NIRMA UNIVERSITY
NAAC ACCREDITED 'A+' GRADE

NU/AC/AC-120324/3(B)/24- 56
Date: 20.06.2024

NOTIFICATION

Read:
1. **R-44 – Empowering Academic Council to approve Teaching & Examination Scheme, Syllabi, etc published vide notification No. NU-442 dated 27.01.2004**
2. **Resolution Nos. 3, 4(I)(A), 5(B), 6(B), 7(A)(ii), 8(A)(ii), 9(B), 10(A)(ii), and 11(B) – Faculty of Technology & Engineering meeting – 14.02.2024**
3. **Resolution No. 3(B) – Academic Council meeting – 12.03.2024**

Sub: **Introduction of 'Minor' along with Teaching & Examination Scheme of Semesters-V to Vi/VII and Syllabi of Semester-V**

It is hereby notified for information of all concerned that the Academic Council in its meeting held on 12.03.2024 under resolution No. 3(B) and in exercise of powers conferred upon it by the Board of Governors under regulation referred at serial 1 above and taking into consideration recommendations of the Faculty of Technology & Engineering, has resolved to approve introduction of following **Minor** along with the Teaching & Examination Scheme of Semesters-V to VI/VII and Syllabi of courses of Semester-V to be offered to the students of **B.Tech.** programmes admitted from academic year 2022-23 onwards and for the Diploma to Degree students admitted from academic year 2023-24 onwards, attached herewith as ***Appendix*-A**:

Executive Registrar

Encl.: Appendix-A

To,
1. Dean, Faculty of Technology & Eng.
2. Director (SoT)
3. All Heads of Department
4. Dy. Registrar (Exam)

Copy to,
1. Asst. Registrar/OS (IT)
2. Exam Section (IT)
3. Library (IT)
4. P.A. to ER

c.f.w.cs. to Director General

Appendix-A
Noti.No. NU-56
Acad.Cou.mtg. – 12.03.24

TEACHING AND EXAMINATION SCHEME
B. TECH. (in any discipline) and Minor in Applied Mathematics
(to be made effective for students admitted in 2022-23 and D to D students admitted in 2023-24)

Sr.	Course Code	Course Title	Teaching Scheme				Examination Scheme			
							Duration Hours	Component Weightage		
			L	T	P	C	SEE	CE	LPW	SEE
SEMESTER – V (Core Courses I and II under Minor)										
1	3MH501IC24	Operations Research	3	-	2	4	3	0.3	0.3	0.4
2	3MH301IC24	Probabilistic Models	3	1	0	4	3	0.6	-	0.4
SEMESTER – VI (Core Course III under Minor)										
1		Advanced Statistical Methods	3	-	2	4	3	0.3	0.3	0.4
SEMESTER – VI (Elective Course I under Minor)										
1		Financial Mathematics and Derivatives	3	1	-	4	3	0.6	-	0.4
2		Advanced Optimization Techniques	3	1	-	4	3	0.6	-	0.4
3		Dynamics and Differential Equations	3	1	-	4	3	0.6	-	0.4

L: Lectures, P/T: Practicals / Tutorial, C: Credits SEE: Semester End Examination

LPW/PW: Laboratory / Project Work CE: Continuous Evaluation

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B. Tech. (All)
Course Code:	3MH501IC24
Course Title:	Operations Research
Course Type:	Core
Year of introduction:	2024-2025

L	T	Practical component				C
		LPW	PW	W	S	
3	-	2	-	-	-	4

Course Learning Outcomes (CLO):

At the end of the course, students will be able to -

1. **identify and express a decision problem in mathematical form and solve it using different optimization methods** **(BL3)**
2. **recognise and formulate transportation, assignment problems and drive their optimal solution** **(BL3)**
3. **model competitive real-world phenomena using concepts from game theory analyse pure and mixed strategy games** **(BL3)**
4. **formulate Network models for service and manufacturing systems, and apply operations research techniques and algorithms to solve these Network problems** **(BL4)**
5. apply the basic theories and techniques related to project management **(BL5)**

Unit	Contents	Teaching hours (Total 45)
Unit I	**Linear Programming:** Structure and Assumption of Linear Programming, Mathematical Form of General LPP, Formulation of an LPP, Slack, Surplus and Artificial Variables, Standard Form of LPP, Solution of LPP using Graphical Method, Simplex Method and Two-Phase Method	07
Unit II	**Transportation Problem:** Mathematical Model of Transportation problem, Methods to find initial basic feasible solution, North-West corner method (NWCM), Least Cost Method (LCM), Vogel's approximation method, Method for finding optimal solution – MODI method, Special cases in transportation Problem	08
Unit III	**Assignment Problem:** Introduction, Mathematical Model, Method to find an optimal solution- Hungarian Method, Variations in assignment problem- multiple optimal solutions, Maximization case in assignment problem, Unbalanced assignment problem, restrictions on assignment	07

Unit IV	**Sequencing problems:** Optimal sequencing of N Jobs on 2 and 3 machines without passing.	07
Unit V	**Game theory:** Introduction to Game theory, Fundamental theorem of game theory, min-max and max-min principle, Formulation of two-person zero sum rectangular games, Solution of rectangular games with saddle points, dominance principle, rectangular games without saddle point – mixed strategy, games, Graphical, algebraic and linear programming solution of m x n games.,	08
Unit VI	**Project Management:** Introduction, Basic Difference between PERT and CPM, Phases of Project Management, PERT / CPM Network Components and Precedence Relationship, Critical Path Analysis-Forward Pass Method , Backward Pass Method , Float of an Activity and Event, Critical Path, Time estimation and Critical Path in Net-Work Analysis	08

Lab Works: This shall consist of 15 practical based on the syllabus using MS-Excel.

Self-Study: Self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from the self-study contents.

Suggested Readings:

1. Introduction to Operation Research, Hillier F. S., Lieberman G. J. and Nag B, McGraw Hill Education
2. Operation Research: An introduction, Taha H, Pearson
3. Kantiswarup, Gupta P. K. and Manmoha. Operations Research, S.Chand & Sons, New Delhi
4. Sharma S.D. Operations Research, Kedarnath Ramnath & Co.Meerut
5. Sharam J. K. Operations Research, Kedarnath Ramnath & Co.Meerut

List of Practical

(This is for information and not restricted to the following)

1) LPP - Graphic solution.
2) LPP - Simplex method.
3) LPP - Two phase simplex methods.
4) Transportation - NWCR.
5) Matrix minima method.
6) VAM for IBFS.
7) Assignment Problem (Balanced).
8) Unbalanced assignment problems.
9) Travelling salesman problems.
10) Sequencing problems- n jobs-2 machines sequencing problem
11) n jobs-3 machine sequencing problem.
12) Solution of Two-Person Zero-Sum pure and mixed strategy game.
13) Linear programming solution of game problem.
14) Project planning (Deterministic case-CPM).
15) Project planning (Probabilistic case-PERT)

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B. Tech.
Course Code:	3MH301IC24
Course Title:	Probabilistic Models
Course Type:	Core
Year of introduction:	2024-2025

L	T	Practical component				C
		LPW	PW	W	S	
3	1	-	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to –

1. **apply various discrete and continuous probability distributions and to study various real-life situations** **(BL3)**
2. **use the probability distribution of bivariate random variables** **(BL3)**
3. **predict the probability of a sequence of events occurring based on the most recent event using Markov Chain** **(BL3)**
4. **analyse queuing models** **(BL4)**
5. evaluate the results of a reliability analysis and present them in written form in a scientific way **(BL5)**

Unit	Contents	Teaching Hours (Total 45)
Unit I	**Random variable and Probability Distributions**: Random variables and its properties, Expectation variance and standard deviation, Law of large numbers, Geometric distribution, Hyper geometric distribution, Multinomial Distribution, Uniform distribution, Gamma Distribution, Exponential Distribution, Beta Distribution, Weibull Distribution, Logistic Distribution, Distribution of sample mean, Central limit theorem.	**09**
Unit II	**Joint Probability Distribution:** Joint mass and density functions, Marginal density functions, Conditional density functions, Expectations and covariances	**06**
Unit III	**Markov Chain:** Chapman-Kolmogorov equations, Classification of states, Limiting Probability, The Gambler's Ruin Problem, A Model for Algorithmic Efficiency, Mean Time Spent in Transient states, Branching Process, Time reversible Markov Chain, Markov Chai Monte Carlo Methods, Markov Decision Process, Predicting the states	**10**

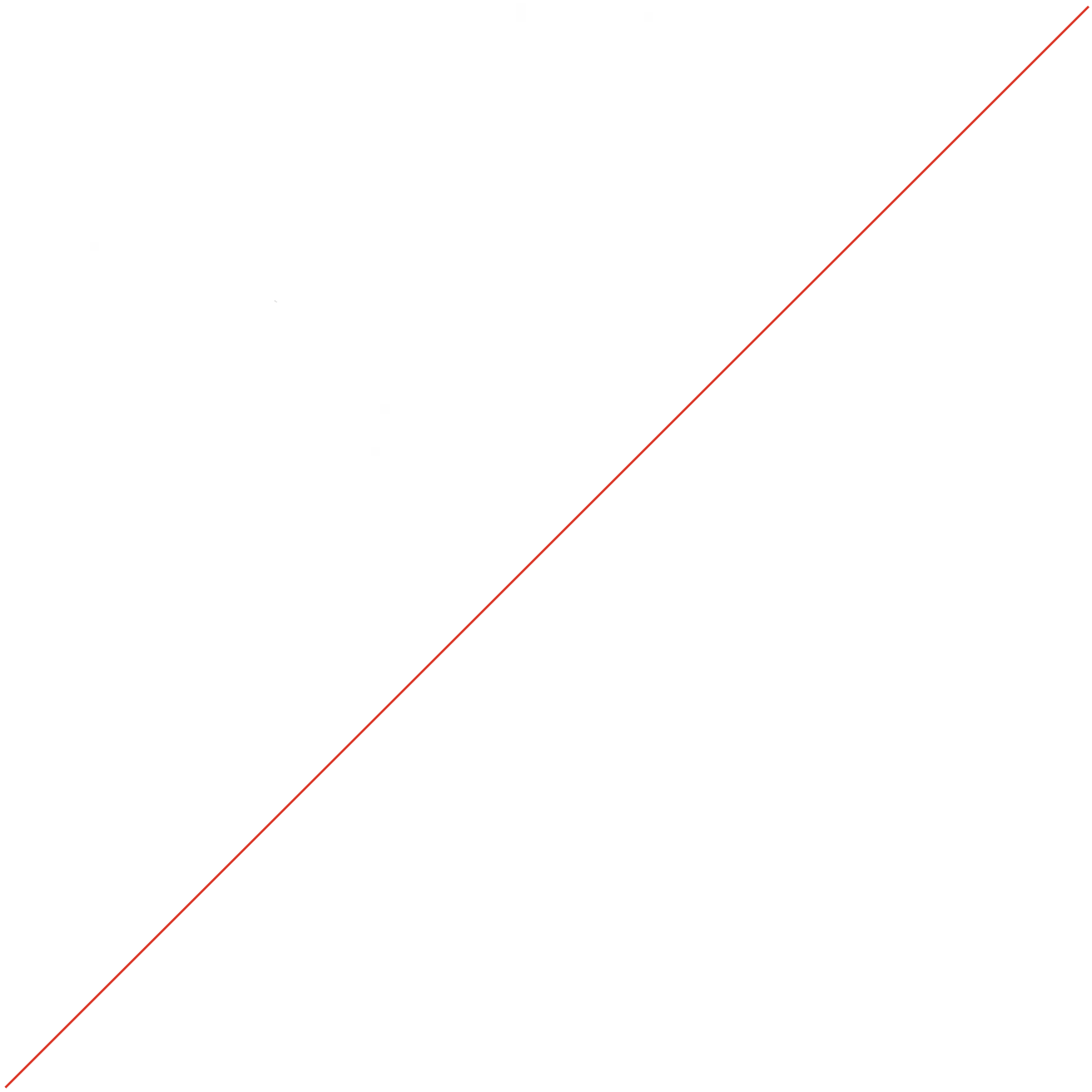
Unit IV	**Queueing Theory:** Cost Equations, steady-state probabilities, Exponential Models (A single-Server Exponential Queuing system, A single-Server Exponential Queuing system having finite capacity, Birth and Death Queueing Models, A Queuing system with Bulk Service), The system M/G/I, Variation on the M/G/I, The model M/G/I	**10**
Unit V	**Reliability Theory:** Structure Functions, Reliability of Systems of Independent Components, bounds on the Reliability Function, System Life as Function of Component Lives Expected System lifetime, systems with repair	**10**

Tutorial Works:
This shall consist of 15 tutorials based on the syllabus.

