circuits for optical and piezoelectric transducers.

Module 6 **Contact hours: 6**

Other transducers: Hall Effect transducers, ultrasonic transducer, proximity transducer, magneto elastic transducers, magneto-resistive transducers, digital transducers, smart sensor, IC Sensor and fiber optic transducer, thermocouple and seismic/vibration transducer.

Books:

1. Curtis D Johnson, Process Control and Instrumentation, PHI, 8th Edition, 2005.
2. D Patranabis, Sensors and Transducers, PHI, 2nd ed., 2003.
3. E. A. Doebelin, Measurement Systems: Application and Design, Mc Graw Hill, New York, 2003.
4. H. K. P. Neubert, Instrument Transducers, Oxford University Press, London and Calcutta

References:

1. D.V.S. Murty, Transducers and Instrumentation, PHI, 1995.
2. A K Sawhney: A course on electrical and electronic measurements and instrumentation, Dhanpat Raj & Co, 2005
3. Bentley, J.P., Principles of measurement systems. Pearson education, 2005.

Paper code: UIE402
Paper name: Analog Circuits
Credit: 3
L-T-P: 3-0-0
Total contact hours: 36
Course Objective:

1. To provide the knowledge of designing amplifiers and oscillators
2. To provide the concepts of OPAmp and its applications
3. To provide the concepts of timer based multivibrators, VCO and PLL

Course Outcome: At the end of this course students will be able to

1. Design amplifiers, sinusoidal and non-sinusoidal oscillators
2. Develop concepts about Differential Amplifier
3. Develop concepts about OpAmp and its characteristics
4. Develop design ability for OpAmp based circuits
5. Develop concepts of timer and timer based multivibrators
6. Develop concepts of VCO and PLL

Module 1: BJT and FET Biasing Schemes **Contact hours: 8**
Basic Configurations, Bias Stabilization, Self-Bias, Fixed Bias and Voltage Divider Bias, small signal model, Hybrid parameters.

Module 2: Power amplifier: **Contact hours: 5**
Introduction-Definition and amplifier types, Series fed Class A power amplifier, Transformer coupled class-A amplifier and efficiency, Class B amplifier operation and efficiency, Push Pull power amplifier.

Module 3: Feedback Amplifiers: **Contact hours: 5**
Classification of feedback amplifiers, Feedback concepts, properties of negative feedback, Principles of operation of four types of feedback amplifiers (voltage series/shunt, current series/ shunt). Input impedance, output impedance, advantage and disadvantages.

Module 4: Differential Amplifier and OpAmp basics: **Contact hours: 6**

Current mirror: Basic topology and its variants, V-I characteristics, output resistance and minimum sustainable voltage (VON), maximum usable load. Differential amplifier: Basic structure and principle of operation, Basics of OpAmp – Ideal and practical characteristics, input bias currents, input offset current, input offset voltage, slew rate and common mode rejection ration (CMMR), etc.

Module 5: OpAmp applications: **Contact hours: 6**

OpAmp as inverting, non-inverting, voltage follower, adder, subtractor, integrator, differentiator, logarithmic, antilogarithmic amplifier, multipliers, dividers and sample & hold device, instrumentation amplifiers, Comparators, Schmitt trigger, Half wave and full wave precision rectifiers,

Module 6: Oscillators and wave generators: Contact hours: 6

Oscillator operations, phase shift oscillator, Wien bridge oscillator, tuned oscillator, crystal oscillator, monostable and astable multi vibrators using OpAmp, square and triangular wave generators using OpAmp, Timer NE/SE555 – monostable, astable and bistable multi vibrators, VCO and PLL.

Text Books:

1. Integrated Electronics: Analog and Digital Circuits and Systems. by Millman and Halkias (Tata McGraw Hill)
2. Electronic Devices and Circuits Theory – Robert L. Boylestad and Louis Nashelsky, Pearson/Prentice Hall, 9th Edition,2006.
3. Opamps and Linear Integrated Circuits – Ramakant A Gayakwad (PHI), 4th Edition, 2015.

Reference Books:

1. Micro Electronic Circuits – Sedra A.S. and K.C. Smith, Oxford University Press, 5th ed., 2012.
2. Micro Electronic Circuits: Analysis and Design – M.H. Rashid, Thomson PWS Publ., 1999.
3. Principles of Electronic Circuits – S.G.Burns and P.R.Bond, Galgotia Publications, 2nd Edition, 1998.
4. Opamps and Linear Integrated Circuits – Driscol and Coughlin
5. Opamps and Linear Integrated Circuits – S Jain and D Roychoudhury
6. Design with Operational Amplifiers and Analog Integrated Circuits – Sergio Franco

COURSE NAME: DIGITAL ELECTRONICS

COURSE CODE: UIE403

SEMESTER-IV

Total Contact Hours: 36 Hours **L-T-P: 3-0-0**

Course Objectives:

1. To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.
2. To prepare students to perform the analysis and design of various digital electronic circuits.

Course Outcomes:

1. Have a thorough understanding of the fundamental concepts and techniques used in digital electronics.
2. To understand and examine the structure of various number systems and its application in digital design.
3. The ability to understand, analyze and design various combinational and sequential circuits.
4. To develop skill to build, and troubleshoot digital circuits.

Course Contents:

1. Number Systems **Contact hours: 4**

Introduction to Digital systems, Introduction to number systems (Binary, Decimal, Octal, Hexadecimal), Number representation in binary (Signed, One's and Two's complement), Binary Codes (BCD, Excess-3, Gray, Alphanumeric, Seven segment display code and Error detection and correction codes), Digital Arithmetic (Binary, BCD, Excess-3 arithmetic).

2. Logic gates **Contact hours: 3**

Introduction to various logic systems (positive & negative), Truth Table, Logic gates (OR, AND, NOT, BUFFER, EX-OR, EX-NOR), Universal gates (NAND, NOR), Tristate logic gates.