Self-Study:
Self-study contents will be declared at the commencement of the semester. Around 10 % of the questions will be asked from the self-study contents.

Suggested Readings/ References:

1. Sheldon M. Ross: Introduction to Probability Models 11-th Edition, Academic Press.
2. John F Shortle, James Thompson, Donald Gross and Carl Harris: Fundamentals of Queueing Theory, Wiley.
3. Nicola Privant: Understanding Markov Chains, Springer.
4. Marvin Rausand and Arnlijot Hoyland: System Reliability Theory, Wiley.



Nirma University
Institute of Technology
Minors from
Department of Humanities and Social Sciences

Minor in Digital Humanities

SEMESTER – V

Sr.	Course Code	Course Title	Teaching Scheme				Examination Scheme			
							Duration Hours	Component Weightage		
			L	T	P	C	SEE	CE	LPW	SEE
1	3HS601IC24	Introduction to Digital Humanities	3	1	-	4	3	0.6	-	0.4
2	3HS602IC24	Digital Storytelling and Narratives	3	-	2	4	3	0.3	0.3	0.4

SEMESTER – VI

Sr.	Course Code	Course Title	Teaching Scheme				Examination Scheme			
							Duration Hours	Component Weightage		
			L	T	P	C	SEE	CE	LPW	SEE
1	XXXXXX	Language and Discourse	3	-	2	4	3	0.3	0.3	0.4

SEMESTER – VI (Elective Pool)

Sr.	Course Code	Course Title	Teaching Scheme				Examination Scheme			
							Duration Hours	Component Weightage		
			L	T	P	C	SEE	CE	LPW	SEE
1	XXXXXX	Gender Digital Narratives	3	-	2	4	3	0.3	0.3	0.4
2	XXXXXX	Visualising Data and Information	3	-	2	4	3	0.3	0.3	0.4

SEMESTER – VII (Elective Pool)

Sr.	Course Code	Course Title	Teaching Scheme				Examination Scheme			
							Duration Hours	Component Weightage		
			L	T	P	C	SEE	CE	LPW	SEE
1	XXXXXX	Digital Humanities Project	3	1	-	4	3	0.6	-	0.4
2.	XXXXXX	E-Lit and Multimodal story telling	3	-	2	4	3	0.3	0.3	0.4

Minor in Diversity and Inclusion

(to be made effective for student admitted in 2022-23)

SEMESTER – V

Sr.	Course Code	Course Title	Teaching Scheme				Examination Scheme			
							Duration Hours	Component Weightage		
			L	T	P	C	SEE	CE	LPW	SEE
1	3HS701IC24	Introduction to Diversity and Inclusion in Engineering	3	1	-	4	3	0.6	-	0.4
2	3HS702IC24	Biases and Stereotyping	3	1	-	4	3	0.6	-	0.4

SEMESTER – VI

Sr.	Course Code	Course Title	Teaching Scheme				Examination Scheme			
							Duration Hours	Component Weightage		
			L	T	P	C	SEE	CE	LPW	SEE
1	XXXXXX	Behavioural Science of Diversity and Inclusion	3	1	-	4	3	0.6	-	0.4

SEMESTER – VI
(Elective Pool)

Sr.	Course Code	Course Title	Teaching Scheme				Examination Scheme			
							Duration Hours	Component Weightage		
			L	T	P	C	SEE	CE	LPW	SEE
1	XXXXXX	Gender and Society	3	1	-	4	3	0.6	-	0.4
2	XXXXXX	Gender and Language	3	1	-	4	3	0.6	-	0.4

SEMESTER – VII
(Elective Pool)

Sr.	Course Code	Course Title	Teaching Scheme				Examination Scheme			
							Duration Hours	Component Weightage		
			L	T	P	C	SEE	CE	LPW	SEE
1	XXXXXX	Women Writings	3	1	-	4	3	0.6	-	0.4
2.	XXXXXX	Gender and Media	3	1	-	4	3	0.6	-	0.4

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B. Tech. (All Programme)
Course Code:	3HS601IC24
Course Title:	Introduction to Digital Humanities
Course Type:	Minor-Core- Digital Humanities
Year of introduction:	2024-25

L	T	Practical component				C
		LPW	PW	W	S	
3	1		-	-	-	4

Course Learning Outcomes (CLOs):
At the end of the course, the students will be able to -

1. understand the understanding of the meaning of digital humanities BL2
2. develop the implications of digital approaches for the humanities BL3
3. demonstrate basic familiarity with core digital humanities methods and practices BL3
4. critically evaluate digital humanities work. BL4

Contents:		**Teaching hours (Total 45)**
Unit I	What is Digital Humanities? Definition. Genealogy and historical development of Digital Humanities. The contemporary position and characteristics of digital humanities. Digitization of the Humanities	06
Unit II	DH as Convergent Practices; DH in Context (Versions of DH across the globe, Post-colonial DH, DH in the Global South); Methodologies; Offline and Online Data Collection (Surveys, Interviews, Focus Groups, Scraping); Qualitative Methods; Quantitative Methods	06
Unit III	Types of Digital Material: Born Digital, Borrowed & Hybrid. How common digital tools work and examples of projects using them. How various file types can be used to create, gather, and organize data	07
Unit IV	Different Waves of DH. Theoretical Premises; Data in DH, Images and other visual cultures	06

Unit V	Digital Humanities and social media - Introduction to New Media, its theories and histories, its social, political and cultural implications; public domain and digital commons, network society, online streaming and authorship debates, piracy and IP rights; media lab as research space; New Media and Indian/global politics	06
Unit VI	Ethics in Digital Environments: Copyright, Digital Rights, Open Access and Digital Knowledge Spaces	05
Unit VII	Usages of digitization: Archiving and Databases; Mapping; role of place and space in cultural visibility; digital heritage	09

Tutorial Work:
This shall consist of 15 tutorials based on the syllabus

Self-Study:
Self-study contents will be declared at the commencement of the semester. Around 10 %
of the questions will be asked from the self-study contents.

Suggested Readings/ References:

Eileen Gardiner, Ronald G. Musto, The Digital Humanities: A Primer for Students and Scholars, Cambridge University Press.
2. Chaudhuri, S., The Metaphysics of Text, Cambridge University Press
3. Gold, Matthew K, Debates in the Digital Humanities, University of Minnesota Press
4. Hockey, Susan., Electronic Texts in the Humanities: Principles and Practice, Oxford University Press.
5. Schreibman, S., Siemens, R., Unsworth, J. Companion to Digital Humanities, Oxford: Blackwell.

L = Lecture, T = Tutorial, P = Practical, C = Credit

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B. Tech. (All Programme)
Course Code:	3HS602IC24
Course Title:	Digital Storytelling & Narratives
Course Type:	Minor- Core- Digital Humanities
Year of introduction:	2024-25

L	T	Practical component				C
		LPW	PW	W	S	
3	1		-	-	-	4

Course Learning Outcomes (CLOs):
At the end of the course, the students will be able to -

1	understand the foundational and generalizable components of stories, including semiotic syntax, user viewpoints, and cultural perspectives.	BL2
2	differentiate between story types, form, context, and content.	BL3
3	Infer online identity, and narration .	BL3
4	create independent narratives for effective use in an array of personal and organizational settings (e.g., design agency, engineering firm, startup venture).	BL6

Contents		**Teaching hours (Total 45)**
Unit I	What is a good Story? Film, Virtual Reality, Gaming, Comics and The Graphic Novel, Social-Media. Medium is the message- The Medium is the Massage: An Inventory of Effects (M. McLuhan and Q. Fiore) (book)	05
Unit II	History, Examples, Use-Cases, And Value of The Medium: Poetry, Short Story, The Essay, Environmental Graphics, Photography Poetry: - This is a photograph of me-Atwood; Little red cap-Carrol Duffy; Short Story: The Fall of House of Usher-Edgar Allen Poe; The Yellow Wallpaper- Charlotte Perkins Gilman; The Essay: Laugh Kookaburra-David Sedaris; Death of the Moth-Virginia Wolf.	15
Unit III	History, Examples, Use-Cases, And Value of The Medium: Perspectives on Storytelling Across Industries, Storytelling in Film, Storytelling in Art/Illustration, Storytelling in Writin; Understanding the Audience	08

Unit IV	Tools & Technology for Story Telling: Introduction to digital storytelling platforms; Hands-on experience with storytelling tools (e.g., Adobe Spark, Twine etc); Coding basics for interactive narratives (HTML, CSS etc)	10
Unit V	Ethics and Digital Storytelling: Responsible use of technology in storytelling; Ethical considerations in creating and sharing narratives; Cultural sensitivity and inclusivity in digital narratives	7

Tutorial Work:

This shall consist of 15 tutorials based on the syllabus

Self-Study:
Self-study contents will be declared at the commencement of the semester. Around 10 %
of the questions will be asked from the self-study contents.

Suggested Readings/ References:

References:
1.Alexander, B, The New Digital Storytelling: Creating Narratives with New Media. Praeger.
2.Pratt, A., & Nunes, J. Interactive Design: An Introduction to the Theory and Application of User-Centered Design. Rockport Publishers.
3.McKee, R. Story: Substance, Structure, Style, and the Principles of Screenwriting. ReganBooks.
4.Lambert, J. Digital Storytelling: Capturing Lives, Creating Community. Routledge.
5.Ryan, M. L. Narrative as Virtual Reality 2: Revisiting Immersion and Interactivity Literature and Electronic Media. Johns Hopkins University Press.
6.Manovich, L. The Language of New Media. MIT Press.

L = Lecture, T = Tutorial, P = Practical, C = Credit

NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B.Tech. All**
Course Code:	3HS701IC24
Course Title:	**Introduction to Diversity and Inclusion**
Course Type:	**Minor- Core (Diversity and Inclusion Minor)**
Year of Introduction:	**2023-24**

L	T	Practical component				C
		LPW	PW	W	S	
3	1	0	-	-	-	**4**

Course Learning Outcomes (CLOs):

At the end of the course, the student will be able to –

1	examine the evolution of Diversity and Inclusion	BL1
2	understand the key concepts related with Diversity and Inclusion	BL2
3	discuss various dimensions of diversity and issues in the professional world	BL2
4	analyse the changing workforce demographics and their effects in the workplace.	BL4

Contents		**Teaching hours (Total 45)**
Unit I	Understanding the fundamentals of Diversity, Equity, & Inclusion (DEI), Key terms and concepts in DEI, Importance of Diversity	5
Unit II	Exploring Key Demographic trends that are redefining the workplace, Cultivating skills & competencies for leadership	5
Unit III	Theories about Diversity, what is a "Minority", Identifiability, Differential Power, Discrimination, Group Awareness, Social Categorization, Stereotyping, Social Identity, Racism, sexism and Other new "Isms"	7
Unit IV	Diverse teams, Sex, Gender, Race, Ethnicity, Sexual Orientation, Religion, Age, Ability, Appearance, Social Class, and Work	6
Unit V	Assessing the Organization's Culture, Organizational Barriers to DEI, Embedding DEI in Organization's Mission, Vision, Values, Creating a DEI plan	5

Unit VI	Understanding Implicit and Unconscious Bias and its Impact in the Workplace, Enhancing Cultural Competence, cultivating a Culture of Inclusion, Equity and Belonging, Inclusive Leadership	6
Unit VII	Inclusion and Diversity as an inter-cultural task, Diversity Competence for Individuals and Organizations, Social and Legal Responsibilities	5
Unit VIII	Importance of Inclusion, Fostering Inclusive environments, Practising Inclusion, Myths about Diversity and Inclusion, Steps for Inclusion	6

Tutorial Work:

This shall consist of 15 tutorials based on the syllabus

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Suggested Readings/ References:

1.Page, Scott. The Diversity Bonus: How Great Teams Pay Off in the Knowledge Economy. Princeton University Press.
2.Oluo, Ijeoma. So You Want to Talk About Race. Seal Press.
3.Sweeney, Charlotte, and Fleur Bothwick. Inclusive Leadership: The Definitive Guide to Developing and Executing an Impactful Diversity and Inclusion Strategy. Pearson.
4.Banaji, Mahzarin R., and Anthony G. Greenwald. Blindspot: Hidden Biases of Good People. Delacorte Press.
5.Hollins, Caprice D., and Ilsa M. Govan. Diversity, Equity, and Inclusion: Strategies for Facilitating Conversations on Race. Rowman & Littlefield.
6.Kaplan, Mark, and Mason Donovan. The Inclusion Dividend: Why Investing in Diversity & Inclusion Pays Off. Bibliomotion, Inc..
7.Winters, Mary-Frances. We Can't Talk about That at Work!: How to Talk about Race, Religion, Politics, and Other Polarizing Topics. Berrett-Koehler Publishers.
8.Unerman, Sue, Kathryn Jacob, and Mark Edwards. Belonging: The Key to Transforming and Maintaining Diversity, Inclusion and Equality at Work. Bloomsbury Publishing.

L = Lecture, T = Tutorial, P = Practical, C = Credit

Nirma University

Institute	Nirma University
Name of the Programme	B Tech All
Course Code	3HS702IC24
Course Title	Biases and Stereotyping
Course Type	Minor- Core (Diversity and Inclusion Minor)
Year of Introduction	Academic Year 2024-25

L	T	Practical Component				C
		LPW	PW	W	S	
3	1	0	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of this course, the student will be able to-

1	distinguish and appreciate the meaning of bias, prejudice, stereotype, and discrimination.	BL2
2	interpret the processes and causes involved in the formation of bias, prejudice, stereotype, and discrimination.	BL2
3	identify gender based discrimination and harassment in the workplace and other institutions.	BL2
4	discuss the legal acts available to promote gender inclusion and equality in India.	BL2

Contents		**Teaching Hours (Total 45)**
Unit I	Definitional Framework: Prejudice, Stereotypes, Discrimination, & Bias; Historical Overview; Theoretical Approach; and Measurement Procedure	7
Unit II	Processes involved in the Formation of Prejudice, Stereotypes, Discrimination, and Bias: Social Cognitive Neural Process; Evolutionary Process; Cognitive Process; Developmental Process; Affective; & Motivational Processes	8
Unit III	Causes of Prejudice, Stereotypes, Discrimination, and Bias: Individual Differences; Self-Categorization; and Social Identity	6
Unit IV	Gender Based Discrimination and Harassment (GBDH): Earlier Approaches to GBDH; Common Forms of Discrimination; Sexual Harassment; Gender Microaggressions; Disguised Forms of GBDH, Consequences of GBDH in the Workplace	10
Unit V	Gender Inclusion and Equality in Organization and Practices: Gender Inclusion and Equality Approaches in Organizations, Support for an Integrative Human Resource Management Model (HRM) of GBDH in the Workplace, Recommendations for Academicians and Practitioners	7

Unit VI	Legal Aspect Related to Gender Inclusion and Equality in India: The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013; The Prevention of Sexual Harassment in Higher Educational Institution (PoSHA) Act, 2013; The Transgender Persons (Protection of Rights) Act, 2019; Equal Remuneration Act, 1976; Case Studies	7

Tutorial Works:

This shall consist of 15 tutorials based on the syllabus

Self Study

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Suggested Readings/References:

Dovidio, J. F., Hewstone, H., Glick, P., & Esses, V. M. (Eds.). The Sage Handbook of Prejudice, Stereotyping, and Discrimination. Sage Publications Ltd.

Stangor, C., & Crandall, C. S. Stereotyping and Prejudice. Psychology Press.

Steele, C. M. Whistling Vivaldi: How Stereotypes Affect Us and What We Can Do. W. W. Norton & Company.

Banaji, M. R., & Greenwald, A. G. Blindspot: Hidden Biases of Good People. Delacorte Press.

Barak, M. E. M. Managing Diversity: Toward a Globally Inclusive Workplace (5th ed.). Sage Publications, Inc.

HANDBOOK on Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013, Government of India, Ministry of Women and Child Development

L = Lecture, T = Tutorial, P = Practical, C = Credit

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
Teaching & Examination Scheme
Disciplinary Minor in Process Design (Disciplinary Minor)

w. e. f. Academic Year 2024-25

Course Code	Course Title	Course Type	Teaching Scheme (hours/week)				Examination Scheme			
			L	T	P	C	Duration Hours	Component Weightage		
							SEE	CE	LPW	SEE
Semester 5 Core Courses–I and II										
3CH602DC24	Transport Phenomena	Core	3	1	0	4	3	0.6	-	0.4
3CH603DC24	Plantwide Process Control	Core	3	1	0	4	3	0.6	-	0.4
Semester 6 Core Course–III										
	Mechanical Design of Process Equipment	Core	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Elective Course-I										
	Advanced Distillation Technologies	Elective	3	0	2	4	3	0.3	0.3	0.4
	Computational Fluid Dynamics	Elective	3	1	0			0.6	-	0.4
Semester 7 Elective Course-II										
	Process Synthesis	Elective	3	1	0	4	3	0.6	-	0.4
	Piping Engineering	Elective	3	1	0			0.6	-	0.4

L: Lectures, P/T: Practical / Tutorial, C: Credits
LPW/PW: Laboratory / Project Work
SEE: Semester End Examination
CE: Continuous Evaluation

*Disciplinary Minor will be offered for the students of Chemical Engineering Department, IT-NU.
w.e.f. for the first-year students admitted in 2022-23 and D to D students admitted in 2023-24 onwards

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B. Tech. (Chemical Engineering)
Course Code:	3CH602DC24
Course Title:	Transport Phenomena
Course Type:	Core
Year of introduction:	2024-25

L	T	Practical component				C
		LPW	PW	W	S	
3	1	-	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, the student will be able to –

1. compare principle underlying between different transport phenomena. (BL4)
2. apply shell balance and boundary conditions for momentum transport systems. (BL3)
3. interpret shell balance for energy and mass transport systems (BL6)
4. solve chemical engineering problems along with appropriate approximations and boundary conditions (BL3)

	Contents	Teaching hours (Total 45)
Unit I	**Principle of Transport Processes** Concept and industrial relevance, analogy between different transport phenomena, equations of change for isothermal systems, equations of continuity and motion. Molecular momentum transport, pressure and temperature dependence of viscosity, viscosity prediction for gases, liquids and mixtures, convective momentum transport.	**05**
Unit II	**Shell Momentum Balances and Velocity Distributions in Laminar Flow** Shell momentum balances and boundary conditions, flow of a falling film, flow through circular tube, flow through annulus, flow of two adjacent immiscible fluids, equations of continuity and motion.	**10**
Unit III	**Energy Transport** Molecular energy transport, temperature and pressure dependence of thermal conductivity, thermal conductivity prediction for gases, liquids, solids and mixtures. Shell energy balances and boundary conditions, heat conduction with an electrical heat source, nuclear heat source, viscous heat source, composite walls, cooling fin, forced and free convection.	**10**

Unit IV	**Mass Transport** Kinetic theory of diffusivity Molecular mass transport, temperature and pressure dependence of diffusivity, diffusivity prediction for gases and liquids. Shell mass balances and boundary conditions, diffusion through a stagnant gas film, diffusion with a homogeneous chemical reaction, diffusion with heterogeneous slow and instantaneous chemical reactions.	**10**

Self Study:
The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Tutorial Work:
Tutorial work will be based on the above content of course.

Suggested Readings/ References:

1. R. Byron Bird, Warren E. Stewart, Edwin N. Lightfoot, Transport Phenomena, John Wiley & Sons, Inc.
2. Bodh Raj, Introduction to Transport Phenomena: Momentum, Heat & Mass, PHI Learning Private Limited.
3. Christie John Geankoplis, Transport Processes and Separation Process Principles, PHI Learning Private Limited.

L= Lecture, T=Tutorial, P= Practical, C=Credit

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B. Tech. (Chemical Engineering)
Course Code:	3CH603DC24
Course Title:	Plantwide Process Control
Course Type:	Core
Year of introduction:	2024-25

L	T	Practical component				C
		LPW	PW	W	S	
3	1	-	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, the student will be able to –

1. analyse a feedback control system (BL4)
2. assess advanced control systems (BL5)
3. design control systems for multivariable processes (BL6)
4. apply digital control system in chemical plant (BL3)

	Contents	Teaching hours (Total 45)
Unit I	**Feedback Control System** Introduction, dynamic behaviour, stability analysis, frequency response analysis, design of feedback control system using frequency response techniques, z-transform.	**06**
Unit II	**Advanced Control Systems** Feedback control of systems with large dead time or inverse response, cascade control, selective control system, split-range control, feedforward control, feedforward–feedback control, ratio control, adaptive and inferential control system.	**10**
Unit III	**Introduction to Plant Control** Multiple input multiple output (MIMO) control system, degrees of freedom, controlled, manipulated and measured variables, generation of alternative loop configurations, interaction of control loops, relative-gain array, selection of loops, design of non-interacting control systems. Design of control system for complete plants: Case studies	**18**
Unit IV	**Process Control using Computers** Digital computer control loops, design of digital feedback controllers, process identification and adaptive control.	**05**

Unit V	**Digital Control System** Programmable logic controller (PLC), distributed control system (DCS), supervisory control and data acquisition systems (SCADA).	**06**

Self Study:
The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Tutorial Work:
tutorial work will be based on the above content of course.

Suggested Readings/References:

1. Stephanopoulos G., Chemical Process Control: An Introduction to Theory and Practice, PHI Learning.
2. Luyben W.L., Process Modeling, Simulation and Control for Chemical Engineers, McGraw-Hill.
3. Seborg D.E., Mellichamp, D.A., Edgar, T.F., Doyle, F.J., Process Dynamics and Control, John Wiley & Sons.
4. Ray W.H., Advanced Process Control, McGraw-Hill.

L= Lecture, T=Tutorial, P= Practical, C=Credit

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
Teaching & Examination Scheme
Inter-disciplinary Minor in Process Engineering

w. e. f. Academic Year 2024-25

Course Code	Course Title	Teaching Scheme (hours/week)				Examination Scheme			
		L	T	P	C	Duration Hours	Component Weightage		
						SEE	CE	LPW	SEE
Semester 5 Core Courses–I and II									
3CH403IC24	Chemical Process Industries	3	0	2	4	3	0.3	0.3	0.4
3CH202IC24	Unit Operations	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Core Course–III									
	Reaction Engineering	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Elective Course-I									
	Energy Efficiency and Plant Utilities and	3	1	0	4	3	0.6	-	0.4
	Computational Tools in Process Engineering	2	1	2	4	3	0.3	0.3	0.4
Semester 7 Elective Course-II									
	Green Chemistry and Technology	3	1	0	4	3	0.6	-	0.4
	Process Plant Safety & Environment	3	0	2	4	3	0.3	0.3	0.4

L: Lectures, P/T: Practicals / Tutorial, C: Credits
LPW/PW: Laboratory / Project Work

SEE: Semester End Examination
CE: Continuous Evaluation

Note: The department will provide relevant learning material in advance to the students of other departments opting interdisciplinary minor, so that they have prerequisite reading prior to initiation of the minor courses.