3. Logic families **Contact hours: 4**

Significance and types of logic families (RTL, DTL, TTL), Characteristic parameters (Fan-out, Fan-in, Noise margin, Propagation Delay etc…).

4. Boolean Algebra and Simplification Techniques **Contact hours: 4**

Introduction to Boolean algebra and its postulates and theorems, SOP and POS Boolean expressions, Simplification techniques (using Boolean theorems, K-Map).

5. Combinational Circuits **Contact hours: 6**

Arithmetic circuits (Adder, Subtractor, parallel binary adder, BCD adder, carry-propagation-look-ahead-carry generator, magnitude comparator), Multiplexer, De-multiplexer, Encoder, Decoder, Parity generator-checker.

6. Sequential Circuits **Contact hours: 6**

Concept of multivibrator, Flip-flops (R-S flip-flop, J-K flip-flop, D flip-flop, T flip-flop), flip-flop with preset and clear inputs, level and edge triggered flip-flops, race-around condition in flip-flops, Counters and Registers (asynchronous and synchronous counters, UP/DOWN counters, Ring counter).

7. Programmable Devices **Contact hours: 5**

PROM, PLA, PAL, FPGA, CPLD

8. Data Converters and Memory Devices **Contact hours: 4**

D/A Converters, A/D Converters, Types of Memory Devices: ROM, PROM, static RAM, Dynamic RAM

Books/References:

1. Morris Mano, Prentice Hall of India, New Delhi: Digital Logic and Computer Design

2. Malvino, Tata McGraw Hill New Delhi: Digital Computer Electronics

3. A. Anand Kumar, PHI Learning Private Limited, Delhi: Fundamentals of Digital Circuits

4. Anil K. Maini, Wiley: Digital Electronics

Paper Code: UIE404 **Paper Name: Signals and Systems**
Credit: 3 **Total contact hours: 36** **L-T-P: 3-0-0**

Course Objectives

1. This gives the basics of Signals and Systems required for all Instrumentation Engineering related courses.
2. To be familiar with the Time and Frequency domain analysis of continuous and discrete signals,

3. To study the behavior of Linear Time Invariant System
4. To be familiar with sampling, digitization and Reconstruction of Analog Signals
5. To be familiar with signals properties, auto and cross-correlation, power spectral density
6. Discuss concepts of Signals and Systems and its analysis using different transform techniques.

Details Syllabus

Module 1: Introduction: Discrete time signals & sequences, linear shift invariant systems, stability, and causality. Linear constant coefficient difference equations.

Module 2: Sampling: Sampling theorem – Graphical and analytical proof for Band Limited Signals, impulse sampling, Reconstruction of signal from its samples, effect of under sampling – Aliasing, Introduction to Band Pass sampling.

Module 3: Convolution and Correlation of Signals: Concept of convolution in time domain and frequency domain, Graphical representation of convolution, Convolution property of Fourier transforms. Cross correlation and auto correlation of functions, properties of correlation function, Energy density spectrum, Parseval's theorem, Relation between convolution and correlation, Detection of periodic signals in the presence of noise by correlation, Extraction of signal from noise by filtering.

Module 4: Laplace Transforms: Review of Laplace transforms, Partial fraction expansion, Inverse Laplace transform, Concept of region of convergence (ROC) for Laplace transforms
Fourier Transforms: Deriving Fourier transform from, Fourier transform of standard signals, Fourier transform of periodic signals, properties of Fourier transforms,

Module 5: Z–Transforms: Fundamental difference between continuous and discrete time signals, Concept of Z- Transform of a discrete sequence. Distinction between Laplace, Fourier and Z transforms. Region of convergence in Z-Transform, constraints on ROC for various classes of signals, Inverse Z-transform, properties of Z-transforms.

Module 6: DFT and FFT: Discrete Fourier transforms: Properties of DFT, linear convolution of sequences using DFT, Computation of DFT, Fast Fourier transforms (FFT) - Radix-2 decimation in time and decimation in frequency, FFT Algorithms, Inverse FFT,

Module 7: IIR and FIR Digital Filters: Design of IIR Digital filters from analog filters, Bilinear transformation method, step and impulse invariance techniques, Characteristics of FIR Digital Filters, frequency response. Design of FIR Digital Filters using Window Techniques,

TEXT BOOKS:
1. Discrete Time Signal Processing – A.V. Oppenheim and R.W. Schaffer, PHI, 1989.
2. Fundamentals of Digital Signal Processing – LoneyLuderman.
3. Digital Signal Processing – S. Salivahanan et al., TMH, 2000.
Digital Signal Processing – Thomas J. Cavicchi, WSE, John Wiley, 2004.
4. Digital Signal Processors, Architecture, Programming & Applications, - B. Venkata
Ramani, M.Bhaskar, TMH, 4th reprint, 2004.

Course Outcomes

At the end of the course student will be able to

1. Define signals and systems classify the signals and apply different operations on signal.
2. Represent any arbitrary signal in time and frequency domain.
3. Understand the characteristics of linear time invariant systems.
4. Determine Fourier series coefficient and Fourier transforms for different types of signals.
5. Determine Laplace transforms with their properties by using the concept of ROC.
6. Determine Z transforms with their properties by using the concept of ROC and relate with Laplace transform.
7. Digital filter design Techniques.