* Interdisciplinary Minor will be offered for the students of departments other than Chemical Engineering, IT-NU.

w.e.f. for first year students admitted in 2022-23 and D to D students admitted in 2023-24 onwards

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B. Tech. (Chemical Engineering)
Course Code:	XXXXX
Course Title:	Chemical Process Industries
Course Type:	Core
Year of introduction:	2024-25

L	T	Practical component				C
		LPW	PW	W	S	
3	-	2	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, the student will be able to –

1. demonstrate various unit operations and unit processes and their applications in chemical process industries (BL2)
2. explain the synthesis of chemical products and determine their properties (BL2)
3. identify major engineering problems associated with the flow diagrams (BL3)
4. construct the process flow diagrams (BL3)

	Contents	Teaching hours (Total 45)
Unit I	**Introduction to Various Unit Operations and Unit processes** Concept of unit operations and unit processes, basic laws governing the chemical processes, introduction and importance of flow diagram	**06**
Unit II	**Fertiliser Industries** Production of synthesis gas- steam reforming process, partial combustion process, ammonia synthesis by Haber process, synthesis of urea, overview of bio fertilisers	**12**
Unit III	**Brief Outlook of Important Chemical Industries** Sulphur and sulphuric acid, chlor-alkali industries, pulp and paper industry, production sugar and starch, production of oil, soaps and detergents	**16**
Unit IV	**Overview of Petroleum Refining and Petrochemicals** Introduction to refining process and technology, petrochemicals	**06**
Unit V	**Flow Sheeting of Chemical Processes** Introduction to flow sheeting, material balance of unit operations, percentage conversion, yield and selectivity	**05**

Self Study:
The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work:
Laboratory work will be based on the above content of course.

Suggested Readings/References:

1. George T. Austin, Shreve's Chemical Process Industries, Tata Mc-Graw Hill Publication
2. M. Gopala Rao and Marshell Sittig, Dryden's Outlines of Chemical Technology, East West Press.
3. Bhatt, B.I. and Thakore, S.B., Stoichiometry, Tata Mc-Graw Hill.
4. Pandey G. N, Text book of Chemical Technology Vol 1, 2, Vikas Publishing.

L= Lecture, T=Tutorial, P= Practical, C=Credit

List of Experiments:

Sr. No.	Practical	No of hours
1	To determine the acid value of given oil sample	02
2	To prepare the caustic soda by chemical method	02
3	Determination of Sodium Carbonate content in washing soda	02
4	To determine the saponification value of given oil sample	02
5	To study the preparation of soap	02
6	To prepare salicylic acid from methyl salicylate	02
7	To determine the Iodine value of given oil sample	02
8	To determine the flash & fire point of a given sample of petroleum products using Cleveland apparatus	02
9	To determine the flash & fire point of the given petroleum products using Pensky-Martin apparatus	02
10	To determine the aniline point and diesel index of given samples	02

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B. Tech. (Chemical Engineering)
Course Code:	XXXXX
Course Title:	Unit Operations
Course Type:	Core
Year of introduction:	2024-25

L	T	Practical component				C
		LPW	PW	W	S	
3	-	2	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, the student will be able to –

1. demonstrate the heat transfer equipment used in chemical industries (BL2)
2. apply concepts of fluid flow to practical systems (BL3)
3. solve problems pertaining to various mass transfer operations in process industries (BL6)
4. summarise solid-fluid operations in chemical industries (BL2)

		Teaching hours (Total 45)
Unit I	**Heat Transfer Operations** Modes of heat transfer: Conduction, Convection, Radiation, Heat transfer equipment used in chemical industries: shell and tube heat exchangers, condensers and reboilers	**10**
Unit II	**Fluid Flow Operations** Fluid Statics: Pressure concept, Rheology of fluids, Viscosity Flow Equations: Continuity equation and Bernoulli's Equation Pipeline flow: Laminar flow in pipes, minor and major losses Transportation and Metering of Fluids in Chemical Industries: Pumps– Positive Displacement Pumps, Characteristics, NPSH, Valves, Flowmeters.	**12**
Unit III	**Mass Transfer Operations** Molecular Diffusion: Molecular diffusion and diffusivity of gases and liquids, concept of Mass transfer coefficient. Liquid-liquid Extraction and adsorption: Stage-wise extraction, equipment for Liquid-Liquid Extraction, Stage-wise Adsorption, Freundlich equation. Distillation: Vapor-liquid equilibria, differential distillation, multistage tray towers, method of McCabe-Thiele. Crystallisation and Humidification	**16**

Unit IV **Solid Fluid Operations** **07**

Properties of Particulate Solids, Size Reduction, Fluidisation

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:

Laboratory work will be based on the above content of course.

Suggested Readings/References:

1. McCabe, W. L., Smith, J. C., and Harriott, P. , Unit Operations of Chemical Engineering. McGraw-Hill.
2. White, M., Fluid Mechanics, Tata Mc-Graw Hill Publication.
3. Treybal, R. E., Mass Transfer Operations, McGraw Hill, New York.
4. Coulson, J. M., Richardson, J. F. Backhurst, J. R. and Harker, J. H., Fluid flow, Heat Transfer and Mass Transfer, Butterworth-Heinemann.
5. Richardson, J. F., Harker, J. H. and Backhurst, J. R., Coulson and Richardson's Chemical Engineering Vol-2, Particle Technology and Separation Processes, Butterworth-Heinemann Publication.

L= Lecture, T=Tutorial, P= Practical, C=Credit

List of Experiments:

Sr. No.	Practical	No. of Hours
1	To study heat transfer in extended surface	2
2	Heat transfer in forced convection	2
3	Emissivity measurement of test plate	2
4	To study the flow pattern of a fluid flowing in a pipe.	2
5	To calibrate the given Orifice meter.	2
6	To determine friction factor of different closed conduits.	2
7	To study the operation of a bubble cap distillation column	2
8	To verify Freundlich's Isotherm equation for adsorption of dilute solution of acetic acid over activated charcoal and to observe the effect of temperature on adsorption rate.	2
9	To evaluate efficiency for multi-stage liquid-liquid extraction of acetic acid from the mixture of acetic acid and water. Compare and analyze the results of single-stage and multi-stage operation.	2
10	To determine diffusion coefficient or diffusivity of CCl_4 in air at ambient conditions using Arnold Diffusion Cell (Stefan Tube).	2

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
Teaching & Examination Scheme
Inter-disciplinary Minor in Sustainable Smart Cities*

w. e. f. Academic Year 2024-25

Course Code	Course Title	Teaching Scheme (hours/week)				Examination Scheme			
		L	T	P	C	Duration Hours	Component Weightage		
						SEE	CE	LPW	SEE
Semester 5 Core Courses–I and II									
3CL205IC24	Smart Cities Planning and Development	3	1	0	4	3	0.6	-	0.4
3CL206IC24	Smart Cities and Sustainability	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Core Course–III									
	Services in Smart Cities	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Elective Course-I									
	Environmental Sustainability in Urban Areas	3	1	0	4	3	0.6	-	0.4
	Application of IoT and e-Governance	3	1	0			0.6	-	0.4
Semester 7 Elective Course-II									
	Smart Transportation Systems	3	1	0	4	3	0.6	-	0.4
	Smart City Management, Risk and Control	3	1	0			0.6	-	0.4

L: Lectures, P/T: Practicals / Tutorial, C: Credits
LPW/PW: Laboratory / Project Work

SEE: Semester End Examination
CE: Continuous Evaluation

Note: The department will provide relevant learning material in advance to the students of other departments opting interdisciplinary minor, so that they have prerequisite reading prior to initiation of the minor courses.

*Interdisciplinary Minor will be offered for the students of departments other than Civil Engineering, IT-NU.

w.e.f. for first year students admitted in 2022-23 and Diploma to Degree students admitted in 2023-24 onwards

NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B. Tech. (All Except Civil Engineering)**
Course Code:	3CL205IC24
Course Title:	**Smart Cities Planning and Development**
Course Type:	**Inter-disciplinary Minor-Core**
Year of introduction:	**2024-25**

L	T	Practical component				C
		LPW	PW	W	S	
3	1	-	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, the student will be able to –

1. identify planning criteria and parameters affecting smart cities (BL3)
2. classify components of smart infrastructure development (BL2)
3. illustrate the role of citizens in the development of smart cities (BL2)
4. make use of performance evaluation criteria and case studies on smart cities. (BL3)

Unit	Contents	Teaching hours (Total 45)
Unit-I	**Introduction to Smart Cities** Definition, concept and focus, Introduction to city planning, smart city philosophy and goal, dimensions of smart cities, green field, brownfield, concept of digital twin city.	08
Unit-II	**Development of Smart Cities** Criteria for selection and development of smart cities, contemporary issues of urban planning- Indian and global perspectives, urbanization and growth for cities, urban patterns and trends, evolution of smart cities, factors affecting the development of smart cities, effect of technology on the development of smart cities, human impact on smart city development, elements of smart city plan, law and legislations, role of stakeholders.	12
Unit-III	**Smart Infrastructures** Urban Infrastructure and overview on state of urbanization Elements of smart infrastructures: ICT, energy, transportation, buildings, people, water, waste management; smart city/infrastructure design principle, challenges and issues, inclusiveness; communication and security systems; interaction and integration between building structure, systems, services, management, control and information technology.	10

Unit-IV	**Role of Citizens in Smart Cities** Needs of the citizens, smart citizens, citizen-centric smart city development approach, inclusiveness, governance and transparency, services and security systems, roles and functions of citizens, civic engagement and citizenship.	08
Unit-V	**Performance Measurement for Smart Cities** Global standards and performance benchmarks, practice codes, monitoring and evaluation, case studies on smart cities.	07

Tutorial Work:
This shall consist of at least 04 tutorials based on the above syllabus.

Self-Study: The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Suggested Readings/ References:

- Kumar, A., *Introduction to Smart Cities.* Pearson.
- Singh, B. & Parmar, M., *Smart City in India. Urban Laboratory, Paradigm or Trajectory?* Routledge India.
- Barlow, M. and Levy-Bencheton, C., *Smart Cities, Smart Future: Showcasing Tomorrow.* Wiley.
- Saravanan, K. & Sakthinathan, G., *Handbook of Green Engineering Technologies for Sustainable Smart Cities (Green Engineering and Technology).* CRC Press.
- Mani, N., Smart Cities and Urban Development in India. New Century Publications
- Barlow, M. and Levy-Bencheton, C., *Smart Cities, Smart Future: Showcasing Tomorrow.* Wiley.
- Cardullo, P., *Citizens in the 'Smart City': Participation, Co-production, Governance*, Routledge.
- Bosselmann, P., *Urban Transformation: Understanding City Form and Design*, Island Press.
- Willis, K. & Aurigi, A., *Digital and Smart Cities*, Routledge.

NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B. Tech. (All Except Civil Engineering)**
Course Code:	3CL206IC24
Course Title:	**Smart Cities and Sustainability**
Course Type:	**Interdisciplinary Minor-Core**
Year of introduction:	**2024-25**

L	T	Practical component				C
		LPW	PW	W	S	
3	-	2	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, the student will be able to –

1. apply criteria for sustainable development of urban areas (BL3)
2. make use of suitable construction materials and technology for smart cities (BL3)
3. select energy conservation measures for efficient smart cities (BL3)
4. examine components of efficient and sustainable smart cities. (BL4)

Unit	Contents	Teaching hours (Total 45)
Unit-I	**Sustainability in Urban Areas** Concept, need for sustainable development, SDGs, climate change: mitigation and adaptation to climate change - plans, policies and strategies, energy management, rating systems, city information modelling, pillars of sustainable cities- human, social, economic and environmental.	12
Unit-II	**Smart City Regulations** Smart city management, urban development control regulations, problems and issues, development of a master plan for smart cities, funding and financing.	05
Unit-III	**Construction Materials and Technologies** Smart materials, sustainable construction materials, smart construction technology, prefabricated construction, additive manufacturing, concept of healthy buildings.	10
Unit-IV	**Energy Conservation** Energy conservation for smart cities, strategies for reliable, economical and efficient energy systems, promotion of renewable energy.	08

Unit-V	**Efficient and Sustainable Smart Cities** Quality of life in smart cities, smart healthcare systems and telemedicine, smart education, social inclusion and thematic planning, emergency response systems, PPPs implementation, protection of environment and safety.	10

Self-Study: The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Suggested Readings/ References:

- Saravanan, K. & Sakthinathan, G., *Handbook of Green Engineering Technologies for Sustainable Smart Cities (Green Engineering and Technology)*. CRC Press.
- Mani, N., *Smart Cities and Urban Development in India.* New Century Publications.
- Barlow, M. and Levy-Bencheton, C., *Smart Cities, Smart Future: Showcasing Tomorrow.* Wiley.
- Kumar, A., *Introduction to Smart Cities.* Pearson.
- Singh, B. & Parmar, M., *Smart City in India. Urban Laboratory, Paradigm or Trajectory?* Routledge India.
- Willis, K. & Aurigi, A., *Digital and Smart Cities*, Routledge.