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Paper code: UIE471 **Paper name: Electrical Machines Lab**

Credit: 1 **Total contact hours: 24** **L-T-P: 0-0-2**

Course Objectives:

1. To provide a basic knowledge of how to handle Electrical Machines.
2. To provide knowledge of how to calculate different parameters of Electrical Machine

List of Experiments:

1. Open circuit characteristics of a DC shunt generator
2. Load test on DC shunt generator
3. Load test on DC series generator
4. Speed control of DC shunt motor
5. Ratio and polarity test on single-phase transformer
6. Open and short circuit test on single-phase transformer
7. Load test on single-phase transformer
8. Study of various parts of three phase induction motor
9. No-load and blocked rotor test on 3-phase induction motor
10. Study of windings of Induction motor

Course Outcomes:

1. Students can have a basic hands-on experience of Electrical Machines.
2. Students can find out the correct mathematical model of an Electrical Machine.

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Course Title: Sensors and Transducers laboratory
Course Code: UIE471 **Credit: 01**
Total contact hours: 2 hours per week **L-T-P: 0-0-2**

Course Objective:

1. Experimental study of selected transducers.
2. To acquaint students about practical implementation of transducers.

Course Outcome:

1. Students will able to perform experiments with selected transducers, collect data, plot graphs between input-output parameters and validate the experimental results with the theories.
2. Students will be familiar with laboratory equipment used for testing and measurements.

LIST OF EXPERIMENTS:

1. To determine the I-V Characteristics of LDR and Photodiode.
2. To determine the I-V Characteristics of Phototransistor.
3. To study strain gauge and plot the change in resistance with respect to strain or weight. Also, determine its sensitivity.
4. To study LVDT and plot the response of output voltage verses displacement. Also, determine its sensitivity.
5. To study RTD and plot the response between resistance verses temperature. Also, design a suitable Signal conditioning circuit for converting the change in resistance to voltage.
6. To study thermocouple and plot the response between voltage verses temperature. Also, design a suitable signal conditioning circuit to linearize the output with respect to the input.
7. To study thermistor and design a suitable signal conditioning circuit for converting the change in temperature to output voltage.
8. To study bellows and plot its characteristics.
9. To study bourdon tube and plot its characteristics.
10. To study temperature compensation in transducers.

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Paper code: UIE472
Paper name: Analog Circuits Lab
Credit: 1
L-T-P: 0-0-2
Total contact hours: 24
Course Objective:

4. To familiarise students with feedback and power amplifiers
5. To provide knowledge for design and analysis of Opamp based circuits
6. To provide knowledge for design and analysis of timer based circuits

Course Outcome: At the end of this course students will

1. Learn design and analysis of feedback amplifiers
2. Learn design and analysis of power amplifiers
3. Learn design and analysis of differential amplifier
4. Learn design and analysis of various Opamp based circuits
5. Learn design and analysis of 555 timer based multivibrators

List of Experiments:

1) To determine the effect of feedback on the frequency response of a
   i. Voltage Series
   ii. Voltage Shunt
   iii. Current Series
   iv. Current Shunt
2) To design a series fed class-A power amplifier in order to achieve max output ac power and efficiency.
3) To find the efficiency of a Complementary symmetry Class B Power Amplifier.
4) To design a differential amplifier with 2 BJTs and determine the common mode and differential gain
5) To Implement Inverting and NonInverting amplifier using OpAmp and determine the gain.
6) To Implement Integrator and Differentiator using Op-Amp and observe output waveform.
7) To Implement Comparator using OpAmp and observe output waveform.
8) To Implement Schmitt Trigger using Op-Amp and observe output waveform.
9) To Implement Low Pass Filter (LPF) using Op-Amp and plot frequency response curve.
10) To Implement High Pass Filter (HPF) using Op-Amp and plot frequency response curve.

11) To Design Astable multivibrator using IC 555 timer and determine its frequency of operation.
12) To Design Monostable multivibrator using IC 555 timer and determine its frequency of operation.

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COURSE NAME: DIGITAL ELECTRONICS LAB

COURSE CODE: UIE473

SEMESTER-IV

Total Contact Hours: 24 Hours **Credits: 01** **L-T-P: 0-0-2**

Course Objectives:

1. To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.
2. To prepare students to perform the analysis and design of various digital electronic circuits.

Course Outcomes: After completing the course students will be able to

1. Understand different types of logic gates, identify their ICs and verify their truth table.
2. Design and implement various combinational circuits like adders, subtractors, multiplexers, decoders etc.
3. Design and implement various sequential circuits like flip-flops, counters etc.
4. Realization of combinational and sequential circuits using simulation tools like Multisim.

LIST OF EXPERIMENTS:

1. Input-output verification of logic gates (ICs 74xx-group).
2. Practical validation of De-Morgan's theorem.
3. Practical validation of Boolean expressions and its minimized expression.
4. Implementation of various gates/Boolean expression by using universal gates only.
5. Design and study of half-adder and full-adder circuits.
6. Design and study of half-subtractor and full-subtractor circuits.
7. Design and study of digital multiplexer (4:1 / 8:1) circuit.

8. Design and study of digital de-multiplexer (1:4 / 1:8) circuit.
9. Design and study of Encoder circuit.
10. Design and study of Decoder circuit.
11. Study of Flip-flop circuits (R-S and J-K).
12. Study of asynchronous counters.
13. Study of synchronous counters.