Laboratory work: Laboratory work will be based on the above syllabus with minimum 05 exercises to be incorporated.

Suggested List of Experiments (not restricted to the following):
(Only for Information)

Sr. No.	Name of Experiments/ Exercises	Hours
1	Smart city planning and rating systems	04
2	Smart city modelling	08
3	Construction materials and technologies	08
4	Energy and smart cities	04
5	Case studies on actual smart cities	06

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
Teaching & Examination Scheme
Inter-disciplinary Minor in Geoinformatics*

w. e. f. Academic Year 2024-25

Course Code	Course Title	Teaching Scheme (hours/week)				Examination Scheme			
		L	T	P	C	Duration Hours	Component Weightage		
						SEE	CE	LPW	SEE
Semester 5 Core Courses–I and II									
3CL702IC24	Principles of Remote sensing	3	1	0	4	3	0.6	-	0.4
3CL703IC24	Geographic Information Systems	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Core Course–III									
	Geodesy and Global Navigation Satellite System	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Elective Course-I									
	Geoinformatics in Environment and Water Resources management	3	1	0	4	3	0.6	-	0.4
	Geoinformatics in smart city planning & management	3	1	0			0.6	-	0.4
Semester 7 Elective Course-II									
	Geoinformatics in Climate change and Disaster Management	3	1	0	4	3	0.6	-	0.4
	Advanced Remote Sensing Techniques & applications	3	1	0			0.6	-	0.4

L: Lectures, P/T: Practicals / Tutorial, C: Credits SEE: Semester End Examination
LPW/PW: Laboratory / Project Work CE: Continuous Evaluation
Note: The department will provide relevant learning material in advance to the students of other departments opting interdisciplinary minor, so that they have prerequisite reading prior to initiation of the minor courses.
*Interdisciplinary Minor will be offered for the students of departments other than Civil Engineering, IT-NU.
w.e.f. for first year students admitted in 2022-23 and Diploma to Degree students admitted in 2023-24 onwards

NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B. Tech. (All Except Civil Engineering)**
Course Code:	
Course Title:	**Principles of Remote Sensing**
Course Type:	**Inter-disciplinary Minor-Core**
Year of Introduction:	**2024-25**

L	T	Practical Component				C
		LPW	PW	W	S	
3	1	-	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, the student will be able to –

1. summarise the concept of linear and angular measurement (BL2)
2. apply remote sensing principles for engineering applications (BL3)
3. explain various platforms of remote sensing (BL2)
4. classify various remote sensing sensors. (BL4)

Unit	Contents	Teaching hours (Total 45)
Unit-I	**Introduction to Surveying** definition, principle of surveying, scale, photogrammetry, cartography, errors and bias, linear and angular measurements, conventional and advanced survey instruments.	10
Unit-II	**Introduction to Remote Sensing** definition, types and components of remote sensing system, sources of energy, electromagnetic spectrum, spectral windows and signatures, interaction with target and atmosphere, spatial, spectral, radiometric and temporal resolution, types of orbit, visual and digital image interpretation, remote sensing programmes.	14
Unit-III	**Remote Sensing Platforms** types and characteristics of platforms, airborne and spaceborne, manned and unmaned vehicles: balloons, helicopters, aircrafts, drones, spacecrafts used for data acquisition. projectile geometry, land coverage, satellites: RESOURCESET, LANDSAT, SPOT, IKONOS, Quickbird, Geoeye, Kompsat, ALOS, Sentinel, SMAP, MODIS, INSET etc.	08
Unit-IV	**Remote Sensing Sensors** types and characteristics, selection of sensor parameters, optical and infrared sensors, quality of image in optical system, imaging mode, photographic camera, television camera, opto-mechanical scanners, push broom and whisk broom cameras, panchromatic, multispectral and hyperspectral scanners, concept of microwave sensors, satellite sensors: Landsat, IRS, SPOT, Sentinel.	08

Unit-V	**Applications of Remote Sensing** applications in agriculture, forest, soil, geology, land use land cover, slow water resources, urban planning, disaster management, transportation and environment.	05

Tutorial Work:
This shall consist of at least 06 tutorials based on the above syllabus.

Self-Study: The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study contents.

Suggested Readings/ References:

- Bhatta B., *Remote Sensing and GIS*, Oxford University Press.
- Reddy, M. A., *Textbook of Remote Sensing and Geographical Information System*, B S Publications.
- Chang, K., *Introduction to Geographic Information Systems*, McGraw-Hill.
- Lillesand, T. M., Kiefer, R. W. & Chipman, K. W., *Remote Sensing and Image Interpretation*, Wiley.
- El-Rabbany, A., *Introduction to GPS: The Global Positioning System*. Artech House.
- George J. & Jaganathan, C. *Fundamentals of Remote Sensing*, The orient Blackswan.
- Chandra, A. M., *Higher Surveying*, New Age International Publishers.
- Anderson, J. M. & Mikhail, E. M., *Surveying: Theory and Practice*, McGraw-Hill Publication.

NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B. Tech. (All Except Civil Engineering)**
Course Code:	
Course Title:	**Geographic Information Systems**
Course Type:	**Inter-disciplinary Minor-Core**
Year of Introduction:	**2024-25**

L	T	Practical Component				C
		LPW	PW	W	S	
3	-	2	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, the student will be able to –

1. summarize fundamentals of Geographic Information Systems (BL2)
2. analyse the vector and raster data using GIS (BL4)
3. build GIS model for various applications (BL6)
4. apply various methods and software tools for exploring different applications using GIS. (BL3)

Unit	Contents	Teaching hours (Total 45)
Unit-I	**Basics of GIS** Introduction and history, components: input devices, hardware, software, datasets, users, output devices. characterization of raster & vector data, geospatial data and relationship, GIS operations, map projections and visualization.	08
Unit-II	**Vector Data Model & Analysis** Vector data model: object based data model, classes, geometric representation of spatial features, interface, topology, geodatabase data model. Vector data analysis: buffering, overlay, distance measurement, pattern analysis, map manipulation.	10
Unit-III	**Raster Data Model & Analysis** Raster data model: elements, types of raster data, raster data structure, data compression, data conversion, integration of raster and vector data. Raster data analysis: concept of satellite image processing, data correction, satellite image analysis, histogram, filter, image enhancement, attribute data management, metadata and spatial data, attributes and levels of measurement. Spatial analysis - interpolation, buffer, overlay, terrain modelling and network analysis. Digital elevation models: representation, vector and raster data analysis tools, spatial and attribute data visualization.	12

Unit-IV	**GIS Model and Modelling** GIS platform, elements of GIS modelling, binary, index, regression and process models, ArcGIS, QGIS, Geoprocessing, cartographic symbolization, map design and layout, terrain mapping and analysis, DEM and its derivatives, TIN model, LULC classification and analysis, geospatial applications in urban planning, environment, water resources and transportation domain.	15

Self-Study: The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study contents.

Suggested Readings/ References:

- Longley, P. A., Goodchild, M., Maguire, D.J., Rhind, D. W., *Geographic Information Systems and Science,* Wiley.
- Chang, K. T., *Introduction to Geographical Information system*, McGraw Hill.
- Lo, C. P. & Yeung, A. K. W., *Concepts and Techniques of Geographic Information Systems*, Pearson.
- Burrough P. A., *Principles of Geographical Information Systems for Land Resources Assessment*, Oxford University Press.
- Aronoff, S., *Geographic Information Systems: A Management Perspective* - WDL Publications.
- Wilson J., *The Handbook of Geographic Information Science*, Wiley-Blackwell.

Laboratory work: Laboratory work will be based on the above syllabus with minimum 08 exercises to be incorporated.

Suggested List of Experiments (not restricted to the following):
(Only for Information)

Sr. No.	Name of Experiment/Exercise	Hours
1	Satellite data input, georeferencing and projection	04
2	Satellite data analysis: digitizing points, lines, polygon features	04
3	Linking spatial & non-spatial data -adding attribute data	04
4	Data analysis using GIS tools and map generation	04
5	Data interpolation, conversion – Vector & Raster	02
6	DEM image analysis, Contour and Cross section	04
7	Development of LULC map using supervised and unsupervised classification method	04
8	Change detection and urban planning using LULC map	04

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
Teaching & Examination Scheme
Disciplinary Minor in Construction Technology and Management*
w. e. f. Academic Year 2024-25

Course Code	Course Title	Teaching Scheme (hours/week)				Examination Scheme			
		L	T	P	C	Duration Hours	Component Weightage		
						SEE	CE	LPW	SEE
Semester 5 Core Courses–I and II									
3CL203DC24	Project Formulation and Appraisal	3	1	0	4	3	0.6	-	0.4
3CL204DC24	Quality and Safety Management	3	1	0	4	3	0.6	-	0.4
Semester 6 Core Course–III									
	Advanced Construction Technologies	3	1	0	4	3	0.6	-	0.4
Semester 6 Elective Course-I									
	Lean Construction and BIM	2	1	2	4	3	0.3	0.3	0.4
	Dispute Resolution & Valuation	3	1	0			0.6	-	0.4
Semester 7 Elective Course-II									
	Computer Applications in Construction Management	2	1	2	4	3	0.3	0.3	0.4
	Quantitative Techniques in Construction Management	3	1	0			0.6	-	0.4

L: Lectures, P/T: Practical / Tutorial, C: Credits SEE: Semester End Examination
LPW/PW: Laboratory / Project Work CE: Continuous Evaluation
*Disciplinary Minor will be offered for the students of Civil Engineering Department, IT-NU.
Students who have opted for Minor in Construction Technology and Management will not be permitted to select department electives i.e. Advances in Construction Management and Advanced Construction Technologies.
w.e.f. for the first-year students admitted in 2022-23 and Diploma to Degree students admitted in 2023-24 onwards

NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B. Tech. (Civil Engineering)**
Course Code:	
Course Title:	**Project Formulation and Appraisal**
Course Type:	**Disciplinary Minor-Core**
Year of introduction:	**2024-25**

L	T	Practical component				C
		LPW	PW	W	S	
3	1	-	-	-	-	4

Course Learning Outcomes (CLO):

At the end of the course, the students will be able to –

1. outline the importance of project formulation (BL2)
2. choose the appropriate ownership models for construction projects (BL3)
3. assess the viability of proposed projects (BL5)
4. evaluate financial metrics for investment decisions. (BL3)

Unit	Contents	Teaching hours (Total 45)
Unit-I	**Project formulation** Project: identification, alternatives and selection, preliminary analysis: market, technical, financial and economic.	07
Unit-II	**Project ownership models** Models: introduction and characteristics, detail examination, advantages and challenges: build operate transfer, build own lease transfer, build own operate transfer models, hybrid annuity, engineering procurement construction, future trends.	10
Unit-III	**Feasibility Study** Project estimates, feasibility study: pre, techno-economic, and detailed, financial modeling, regulatory and legal aspects, project clearance requirements.	08
Unit-IV	**Project Appraisal** Introduction, economic analysis, payback period, benefit-cost ratio analysis, Indian and international practice of investment appraisal, environmental appraisal, detailed project report.	10
Unit-V	**Project Financing** Introduction, sources, project and corporate finance, special schemes, financial indicators, capital investments: importance and difficulties, financial statement, working capital management, financial estimate and projections.	10

Tutorial Work:
This shall consist of at least 06 tutorials based on the above syllabus.

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Suggested Readings/ References:

- Chandra, P., *Projects – Planning, Analysis, Selection, Financing, Implementation and Review*, McGraw Hill.
- Van Horne, J C. & Wachowicz, J. M., *Fundamentals of Financial Management*, FT Publishing International.
- Taylor, G. A. *Managerial and Engineering Economy: Economic Decision-Making*. Van Nostrand Reinhold Inc.
- Lewis, J. P., *Fundamentals of Project Management*, Amacom.
- Chapman, C. & Ward, S. *Project Risk Management Processes, Techniques and Insights*, Wiley.

NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B. Tech. (Civil Engineering)**
Course Code:	
Course Title:	**Quality and Safety Management**
Course Type:	**Disciplinary Minor-Core**
Year of Introduction:	**2024-25**

L	T	Practical component				C
		LPW	PW	W	S	
3	1	-	-	-	-	4

Course Learning Outcomes (CLO):

At the end of the course, students will be able to –

1. illustrate the fundamental concept of quality management (BL2)
2. apply quality assurance and control techniques in construction projects (BL3)
3. outline occupational health and safety threats in construction projects (BL2)
4. develop safety policies for construction projects. (BL3)

Unit	Contents	Teaching hours (Total 45)
Unit-I	**Quality Control and Assurance in Construction** Quality: definitions, purpose, importance, quality gurus, distinction between quality assurance and control, quality assurance plans and strategies, integrating quality management systems into construction processes, cost and value of quality.	11
Unit-II	**Quality Control Techniques** Inspection and testing procedures, documentation and reporting of quality issues, ISO 9001 standards and their application, quality audits and certifications, tools of total quality management, reliability, availability, maintainability, quality culture in the process and development, quality through employee, quality through product.	11
Unit-III	**Occupational Health and Safety in Construction** Safety: definitions, purpose, importance, principles, system, international and national safety standards, workplace hazards and health risks, human errors and mistakes, behaviour based safety protocol, hazard identification and risk assessment, personal protective equipment (PPE) and safety protocols, health and safety training and awareness programs, safety performance measurement and audit.	12

Unit-IV	**Safety Policies and Culture** Safety acts and regulations; contractor and subcontractor responsibilities; incident, investigation, reporting, record keeping, emergency response; accident prevention program, safety and health culture in construction teams, designing and implementing safety management systems; safety budget and incentives.	11

Tutorial Work:
This shall consist of at least 06 tutorials based on the above syllabus.

Self-Study: The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Suggested Readings/ References:

- Jha, K.N., Patel, D. A. & Singh, A, *Construction Safety Management*, Pearson.
- Kulkarni, V. A. & Bewoor, A. K., *Quality Control*, Willey.
- Mitra, A., Fundamentals of Quality Control and Improvement, Willey.
- Li, R. Y. M., *Construction Safety and Waste Management: An Economic Analysis (Risk Engineering)* Springer.
- Jerome, J. O'Brien, *Construction Inspection Handbook: Total Quality Management,* New York: Chapman & Hall.
- Howarth, T. & Greenwood, D., *Construction Quality Management: Principles and Practice, Routledge.*

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
Teaching & Examination Scheme
Disciplinary Minor in Structural Engineering*

w. e. f. Academic Year 2024-25

Course Code	Course Title	Teaching Scheme (hours/week)				Examination Scheme			
		L	T	P	C	Duration Hours	Component Weightage		
						SEE	CE	LPW	SEE
Semester 5 Core Courses–I and II									
3CL103DC24	Experimental Techniques for Structures	2	1	2	4	3	0.3	0.3	0.4
3CL104DC24	Computational Tools for Structural Analysis	2	1	2	4	3	0.3	0.3	0.4
Semester 6 Core Course–III									
	Computer-Aided Structural Design	2	1	2	4	3	0.3	0.3	0.4
Semester 6 Elective Course-I									
	Design of Tall Buildings	3	0	2	4	3	0.3	0.3	0.4
	Design of Marine Structures								
	Seismic Retrofitting of Structures								
Semester 7 Elective Course-II									
	Design of Bridge Structures	3	0	2	4	3	0.3	0.3	0.4
	Design of Steel-Concrete Composite Structures								
	Design of Chimney and Silos								

L: Lectures, P/T: Practical / Tutorial, C: Credits SEE: Semester End Examination

LPW/PW: Laboratory / Project Work CE: Continuous Evaluation

*Disciplinary Minor will be offered for the students of Civil Engineering Department, IT-NU.

w.e.f. for the first-year students admitted in 2022-23 and Diploma to Degree students admitted in 2023-24 onwards

NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B. Tech. (Civil Engineering)**
Course Code:	
Course Title:	**Experimental Techniques for Structures**
Course Type:	**Disciplinary Minor-Core**
Year of introduction:	**2024-25**

L	T	Practical component				C
		LPW	PW	W	S	
2	1	2	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, the student will be able to –

1. demonstrate the importance of experimentation (BL3)
2. select and operate instruments for measurement of physical quantities (BL3)
3. develop an experimental setup for testing of structure (BL3)
4. compile results and outcomes of experiment. (BL4)

Unit	Contents	Teaching hours (Total 45)
Unit-I	**Experimental Programme and Model** Experimental Programme: planning and design, Model: similitude law, dimensional analysis, Buckingham's Pi theorem, types of model investigation, indirect and direct models, elastic and inelastic models (steel, concrete and masonry), size effects.	08
Unit-II	**Instrumentation** Basic concept of mechanical, electrical, electronic system operation, calibration, performance characteristics (static, dynamic, determination of parameter), measurement of motion and dimension, strain & stress, temperature, pressure, force, data acquisition system, data processing.	08
Unit-III	**Measurement** Capacity assessment of structural members under static & dynamics loading, non-destructive testing for condition assessment, error and uncertainty in experiment, Interpretation of data, statistical analysis, virtual experimentation.	10
Unit-IV	**Validation of Experimental Results** Analytical and numerical methods, sensitivity analysis.	04

Tutorial Work:
This shall consist of at least 04 tutorials based on the above syllabus.

Self-Study: The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Suggested Readings/ References:

- Harris, H. G. & Sabnis, G. M., *Structural Modeling and Experimental Techniques*, CRC Press.
- Bungey, J. H., Millard, S. G. & Grantham, M. G., *Testing of Concrete in Structures*, CRC Press.
- Dally, W. F. & Riley, W. F., *Experimental Stress Analysis*, McGraw Hill.
- Mithura, B., *LabVIEW for Data Acquisition*, Prentice Hall.
- Wilson, J., Ball, S. & Kester, W., *Test and Measurement*, Burlington

Laboratory work: Laboratory work will be based on the above syllabus with minimum 06 exercises to be incorporated.

Suggested List of Experiments (not restricted to the following):
(Only for Information)

Sr. No.	Name of Experiments/Exercises	Hours
1.	Introduction to instruments	02
2.	Uniaxial stress-strain behaviour of metal specimen	04
3.	Evaluate mechanical property of metal under flexural load using digital instrumentation	06
4.	Non-destructive test on concrete specimen	06
5.	Biaxial State of stress at a point on the surface of concrete specimen	06
6.	Dynamic property of single degree of freedom system	06

NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B. Tech. (Civil Engineering)**
Course Code:	
Course Title:	**Computational Tools for Structural Analysis**
Course Type:	**Disciplinary Minor-Core**
Year of introduction:	**2024-25**

L	T	Practical component				C
		LPW	PW	W	S	
2	1	2	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, the student will be able to –

1. apply linear and nonnumerical methods for structural engineering problem solution (BL3)
2. solve structural engineering problems using numerical differentiation and integration (BL3)
3. analyse partial differential equations for structural engineering applications (BL4)
4. appraise the application of optimisation and curve fitting for structural engineering applications. (BL5)

Unit	Contents	Teaching hours (Total 45)
Unit-I	**Linear Systems and Non-Linear Systems** Solving linear systems – Gaussian Elimination, Gauss-Jordan, Iterative methods, applications in structural engineering, Solving nonlinear systems –Newton-Raphson method, structural engineering applications.	05
Unit-II	**Numerical differentiation and Integration** Newton's difference formulas, higher order differentiation, multivariate differentiation, differentiation of tabular data, Numerical integration techniques and structural engineering applications – Newton-cotes formulas, line integrals, multi-dimensional integrals, integrating tabular data, Gauss-quadrature, Monte-Carlo integration, Application of numerical integration and differentiation in structural engineering.	10
Unit-III	**Partial difference equations** Finite-difference methods – elliptic, parabolic and hyperbolic systems, boundary conditions.	05

Unit-IV	**Optimisation** One-dimensional Unconstrained Optimization: golden section search, parabolic interpolation, Newtons's Method, Multidimensional Unconstrained Optimization: Direct Method, Gradient Methods, Optimisation application in Structural Engineering.	05
Unit- V	**Curve fitting and Inverse problems** Least-squares regression, interpolation, linear and non-linear regression with applications in structural engineering.	05

Tutorial Work:
This shall consist of at least 04 tutorials based on the above syllabus.

Self-Study: The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Suggested Readings/ References:

- Dahlquist, D. & Dan, A. B. *Numerical Methods*, Prentice Hall.
- Chapra, S. C., & Canale, R. P. *Numerical methods for engineers (Vol. 2)*, Mcgraw Hill.
- Boyce, W. E., DiPrima, R. C., & Meade, D. B. *Elementary Differential Equations and Boundary Value Problems*, Wiley.
- Datta, K.B. *Matrix and Linear Algebra Aided with MATLAB*, PHI Learning Private Limited.
- Gilat, A. *Matlab: An Introduction with Application*, John Wiley & Sons.
- Kong, Q., Siauw, T. & Bayen A., *Python Programming and Numerical Methods.* Academic Press.
- Gezerlis, A., *Numerical Methods in Physics with Python.* Cambridge University Press

Laboratory work: Laboratory work will be based on the above syllabus with minimum 05 exercises to be incorporated.

Suggested List of Experiments (not restricted to the following):
(Only for Information)

Sr. No.	Name of Experiments/Exercises	Hours
1.	Application of solution of the linear system of equations to structural engineering problems	06
2.	Application of solution of the non-linear system of equations to structural engineering problems	06
3.	Application of differential equation to structural engineering problems	06
4.	Application of numerical integration to structural engineering problems	06
5.	Application of optimisation and curve-fitting technique in structural engineering problems	06

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
Electronics and Instrumentation Engineering Department
Teaching & Examination Scheme
Inter-disciplinary Minor in Industrial Automation*

w. e. f. Academic Year 2024-25

Course Code	Course Title	Course Type	Teaching Scheme (hours/week)				Examination Scheme			
			L	T	P	C	Duration Hours	Component Weightage		
							SEE	CE	LPW	SEE
Semester 5 Core Courses–I and II under Minor										
3EI103IC24	Programmable Logic Controller	Core	3	0	2	4	3	0.3	0.3	0.4
3EI104IC24	Industrial Control System	Core	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Core Course–III under Minor										
	Factory Automation	Core	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Elective Course-I under Minor										
	Edge Computing Application in Automation **(Except CSE)**	Elective -I	3	0	2	4	3	0.3	0.3	0.4
	Sensors and Transducers	Elective -I	3	0	2	4	3	0.3	0.3	0.4
	Advanced Microcontroller **(Except EC)**	Elective -I	3	0	2	4	3	0.3	0.3	0.4
Semester 7 Elective Course-II under Minor										
	Robotics in Automation **(Except Mech)**	Elective-II	3	1	0	4	3	0.6	-	0.4
	Industrial Instrumentation	Elective-II	3	1	0	4	3	0.6	-	0.4
	Biomedical Instrumentation **(Except EC)**	Elective-II	3	1	0	4	3	0.6	-	0.4

L: Lectures, P/T: Practicals / Tutorial, C: Credits
LPW/PW: Laboratory / Project Work
SEE: Semester End Examination
CE: Continuous Evaluation

Note: The department will provide relevant learning material in advance to the students of other departments opting interdisciplinary minor, so that they have prerequisite reading prior to initiation of the minor courses.