Course Layout of Bachelor of Design

SEMESTER IV

Sl. No.	Course Code	Course Name	L	T	P	C
01.	UMD401	3D Modeling and Texturing	2	0	0	2
02.	UMD402	Rigging for Animation	2	0	0	2
03.	UMD403	Web Design Technology	2	0	0	2
04.	UMD404	Concept of Film Making	2	0	0	2
05.	UMD471	3D Modeling and Texturing Lab	0	0	4	2
06.	UMD472	Rigging for Animation Lab	0	0	4	2
07.	UMD473	Web Design Technology Lab	0	0	4	2
08.	UMD474	Concept of Film Making Lab	0	0	4	2
09.	UMD491	Design Studio – IV (Modeling and Texturing)	0	0	4	2
10	UMD41*	Elective – I (Project based)	0	0	4	2
	Contact Hours: 32		**8**	**0**	**24**	**20**
Elective Subjects						
1.	UMD411	Graphic Design for Communication	0	0	4	2
2.	UMD412	Comics and Visual Narrative	0	0	4	2
3.	UMD413	Art of Acting and Voiceover for Animation	0	0	4	2
4.	UMD414*	Any other subject offered from time to time	0	0	4	2

Course Contents | Semester – 4

Course Title: 3D Modeling and Texturing L-T-P-C: 2-0-4-4

Course Code: UMD401/471

Class Hours/week	Expected weeks	Total hours of classes
2	12	24
4	12	48

Course Objective:

The course aims to provide students with a comprehensive foundation in 3D modeling, texturing, and shading using Autodesk Maya and related tools. It focuses on understanding the 3D production pipeline, creating organic and hard-surface models, and developing environments and characters for digital media. Students will learn UV mapping, texturing workflows, and material creation using PBR techniques, leading to the production of visually detailed and industry-ready 3D assets for films, games, and animation.

Learning Outcomes:

1. Understand the 3D production pipeline and efficiently navigate the Maya interface for modeling, texturing, and rendering tasks.
2. Create 3D assets and environments using polygonal and subdivision modeling techniques with proper topology and edge flow.
3. Design and model organic and hard-surface characters with accurate anatomy, proportions, and detailing.
4. Apply UV mapping and PBR-based texturing techniques using tools like Substance 3D Painter and Photoshop for realistic surface detailing.
5. Develop and present shaded and textured 3D models with appropriate materials, lighting, and rendering for a professional portfolio.

Textbook/ References:

1. Kelly L. Murdock — Autodesk Maya 2024 Basics Guide. SDC Publications, July 2023. ISBN: 978-1-63057-580-9.
2. CADCIM Technologies / Prof. Sham Tickoo — Autodesk Maya 2024: A Comprehensive Guide (15th Edition). 2023-24. ISBN: 978-1-64057-185-3.
3. Frédéric Durand — Cinematic CG Lighting and Rendering: CG Enlightenment with Maya, Nuke, Arnold and V-Ray. Bloomsbury Academic, 2022. ISBN: 978-1-35002-543-1.
4. Zhou Jing Lai — Maya Arnold Material Lighting Rendering Technology from Entry to Actual Combat (Micro-Course Video Version) (Chinese Edition). Tsinghua University Press, February 2024. ISBN: 978-7-3026-5379-0.
5. Lee Lanier, Advanced Maya Texturing and Lighting, Third Edition, Autodesk Maya Press, Wiley Publishing Inc., 2015.

Unit	Topics	Contents	Hours T/P
1	**Fundamentals of 3D Modeling Interface**	• Overview of the 3D production pipeline (Modeling → Texturing → Rendering) • Maya interface and workspace navigation • Understanding the viewport, outliner, and project organization • Working with 3D transforms – translate, rotate, and scale • Managing scene hierarchy, pivots, grouping, and parenting • File management and scene setup for efficient workflow ***Lab-1:*** explore the Maya interface and workspace, learning to navigate viewports, use the outliner, and organize projects effectively. They will practice basic 3D transforms—translate, rotate, and scale—while understanding hierarchy, pivots, grouping, and parenting. The task includes setting up a clean scene with proper file management and saving conventions to ensure an organized 3D workflow.	2/4
2	**Unit – 2 Introduction to 3D Assets and Environment**	• Understand environment design principles and the use of polygonal modeling tools such as extrude, bevel, bridge, and insert edge loop. • Apply subdivision surface modeling and maintain clean edge flow for accurate 3D assets. • Model simple props and structures to create indoor and outdoor environment layouts with proper scene setup and camera placement. ***Lab-2:*** Create a simple 3D environment by modeling basic props and architectural elements using polygonal tools like extrude, bevel, and bridge. Arrange the assets into a cohesive indoor or outdoor scene, set up appropriate camera angles, and prepare the scene for presentation.	2/6
3	**Unit – 3 3D Character Modeling for Organic and Hard Surfaces**	• Study anatomy and proportions for accurate 3D character design. • Create base character forms using block modeling for humanoids and creatures. • Refine models through sculpting and topology optimization. • Incorporate hard-surface elements like armor, accessories, and mechanical parts. • Model facial features, body, and limbs with proper edge loops. • Integrate organic and mechanical modeling techniques for detailed character design. ***Lab-3:*** Create a 3D character model starting from basic block forms, refining it through sculpting and proper topology. Add both organic and hard-surface details such as facial features, armor, or accessories. Ensure correct	4/10

		anatomy, edge flow, and proportions suitable for animation or game production.	
4	**Unit-4 UV Mapping Fundamentals**	• Understand UV mapping concepts and coordinate systems • Explore different UV layout techniques — planar, cylindrical, automatic, and unfolding • Learn to use the UV Editor for proper layout organization ***Lab-4:*** Unwrap a simple 3D prop using planar and cylindrical mapping techniques. Organize UV shells efficiently within the UV space, ensuring minimal stretching or distortion for improved texturing and look development.	6/10
5	**Unit-5 Texture Baking and Painting**	• Learn and apply texture baking workflows to transfer surface details between 3D models. • Practice hand-painting and procedural texturing using Substance 3D Painter or Photoshop. • Organize, export, and apply texture maps for rendering and final presentation. ***Lab- 5***: Bake high- and low-poly model details using appropriate texture baking workflows. Create and refine textures in Substance 3D Painter or Photoshop, applying both hand-painted and procedural techniques. Finally, organize and export texture maps, then apply them to the 3D model for a polished, render-ready presentation.	6/10
6	**Unit – 6 Look Development**	• Introduction to shading networks using Hypershade or Shader Editor. • Understanding material properties such as diffuse, reflection, refraction, and transparency. • Creating node-based shaders for customized material effects. • Exploring procedural and image-based shading techniques. • Linking and combining texture maps to enhance surface realism. • Basic lighting and rendering setup for final output. • Preparing and presenting portfolio-ready renders of textured and shaded models. ***Lab-5:*** Create and apply various materials using the Hypershade or Shader Editor in Maya. Experiment with diffuse, metallic, roughness, normal, displacement, and transparency properties to build realistic shaders. Combine procedural and image-based textures to enhance surface detail, then light and render the final scene for a polished portfolio presentation.	4/8