* Interdisciplinary Minor will be offered for the students of departments other than Electronics and Instrumentation Engineering, IT-NU.

w.e.f. for first year students admitted in 2022-23 and D to D students admitted in 2023-24 onwards

NIRMA UNIVERSITY

INSTITUTE OF TECHNOLOGY

Electronics and Instrumentation Engineering Department

Teaching & Examination Scheme

Disciplinary Minor in Smart Automation*

w. e. f. Academic Year 2024-25

Course Code	Course Title	Course Type	Teaching Scheme (hours/week)				Examination Scheme			
			L	T	P	C	Duration Hours	Component Weightage		
							SEE	CE	LPW	SEE
Semester 5 Core Courses–I and II under Minor										
3EI201DC24	Industrial Internet of Things (IIOT)	Core	3	0	2	4	3	0.3	0.3	0.4
3EI302DC24	Robotics Application in Industries	Core	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Core Course–III under Minor										
	Vision Based Automation	Core	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Elective Course-I under Minor										
	AI for Automation	Elective-I	3	0	2	4	3	0.3	0.3	0.4
	Smart Sensors and Transducers	Elective-I	3	0	2	4	3	0.3	0.3	0.4
	System Identification	Elective-I	3	0	2	4	3	0.3	0.3	0.4
Semester 7 Elective Course-II under Minor										
	Industrial Communication Protocols	Elective-II	3	1	0	4	3	0.6	-	0.4
	Cyber Physical Systems	Elective-II	3	1	0	4	3	0.6	-	0.4
	Analytical Instruments	Elective-II	3	1	0	4	3	0.6	-	0.4

L: Lectures, P/T: Practicals / Tutorial, C: Credits
LPW/PW: Laboratory / Project Work

SEE: Semester End Examination
CE: Continuous Evaluation

*Disciplinary Minor will be offered for the students of Electronics and Instrumentation Engineering Department, IT-NU.

w.e.f. for first year students admitted in 2022-23 and D to D students admitted in 2023-24 onwards

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	Minor in Industrial Automation (Inter-disciplinary) Offered by B.Tech. in Electronics and Instrumentation Engineering.
Semester:	V
Course Code:	3EI103IC24
Course Title:	Programmable Logic Controller
Course Type:	Core Course - I under Minor (Interdisciplinary)
Year of Introduction:	2024-25

L	T	Practical component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to –

1. understand the fundamental principles of programmable logic controller **(BL2)**
2. develope the PLC programme using standard programming techniques **(BL4)**
3. design programs using IEC standards programming software **(BL4)**
4. apply PLC project programming for various applications. **(BL4)**

Unit	Contents	Teaching hours (Total 45)
Unit-I	**Introduction** Introduction, Evolution History, IEC standards, Importance of PLC, type of PLC's and basic architecture	**04**
Unit- II	**Internal architecture and interfacing module** CPU, Memory Organization, Power Supply, Input/ Output Interface, Analog and digital input-output modules, Special purpose modules.	**05**
Unit-III	**Basic operation and programming** IEC standards for PLC programming, PLC operation, Ladder logic, Logic functions, Basic relay instructions, Timer/Counter Instructions, string operators.	**12**
Unit- IV	**PLC programming instructions** Comparison, Arithmetic, Logical, Data handling, input-output instructions, Data handling instructions, Data Conversions instructions, Case studies of different industrial applications.	**12**
Unit- V	**PLC project development** PLC specification and selection criteria, Sensor/Actuator selection, wiring connection with sourcing and sinking module, Wiring diagram, communication methods	**12**

Self Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:

This shall consist of at least 10 practical based on the above syllabus.

Suggested Reading:

1. Programmable Logic Controllers,Frank Petruzzula, Tata Mc-Graw Hill
2. Programmable Logic Controllers Principles and Applications, John W. Webb, Ronald A. Reis, Prentice Hall of India Publication
3. Programmable Logic Controllers Industrial Automation an Introduction, Madhuchannd Mitra and Samerjit Sengupta, Penram International Publishing Pvt. Ltd.
4. Programmable Logic Controllers Principles and Applications, J. R. Hackworth and F. D. Hackworth, Pearson publication

Suggested List of Experiments (not restricted to the following): (Only for Information)

1.	To understand the programming and architecture of PLC.	**(02 Hrs)**
2.	Programming PLC with relay based instructions.	**(02 Hrs)**
3.	Programming of PLC using Timer Instructions.	**(02 Hrs)**
4.	Programming of PLC using Counter Instructions.	**(02 Hrs)**
5.	Programming of PLC using Mathematical Instruction.	**(02 Hrs)**
6.	Programming of PLC using Comparison and Logical instructions.	**(02 Hrs)**
7.	Programming of PLC uses data handling and moving instructions.	**(02 Hrs)**
8.	Design drum level control system.	**(02 Hrs)**
9.	Design temperature control system.	**(04 Hrs)**
10.	To Prepare a demonstration of control system using PLC.	**(04 Hrs)**

L = Lecture, T = Tutorial, P = Practical, C = Credit

w.e.f. the academic year 2024 - 25 and onwards

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	Minor in Industrial Automation (Inter-disciplinary) Offered by B.Tech. in Electronics and Instrumentation Engineering
Semester:	V
Course Code:	3EI104IC24
Course Title:	Industrial Control System
Course Type:	Core Course- II under Minor (Interdisciplinary)
Year of Introduction:	2024-25

L	T	Practical component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to –

1. develop mathematical model of the given process **(BL3)**
2. design proper controller as per the system requirements **(BL3)**
3. apply the tuning rules to achieve optimum performance **(BL3)**
4. select advanced control strategy to achieve the objectives of control system **(BL4)**

Unit	Contents	Teaching hours (Total 45)
Unit- I	**Mathematical modelling** Transfer function, Signal Flow diagram, Analogy between mechanical and electrical systems, interacting and noninteracting systems, second order systems, system with transportation lag	**08**
Unit- II	**Time response analysis** Time response of first order and seconder order system and related time domain specifications, need of time domain compensation	**04**
Unit- III	**Conventional controllers** Concept of compensator design in time domain, Introduction to various controller modes, response of different controller for various errors, selection criteria for controllers. Proportional controller response for set point and load change, proportional-integral and proportional-integral-derivative response for set point and load change. State feedback controllers	**15**
Unit- IV	**Tuning of controllers** Need of controller tuning, criteria for good control, tuning methods – Ziegler-Nichols and Choen-Coon, error based performance criteria, process identification for controller tuning	**08**
Unit- V	**Advanced control algorithms** Need of advanced control strategies, cascade control, feedforward-feedback control, ratio control, dead time compensator, compensator for inverse response system, split range control, selective control, inferential control, reset windup, adaptive control, applications of advanced control strategies in various unit operations	**10**

Self Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:
This shall consist of at least 10 practicals based on the above syllabus.

Suggested Reading:

1. Donald R Coughanowr and S.E.leBlanc, Process Systems Analysis and Control, McGraw Hill Publication.
2. I.J. Nagrath and M. Gopal, Control System Engineering, New Age Publishers
3. Curtis Johnson, Process Control Instrumentation Technology, Prentice Hall of India Publication
4. Seborg, Edgar, Millichamp and Doyle, Process Dynamics and Control, Wiley Student Edition
5. Bela G. Liptak, Instrument Engineers Handbook, Process Control, Elsevier

Suggested List of Experiments (not restricted to the following):
(Only for Information)

1.	To develop mathematical model for mechanical and electrical system	**(02 Hrs)**
2.	To develop mathematical model using signal flow graph	**(02 Hrs)**
3.	To Evaluate the dynamic behavior of first order and second order system	**(02 Hrs)**
4.	To Measure time response parameters of the system	**(02 Hrs)**
5.	To Check continuous cycling method for controller tuning	**(02 Hrs)**
6.	To implement state feedback controllers	**(02 Hrs)**
7.	To implement conventional control algorithm	**(04 Hrs)**
8.	To Perform the cascade control scheme	**(02 Hrs)**
9.	To study Ratio Control scheme	**(02 Hrs)**
10.	To check the performance of Split Range Control scheme using PROSIM software	**(04 Hrs)**

L = Lecture, T = Tutorial, P = Practical, C = Credit

w.e.f. the academic year 2024 - 25 and onwards

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	Minor in Smart Automation (Disciplinary) Offered by B.Tech. in Electronics and Instrumentation Engineering
Semester:	V
Course Code:	3EI201DC24
Course Title:	Industrial Internet of Things (IIoT)
Course Type:	Core Course - I under Minor (Disciplinary)
Year of Introduction:	2024-25

L	T	Practical component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course,the students will be able to –

1. understand the fundamentals of the industrial Internet of things **(BL2)**
2. realize the importance of data security **(BL3)**
3. select the sensor, actuators and IoT hardware **(BL4)**
4. develop the ability to design IoT applications for various applications. **(BL4)**

Unit	Contents	Teaching hours (Total 45)
Unit- I	**Introduction to industrial IoT (IIoT) systems** IIoT-Introduction, Various Industrial Revolutions, Industry 4.0 revolutions, Support System for Industry 4.0, Smart Factories.	**05**
Unit- II	**Sensor and control devices for IIoT** Platforms for data acquisitions, different types of sensors and actuators, Programmable Controllers, Embedded PCs, Wireless sensor nodes, IoT Hub systems.	**10**
Unit-III	**IIoT data monitoring and control** Cloud computing, real-time dashboard for data monitoring, data analytics, Predictive Maintenance, Case study	**10**
Unit-IV	**IIoT- security** Industrial IoT: Security and Fog Computing - Cloud Computing in IIoT, Fog Computing in IIoT, Security in IIoT.	**10**
Unit-V	**Industrial IoT- applications** Factory Automation, Process Automation, Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security, Facility Management.	**10**

Self Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:
This shall consist of at least 10 practicals based on the above syllabus.

Suggested Reading:

1. Industry 4.0: The Industrial Internet of Things Alasdair Gilchrist , Apress
2. The Concept Industry 4.0 An Empirical Analysis of Technologies and Applications in Production Logistics, Bartodziej, Christoph Jan, Springer
3. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, Dr. OvidiuVermesan, Dr. Peter Friess, River Publishers

Suggested List of Experiments (not restricted to the following):
(Only for Information)

1.	Setting up a Raspberry Pi and connecting to a network.	**(02 Hrs)**
2.	Familiarization with GPIO pins and control hardware through GPIO pins.	**(02 Hrs)**
3.	Speed Control of motors using PWM with an embedded controller.	**(02 Hrs)**
4.	Dashboard design for temperature, humidity, light and distance	**(02 Hrs)**
5.	Web based hardware control	**(02 Hrs)**
6.	Connect IoT devices through the cloud using as IoT protocol such as MQTT.	**(02 Hrs)**
7.	Controlling IoT devices using Arduino.	**(02 Hrs)**
8.	Create a wireless network of sensors using Zigbee.	**(02 Hrs)**
9.	Project-I	**(04 Hrs)**
10.	Project-II	**(04 Hrs)**

L = Lecture, T = Tutorial, P = Practical, C = Credit

w.e.f. the academic year 2024 - 25 and onwards

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	Minor in Smart Automation (Disciplinary) Offered by B.Tech. in Electronics and Instrumentation Engineering
Semester :	V
Course Code:	3EI302DC24
Course Title:	Robotics Application in Industries
Course Type:	Core Course - II under Minor (Disciplinary)
Year of Introduction:	2024-2025

L	T	Practical component				C
		LPW	PW	W	S	
3	0	2	--	--	--	4

Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to –

1. understand the basics of robotics and automation **(BL2)**
2. describe the properties of robotic hardware useful in industrial robot **(BL2)**
3. determine control techniques for industrial robots **(BL3)**
4. analyse industrial application using robotic assembly line **(BL3)**

Unit	Contents	Teaching hours (Total 45)
Unit-I	**Introduction** Fundamental of robotics, robot arm components, robot in automation, types of robot manipulators, work envelope of robot manipulators.	03
Unit-II	**Robot sensor and end effector** Sensor in robotics arm application, selection of transducers, position and displacement sensors, types of end effectors, tools and end effector interface, robotic arm configurations with various sensors, types of end effectors as a tool and as gripper, pneumatic/hydraulic sequencing operation.	08
Unit-III	**Robot peripheral control** Control system analysis, modeling and control of joint robot, robot arm IO control, Introduction to manipulator kinematics, fundamental of robotic arm kinematics, denavit-hartenberg presentations, direct kinematics problems, joint space trajectory planning for robotic arm, consideration of joint interpolated trajectory.	10
Unit-IV	**Robot application in manufacturing** Multiple robot and machine interface, work cell control, programming language-feature and application, program for PNP (pick and Place) activity, robotic arm control system in industrial applications-material handling, welding, spray painting, machining, robotic arm configuration for pick and place process, spot welding process in car manufacturing, use of robots in automotive industries, case studies of effective robot used in industry.	12
Unit-V	**Robot programming language** Use of program for robot work cycle, manual programming method, walk through programming method, teach pendent through programming method, offline programming method, requirement of robot programming languages.	07
Unit-VI	**Robot vision system**	05

Components and function of robot vision system, camera illumination, frame grabber with image presentation, application of machine vision, industrial usage of vision controlled robotic system.