Course Title: Rigging for Animation L-T-P-C: 2-0-4-4

Course Code: UMD402 / 472

Class Hours/week	Expected weeks	Total hours of classes
2	12	24
4	12	48

Course Objectives:

1. To introduce the basics and importance of rigging in 3D animation.
2. To make the students understand joints, pivots, hierarchies, and constraints.
3. To create character skeletons and apply FK/IK systems.
4. To develop intuitive control rigs for animation.
5. To apply skinning and weight-painting for realistic movement.

Learning Outcomes:

1. Understand the role of rigging in the 3D animation workflow.
2. Build joint hierarchies and apply constraints effectively.
3. Implement forward and inverse kinematics for character motion.
4. Use deformers and skinning methods for natural deformations.
5. Design a functional animation-ready character rig

Unit	Topics	Content	Hours T/P
1	Rigging Basics	Basic concept of rigging, Character rigging in 3D production, Role rigging artist. Parenting v/s Grouping, Constraints, Types of constraints, understanding joints, Bone set-up, importing character in Maya, setting up bones for biped character, managing hierarchies.	5/6
2	Character Rigging	Character Rigging: Anatomy study, Understanding Skeletons and Joints, Use of Deformers, Creating bones for Character.	5/10
3	Kinematics	Kinematics: Inverse kinematics (IK) & forward kinematics (FK)	5/10
4	Character setup	Character set-up for a wide range of complex body movement, with controls that are intuitive and flexible.	5/14
5	Skinning Methods	Binding & Weight for character, direct and indirect skinning methods	4/8

Textbooks / References Books:

1. *Inspired 3D Advanced Rigging and Deformations* by Brad Clark, John Hood & Joe Harkins; Course Technology PTR; 1 edition (March 25, 2005), ISBN-10: 1592001165.
2. *Rig it Right! Maya Animation Rigging Concepts*, by Tina O'Hailey; 3rd Edition, Routledge, 2018.
3. Digital Creature Rigging: Wings, Tails & Tentacles for Animation & VFX by Stewart Jones, CRC Press, 2019.
4. 3D Character Development Workshop: Rigging Fundamentals for Artists and Animators by Erik Van Horn, Mercury Learning & Information, 2018.
5. *Mastering 3D Animation, Paperback* by Peter Ratner; Allworth Press, U.S., 2000.

Course Title: Web Design Technology L-T-P-C: 2-0-4-4

Course Code: UMD403 / 473

Class Hours/week	Expected weeks	Total hours of classes
2	12	24
4	12	48

Course Objective:

The primary objectives of this course are to introduce students to the fundamental technologies, tools, and historical context of web design, and to develop their practical skills in creating, authoring, and optimising basic web content.

Learning Outcomes:

1. Analyse and articulate the historical evolution and background of the World Wide Web and its impact on contemporary design and communication.
2. Demonstrate proficiency in using industry-standard design and authoring software (e.g., Photoshop, Dreamweaver, etc.) for creating and managing web assets and layouts.
3. Apply foundational knowledge of essential web languages, including HTML for structuring content, CSS for styling, and basic concepts of JavaScript and PHP for interactivity and dynamic functionality.
4. Design and launch basic websites using a Content Management System like WordPress and apply basic Search Engine Optimisation (SEO) principles to improve content visibility and search engine ranking.
5. Independently plan, design, and execute small-scale web design projects, integrating all learned technologies and tools, and effectively participate in constructive design discussions.

Unit	Topics	Content	Hours T/P
1	History	History of the Web and its background	6/0
2	Design Essentials	Web design tools and techniques – including Photoshop, Dreamweaver, Flash, FrontPage, and other essential tools and software - for web authoring.	6/12
3	Design and Development	Web design technology – Introduction to HTML, CSS, Java, and PHP.	6/12
4	Web Applications	WordPress tools, SEO technology, and Search engine technology.	6/12
5	Project and Discussions	Assignments and Discussions	0/12

Textbooks / References:

6. Using the internet (4th Ed.), Prentice Hall, New Delhi, 2000.
7. Building a website, Tim Worsley, Orling Kindersely, New Delhi, 2000.
8. Web Designing Fundamentals, Daniel Gray, Dreamtech Press, New Delhi, 2000.
9. How the Internet Works, Millennium Edition by Preston Gralla.
10. Adaptive Web Design, 2nd Edition, by Aaron Gustafson, New Riders, December 2015.

Course Title: Concept of Film Making L-T-P-C: 2-0-4-4

Course Code: UMD404/474

Class Hours/week	Expected weeks	Total hours of classes
2	12	24
4	12	48

Course Objectives:

1. To introduce students to the aesthetic, narrative, and technical foundations of filmmaking.
2. To provide an understanding of visual storytelling, film language, and cinematic structure.
3. To develop basic skills in pre-production, production, and post-production processes.
4. To encourage critical engagement and creative expression through short film projects.

Learning Outcomes:

By the end of the course, students will be able to:

1. Demonstrate understanding of fundamental film concepts and language.
2. Apply narrative and visual techniques in short film projects.
3. Operate basic filmmaking tools and software.
4. Critically analyse film form, content, and cultural context.

Unit	Topics	Content	Hours T/P
1	**Introduction to Cinema and Film Language**	Evolution of cinema: From silent era to digital age • Film as art, communication, and cultural expression • Understanding film language: shot, scene, sequence, frame, mise-en-scène • Genre and narrative conventions • Key film movements: Realism, Expressionism, Neo-Realism, New Wave, etc.	4/8
2	**Storytelling and Screenwriting**	Idea generation and concept development • Three-act structure and dramatic arc • Character development, dialogue, and conflict • Writing for screen: short film script format and screenplay essentials • Visual narration and storyboarding.	4/10
3	**Pre-Production and Production**	• Stages of film production • Script breakdown, location scouting, casting, and scheduling • Camera types, lenses, and basic cinematography • Lighting design: principles and techniques • Sound recording and direction basics	6/10
4	**Post-Production and Editing**	• Principles of editing: continuity, rhythm, montage • Introduction to editing software (Adobe Premiere Pro) • Sound design and Foley • Music and its role in emotion and storytelling • Color correction and final output	6/10
5	**Film Appreciation and Analysis**	• Reading visual texts: narrative, aesthetics, and ideology • Auteur theory and directorial style • Indian and World Cinema: Case studies	4/10

		• Documentary vs Fiction • Ethics and cultural representation in filmmaking	

Textbooks / References:

1. Renee Dunlop, *Production Pipeline Fundamentals for Film and Games*, Focal Press.
2. Eve Light Honthaner, *The Complete Film Production Handbook*, Focal Press.

Course Title: Design Studio – IV (Modeling & Texturing) L-T-P-C: 0-0-4-2

Course Code: UMD491

Class Hours/week	Expected weeks	Total hours of classes
0	0	0
4	12	48

Course Objective/s:

The primary objectives of this project-based course are to master fundamental 3D asset creation pipelines, focusing on polygonal and NURBS modelling techniques, and to develop advanced skills in UV mapping, digital sculpting, and texture application for characters and environments.

Learning Outcomes:

1. Construct complex 3D models (characters and/or environment sets) utilising appropriate geometry types, specifically demonstrating proficiency in both polygonal and NURBS modelling techniques.
2. Utilise digital sculpting tools to add high-fidelity detail, form, and organic complexity to modelled characters and environment sets, moving beyond base geometry.
3. Create and manipulate effective UV texture maps for complex 3D assets (characters/objects), ensuring minimal distortion and optimal placement for subsequent texturing.
4. Apply various texture mapping techniques (e.g., diffuse, specular, and normal maps) to 3D objects and characters to define surface properties, colour, and visual fidelity, enhancing the final design aesthetics.
5. Analyse and document the full 3D asset creation pipeline (modelling, sculpting, UV mapping, texturing) in a comprehensive final design-based project report.

Unit	Topics	Content	Hours T/P
1	**Project 1**	**Project based on the following contents:** Designing and Modeling a character with Polygons or NURBS/ Designing a 3D environment set.	0/12
2	**Project 2**	**Project based on the following contents:** Sculpting the Character/ Environment set, Projection UVs map /Utilises the UV texture, etc.	0/12
3	**Project 3**	**Project based on the following contents:** Adding texture mapping to objects/characters.	0/12
4	**Project 4**	**Final design-based project report.**	0/12

Course Title: Graphic Design for Communication (Project Based) L-T-P-C: 0-0-4-2

Course Code: UMD411

Class Hours/week	Expected weeks	Total hours of classes
0	0	0
4	12	48

Course Objective/s:

The primary objectives of this course are to establish a solid foundation in the principles of visual communication, enabling students to translate ideas into effective graphic design solutions for both print and digital media, and to understand the technical workflow from concept to final reproduction.

Learning Outcomes:

1. Develop and execute visual solutions by applying various drawing and illustration techniques, effectively communicating complex ideas and concepts through images and new media.
2. Design effective visual compositions for both page (print) and screen (digital) environments, demonstrating a critical understanding of how to integrate text, image, and graphic elements.
3. Differentiate and evaluate various traditional (Lithography, Screen Printing, etc.) and digital printing technologies, making informed decisions on paper choice and understanding factors like dot gain that affect print quality.
4. Manage the technical pre-press workflow, including tasks such as Desktop Publication (DTP) production, colour separation, and preparing final files (positives/plates) for professional offset printing.
5. Independently design and produce professional-quality collateral such as stationery, booklets, and product labels, adhering to industry standards for file preparation and delivery.

Unit	Topics	Content	Hours T/P
1	**Foundations of Visual Communication**	Communicating ideas and concepts through various drawing and illustration techniques, and creating artworks for reproduction using new media tools. Basic visual compositions using text and image for both page and screen.	0/12
2	**Introduction to Printing Technology**	Traditional vs. Digital Printing: Lithography, Gravure, Letterpress, Screen Printing, Digital Printing. Dot gain and choice of papers for different quality of printing. Paper sizes and their formats.	0/12
3	**Pre-Press and Desktop Publishing (DTP)**	Desktop Publication production, colour separation, positives and plate making, exposure to pre-press activities in offset printing.	0/12
4	**Applied Design Projects**	Assignments in the design of stationery (visiting cards, letter heads, etc.), booklets, or label designs for small products.	0/12

Texts/References:

3. B. Gordon and M. Gordon, *Complete Guide to Digital Graphic Design*, Thames & Hudson, 2002
4. A. Pipes, *Production for Graphic Designers*, Laurence King Publication, 1997
5. T. Porter and S. Goodman, *Manual of Graphic Techniques*, Vols. 1, 3, 4, Architectural Press, 1999
6. A. Glossman, *Printing Fundamentals*, Tappi Press, 1985
7. T. Porter, *Design Drawing techniques for architects, graphic designers and artists*, Architectural Press, Oxford, 1991.

Course Title: Comics and Visual Narrative L-T-P-C: 0-0-4-2

Course Code: UMD412

Class Hours/week	Expected weeks	Total hours of classes
0	0	0
4	12	48

Course Objective/s:

The primary objectives of this course are to immerse students in the art and craft of sequential storytelling, enabling them to master the language of comics through hands-on practice in narrative construction, visual design, and digital production techniques, and to develop a unique personal voice within the medium.

Learning Outcomes:

1. Analyse and articulate the complex interplay of visual composition, panel transitions, and literary elements that construct compelling sequential narratives in both global and Indian comics.
2. Translate abstract concepts into a structured comic script, effectively utilising key elements like character design, storyboarding, and pacing to convey emotion, motion, and meaning.
3. Demonstrate proficiency in fundamental comics techniques, including effective panel layout, framing, and lettering, to control the reader's experience and flow across the page.
4. Conceptualise, design, and produce a complete, professional-quality digital comic book (10–12 pages), utilising iterative prototyping and appropriate traditional/digital tools from concept to finished piece.
5. Critically evaluate and document their complete comic creation workflow, clearly articulating design choices, style development, and technical production processes in a reflective report.

Unit	Topics	Content	Hours T/P
1	**Foundations of Sequential Art**	Introduction to the art and craft of visual storytelling and comics as a medium. Analysis of narrative structures, visual composition, and the relationship between words and images. Study of exemplary global and Indian comics for deconstruction.	0/12
2	**Narrative Design and Pre-Production**	Focus on character design, writing for comics, and developing the visual blueprint. Techniques include storyboarding, scripting, framing, and establishing pacing and rhythm in panels. Emphasis on communicating emotion and meaning.	0/12
3	**Production and Prototyping**	Hands-on experimentation with traditional and digital tools for drawing and inking. Iterative prototyping of pages. Focus on panel layout, page design, and developing a personal voice and style. Development of a short-finished piece.	0/12
4	**Final Production and Reflection**	Conceptualising, designing, and producing the final long-form comic project (10–12 pages). Finalising the visual style, colouring/shading, and preparing the book for digital output (PDF/interactive format). Documentation of the creative process.	0/12

Textbook/References:

1. McCloud, Scott - *Understanding Comics: The Invisible Art* (William Morrow Paperbacks, 1994).
2. McCloud, Scott - *Making Comics: Storytelling Secrets of Comics, Manga and Graphic Novels*. (William Morrow Paperbacks, 2006)
3. McCloud, Scott - *Reinventing Comics: How Imagination and Technology Are Revolutionising an Art Form*. (William Morrow Paperbacks, 2000)

Course Title: Art of Acting and Voiceover for Animation L-T-P-C: 0-0-4-2

Course Code: UMD413

Class Hours/week	Expected weeks	Total hours of classes
0	0	0
4	12	48

Course Objective/s:

1. Develop foundational skills in acting and voice performance for animated characters.
2. Understand the relationship between physical expression, vocal delivery, and visual design.
3. Experiment with hand-drawn animation techniques to support character development.
4. Create original animated scenes incorporating voiceover and performance elements.
5. Build a portfolio showcasing creative and technical competencies for future career opportunities.

Learning Outcomes:

1. Demonstrate proficiency in voice modulation, timing, and emotional range to create distinct and believable vocal characterisations suitable for animation and dubbing.
2. Analyse and apply foundational acting techniques, understanding how gesture, expression, and vocal delivery directly inform and enhance the visual design and storytelling of an animated character.
3. Execute the technical process of synchronisation, effectively aligning recorded voice tracks with animated movement (lip-sync) and physical action.
4. Employ basic hand-drawn animation techniques as an experimental tool to study and convey timing, gesture, and expressive emotional movement.
5. Design and produce an original animated scene or short project, successfully integrating all aspects of voiceover recording, performance, and visual execution into a professional portfolio piece.

Unit	Topics	Contents	Hours T/P
1	**Foundations of Animated Performance**	Fundamentals of acting for animation. Exploring the relationship between physical expression, vocal delivery, and visual design. Introduction to character development through gesture and expression.	0/12
2	**Voice and Emotional Delivery**	Intensive focus on voice modulation, timing, and emotional delivery tailored for animated characters. Techniques for creating distinct vocal personas and conveying complex feelings through sound.	0/12
3	**Integration and Synchronisation**	Synchronisation of voice with animated movement (lip-syncing and action-syncing). Practical application of hand-drawn animation techniques to support expressive storytelling and character development.	0/12
4	**Production and Portfolio Project**	Recording and editing voiceover for animated scenes. Integration of performance with design workflows (animatics/storyboards). Creation of original animated scenes incorporating voiceover.	0/12

Textbook/References:

1. Alburger, James R. *The art of voice acting: The craft and business of performing for voiceover*. Focal Press, 2023.
2. Hayes, Derek. *Acting and performance for animation*. Routledge, 2013.

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[Proposed syllabus of the B. Tech (Computer Sciences and Engineering branch only) 4th Semester]

Subject Code	Subject Name	L-T-P	Credit
UMA401	DISCRETE MATHEMATICS	2-1-0	3

Course Objectives: The objective of this course is to introduce students to the fundamental concepts of discrete mathematics that form the theoretical foundation of computer science and advanced mathematical studies.

Main objectives of the course is

- to understand and apply basic structures such as sets, relations, functions.
- to understand and apply basic concepts of the algebraic structures such as group and rings, field, integral domain and partial orders.
- to understand and apply the basic concepts of graphs and trees.

It emphasizes logical thinking, abstraction, and the use of mathematical reasoning for problem-solving.

Unit-I

Set Theory: Introduction, Combination of sets, Multisets, Ordered pairs. Proofs of some general identities on sets. Relations: Definition, Operations on relations, Properties of relations, Composite Relations, Equality of relations, Recursive definition of relation, Order of relations. Functions: Definition, Classification of functions, Operations on functions.

Unit-II

Algebraic Structures: Definition, Groups, Subgroups and order, Cyclic Groups, Cosets, Lagrange's theorem, Normal Subgroups, Permutation and Symmetric groups, Group Homomorphisms, Definition and elementary properties of Rings and Fields, Integers Modulo n. Partial order sets: Definition, Partial order sets, Combination of partial order sets, Hasse diagram.

Unit-III

Trees and Tree's Properties Graphs: Definition and terminology, Representation of graphs, Multigraphs, Bipartite graphs, Planar graphs, Isomorphism and Homeomorphism of graphs, Euler and Hamiltonian paths.

Course Outcomes:

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

1) Apply fundamental concepts of set theory, including operations on sets, multisets, ordered pairs, and general identities, to solve mathematical and computational problems.

2) Analyze and construct various types of relations and functions, determine their properties, and perform operations such as composition and classification.

3) Demonstrate an understanding of algebraic structures by identifying and working with groups, subgroups, cyclic groups, cosets, normal subgroups, and group homomorphisms.

4) Apply foundational concepts of rings, fields, and integers modulo *n* to solve algebraic problems and understand their relevance in discrete mathematical systems.

5) Interpret and analyze partially ordered sets, their combinations, and represent them using Hasse diagrams.

6) Understand, represent, and analyze graphs and trees, including their properties, types, and applications, and solve problems involving isomorphism, planarity, Euler paths, and Hamiltonian paths.

References:

1. Koshy, Discrete Structures, Elsevier Pub. 2008
2. Kenneth H. Rosen, Discrete Mathematics and Its Applications, 6/e, McGraw-Hill, 2006.
3. B. Kolman, R.C. Busby, and S.C. Ross, Discrete Mathematical Structures, 5/e, Prentice Hall, 2004.
4. E.R. Scheinerman, Mathematics: A Discrete Introduction, Brooks/Cole, 2000.
5. R.P. Grimaldi, Discrete and Combinatorial Mathematics, 5/e, Addison Wesley, 2004.
6. Jean Paul Trembley, R Manohar, Discrete Mathematical Structures with Application to Computer Science, McGraw-Hill, Inc. New York, NY, 1975.

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Name of the Programme:	B. Tech
Semester:	Fourth

Course Code:	UHS401
Course Title:	Engineering Economics
Course Credit:	3 (L: 3 T:0 P: 0)
Course objective:	• To introduce the fundamental concepts and principles of economics and their applications in engineering and management decisions. • To develop an understanding of consumer behaviour, utility, demand–supply mechanisms, production and cost analysis, profit estimation, and break-even analysis for effective decision-making. • To analyze different market structures, price–output determination, and key macroeconomic • To introduce the concepts such as national income, taxation, inflation, and banking. • To familiarize students with economic reforms and current situation in India—as well as international trade, global financial institutions, and capital markets.
Pre-requisites:	As this paper is introductory in nature, no prerequisite knowledge is required.
Course outcomes:*	After completion of this course, students will be able to 1. Comprehend and apply the fundamental concepts and principles of economics in engineering and managerial decision-making. 2. Analyse consumer behaviour and producer behaviour, demand–supply dynamics, and production–cost relationships to support efficient resource utilization and planning. 3. Evaluate market structures and differentiate among various market forms. 4. Understand macroeconomic variables influencing business operations and national economic performance. 5. Assess the impact of economic reforms, international trade, and global financial institutions on the Indian and world economies. 6. Demonstrate awareness of the stock exchange and the regulatory roles of SEBI and IRDA.

Unit/ Module no.	Topic	Nos. of contact hours	Distribution of marks (out of 100)
1	**Key Economic Concepts**: Definition of	12	30

	Economics and concept of Engineering Economics. Consumer behaviour, Utility analysis and demand analysis, Types of Demand, Law of Demand, Concept of supply and Law of Supply, Elasticity of Demand and supply: Types and Measurement Concept of Production function and Revunue function, Cost Analysis, Profit and Break Even Analysis.		
2	**Market Forms**: Perfect and Imperfect markets, Features of Perfect competition, Monopoly and Monopolistic competition. Price and output determination under Perfect Competition, Monopoly, Monopolistic and Oligopoly market, etc.	10	20
3	**Key Macroeconomic Concepts**: National Income and various methods of measuring it, Source of Public Revenue-Tax Revenue and Non-Tax Revenue, Direct and Indirect Tax. Inflation and Deflation. Banking-Definition - Types of Banks and their various functions.	10	25
4	**Reforms and Regulatory Institutions and Global Financial Institutions**: Economic Reforms in India - Concept and Implications,Overview of the Current Indian Economic Scenario. Concept of Stock Exchange Market, Role of SEBI and IRDA. International Trade, Gains from International Trade, Role and Function of IMF, World Bank and WTO.	8	25

Text Books:

1. Koutsoyiannis, A. (1993). Modern Microeconomics (3rdEd.). Macmillan Education
2. Salvatore, D. (2005). Principles of Microeconomics (5thEd.).Oxford University Press
3. Uma Kapila (ed.) (2024).Indian Economy since Independence: A Comprehensive and Critical Analysis of India's Economy, 1947- 2023. Academic Foundation
4. Mankiw, N. Gregory (2017). Macroeconomics (11thEd.). Macmillan Learning

** In the context of accreditation, a course outcome (CO) is a specific, measurable statement that describes what students should know, understand, and be able to do after completing a course. The maximum number of outcomes for a course is expected to be around 6 as per NBA*

document. COs should reflect on the measurable outcomes towards attaining the outcomes of the Programme.