Self Study:
The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:
This shall consist of at least 10 practicals based on the above syllabus.

Suggested Reading:

1. Mikell Groover, Industrial robotics, McGraw Hill Education Pvt Ltd
2. R.K Rajput, Robotics and industrial automation, S. Chand Publishing
3. Richard K Miller, Industrial robot handbook, Springer
4. Norberto Pires, Industrial robot programming, Springer

Suggested List of Experiments (not restricted to the following):
(Only for Information)

1.	To analyse servo motor sequence using servo controller	**(02 Hrs)**
2.	To demonstrate working of encoder sensor	**(02 Hrs)**
3.	To study working of end effectors	**(02 Hrs)**
4.	To study robotic arm kinematics	**(02 Hrs)**
5.	To learn and demonstrate working of forward kinematics of robotic arm	**(02 Hrs)**
6.	To demonstrate inverse kinematics of robotic arm	**(02 Hrs)**
7.	To determine path and trajectory planning for robotic arm	**(02 Hrs)**
8.	To demonstrate robot programming on robotic arm kit	**(02 Hrs)**
9.	To demonstrate motion control of robotic arm	**(02 Hrs)**
10.	To perform pick and place algorithm using industrial ARM	**(02 Hrs)**
11.	To simulate robotic arm and conveyor belt-based application	**(02 Hrs)**
12.	To simulate object sorting mechanism using robotic arm	**(02 Hrs)**

L = Lecture, T = Tutorial, P = Practical, C = Credit

w.e.f. the academic year 2024 - 25 and onwards

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
B.Tech. Electronics & Communication Engineering
Teaching & Examination Scheme

Disciplinary Minor in 5G Technology and IoT Applications

w.e.f. Academic Year 2024-25

Course Code	Course Title	Teaching Scheme (hours/week)				Examination Scheme			
		L	T	P	C	Duration Hours	Component Weightage		
						SEE	CE	LPW	SEE
Semester 5 Core Courses–I and II									
3EC501DC24	Microprocessor and Peripheral Integration	3	-	2	4	3	0.3	0.3	0.4
3EC304DC24	Optical Wireless Communication	3	1	-	4	3	0.6	-	0.4
Semester 6 Core Course–III									
	Introduction to IoT	3	-	2	4	3	0.3	0.3	0.4
Semester 6 Elective Course-I									
	IoT Protocols & Standards	3	1	-	4	3	0.6	-	0.4
	Industrial IoT and Industry 4.0	3	1	-	4	3	0.6	-	0.4
	Software Defined Radio	3	1	-	4	3	0.6	-	0.4
Semester 7 Elective Course-II									
	IoT System Design	3	1	-	4	3	0.6	-	0.4
	IoT Security	3	1	-	4	3	0.6	-	0.4
	Cellular IoT standards	3	1	-	4	3	0.6	-	0.4

L: Lectures, P/T: Practicals / Tutorial, C: Credits
LPW/PW: Laboratory / Project Work

SEE: Semester End Examination
CE: Continuous Evaluation

Disciplinary Minor will be offered to the students of Electronics and Communication Engineering IT-NU.

w.e.f. for first year students admitted in 2022-23 and D to D students admitted in 2023-24 onwards

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. Electronics & Communication Engineering Minor in 5G Technology and IoT Applications (Disciplinary)
Course Code:	3EC501DC24
Course Title:	Microprocessor and Peripheral Integration
Course Type:	Minor Core
Year of Introduction:	2024-25

L	T	Practical component				C
		LPW	PW	W	S	
3	-	2	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, students will be able to-

1. execute assembly-level programs for data exchange and manipulation with microprocessor-based systems. BL-3
2. configure ARM processors in different modes of operation. BL-3
3. interface peripherals with a microprocessor to build applications. BL-4
4. design multiprocessor system with coprocessors and ARM controller. BL-6

Unit No.	Contents	Teaching hours (Total 45)
I	**ARM Embedded Systems:** The RISC design philosophy, the ARM design philosophy, embedded system hardware, embedded system software	06
II	**ARM Processor Fundamentals:** ARM registers set, current program status register, pipelining, Exceptions, interrupts, interrupt vector table, core extensions, ARM architectures, ARM processor families	10
III	**ARM Instruction Set:** Data processing instructions, branch instructions, load-Store instructions, software interrupt instruction, program status register instructions, loading constants, ARMv5E extensions, conditional execution, Thumb instruction set	12
IV	**ARM Programming and Peripheral Interfacing:** Embedded C programming, GPIO programming, LCD interfacing, serial port programming, interrupt programming, keypad interfacing, logical programming, sensor interfacing	12
V	**ARM Extensions:** Coprocessor 15 and caches, memory protection units, memory management units	05

Self-Study:

The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Laboratory Work:
Laboratory work will be based on the above syllabus with a minimum of 10 experiments to be incorporated.

Suggest List of Experiments (not restricted to the following):
(Only for information)

Sr. No.	Title of the experiment	Hours
1.	Understand the architecture of ARM microprocessor and embedded C programming concepts	02
2.	Introduction to Keil µVision Integrated Development Environment (IDE) and its features	02
3.	Programming of general-purpose input output in ARM	02
4.	Serial port programming in ARM	02
5.	LCD interfacing with ARM	02
6.	Keypad interacting with ARM	02
7.	Sensor interfacing with ARM	02
8.	Motor interfacing with ARM	02
9.	7-Segment LED interfacing with ARM	02
10.	Stepper Motor interfacing with ARM	02
11.	Relay interfacing with ARM	02
12.	Graphic LCD interfacing with ARM	02
13.	Touch Screen interfacing with ARM	02
14.	GSM modem interfacing with ARM	02
15.	Finger print sensor interfacing with ARM	02
16.	Thermal printer interfacing with ARM	02

Suggested Readings:

1. Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield, ARM System Developer's Guide, Elsevier
2. Steve Furber, ARM System-on-Chip Architecture, Addison-Wesley
3. Sriram Iyer, Pankaj Gupta, Embedded Realtime Systems Programming, Tata McGraw Hill
4. Shibu K V, Introduction to Embedded Systems, Tata McGraw Hill

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. Electronics & Communication Engineering Minor in 5G Technology and IoT Applications (Disciplinary)
Course Code:	3EC304DC24
Course Title:	Optical Wireless Communication
Course Type:	Minor Core
Year of Introduction:	2024-25

L	T	Practical component				C
		LPW	PW	W	S	
3	1	-	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, students will be able to-

1. articulate the challenges associated with Optical Wireless Communication. BL-3
2. apply the mitigation techniques to overcome the challenges. BL-3
3. analyse devices and systems used in OWC considering efficiency, power, and bandwidth. BL-4
4. evaluate various modulation techniques used in OWC. BL-5

Unit No.	Contents	Teaching hours (Total 45)
I	**Fundamental principles of OWC: E**xisting wireless access techniques, owc techniques, owc/radio comparison, potential owc application areas, challenges and mitigation techniques	08
II	**Devices and systems for OWC:** LEDs and Lasers: efficiency, power, bandwidth and modulation PIN and APD photodetector, photodetection techniques, photodetection noise, optical amplifiers	08
III	**Channel models:** Indoor, outdoor, and underwater OWC channels, lognormal channel, gamma-gamma channel, exponentiated Weibull channel models	08
IV	**Modulation techniques:** Digital baseband and passband modulation techniques, and multi-carrier modulation (OFDM) for OWC	08
V	**System performance analysis:** Performance analysis of terrestrial FSO, earth to satellite FSO link, lifi, challenges and mitigation techniques.	08
VI	**Applications and case study:** LiFi, UWOC, visible light communication, V2V communication	05

Self Study:

The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Sr. No	Title of the tutorial	Hours
1.	Introduction to Matlab: Matrix manipulation, random number generation of different distributions, statistical and Mathematical functions	01
2.	Matlab for simulation of communication systems: Modulation, Demodulation, SNR, BER, Channel capacity	01
3.	Simulation of the effect of atmospheric losses on terrestrial and satellite FSO link performance	01
4.	Simulation of the effect of atmospheric turbulence on the performance of FSO link	01
5.	Simulation of the effect of atmospheric turbulence and pointing errors on the performance of FSO link	01
6.	Performance simulation CSK modulation for VLC	01
7.	Performance comparison of different modulation techniques for FSO and Lifi channels	01
8.	Simulation of channel parameters' effect on indoor VLC link performance	01
9.	Simulation of the effect of turbulence on the performance of UWFSO link	01
10.	Simulation of dual-hop FSO communication link	01
11.	Simulation of dual-hop hybrid RF-FSO communication link	01
12.	Simulation of parallel hybrid RF-UWFSO communication	01
13.	Simulation of RF-VLC-FSO hybrid communication	01
14.	Analysis of OP, BER and channel capacity of log-normal FSO channel in presence of pointing error	01
15.	Analysis of OP, BER and channel capacity of Dual-Hop RF-FSO link	01

Suggest List of Tutorials (not restricted to the following):
(Only for information)

Suggested Readings:

1. Shlomi Arnon, John Barry, George Karagiannidis, Robert Schober, and Murat Uysal, Advanced Optical Wireless Communication Systems, Cambridge University Press
2. Z. Ghassemlooy, Popoola S. Rajbhandari, Optical Wireless Communications System and Channel Modelling , CRC Press
3. Gerd Keiser, Optical Communications, Tata McGraw Hill
4. Hemani Kaushal, V.K. Jain, Subrat Kar, Free Space Optical Communication, Springer

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
B.Tech. Electronics & Communication Engineering
Teaching & Examination Scheme

Disciplinary Minor in Systems Engineering

w.e.f. Academic Year 2024-25

Course Code	Course Title	Teaching Scheme (hours/week)				Examination Scheme			
		L	T	P	C	Duration Hours	Component Weightage		
						SEE	CE	LPW	SEE
Semester 5 Core Courses–I and II									
3EC702DC24	Introduction to Systems Engineering	3	0	2	4	3	0.3	0.3	0.4
3EC703DC24	Cyber Physical Systems	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Core Course–III									
	Electronics System Design	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Elective Course-I									
	Networking the Physical World	3	1	0	4	3	0.6	-	0.4
	Software Systems Engineering	3	1	0	4	3	0.6	-	0.4
	Bio Medical Signal Processing	3	1	0	4	3	0.6	-	0.4
Semester 7 Elective Course-II									
	Space Systems Engineering	3	1	0	4	3	0.6	-	0.4
	Introduction to Autonomous Vehicle Systems	3	1	0	4	3	0.6	-	0.4
	Applied Algorithms for System Engineers	3	1	0	4	3	0.6	-	0.4

L: Lectures, P/T: Practicals / Tutorial, C: Credits
LPW/PW: Laboratory / Project Work

SEE: Semester End Examination
CE: Continuous Evaluation

Disciplinary Minor will be offered to the students of Electronics and Communication Engineering, IT-NU.

w.e.f. for first year students admitted in 2022-23 and D to D students admitted in 2023-24 onwards

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. Electronics & Communication Engineering Minor in Systems Engineering (Disciplinary)
Course Code:	
Course Title:	Introduction to Systems Engineering
Course Type:	Minor Core
Year of Introduction:	2024-2025

L	T	Practical component				C
		LPW	PW	W	S	
3	-	2	-	-	-	4

Course Learning Outcomes (CLOs):
At the end of the course, students will be able to-

1. apply systems engineering principles to solve engineering problems. BL-3
2. analyse real-world systems using systems engineering methodologies. BL-4
3. evaluate system requirements and specifications. BL-5
4. design system architectures based on system requirements and design constraints. BL-6

Unit No.	Contents	Teaching hours (Total 45)
I	**Systems Engineering:** What is, origin, and examples, systems engineering as a profession power of systems engineering and examples; systems engineering viewpoint, perspectives, domains; systems engineering fields, approaches, engineering activities and products	06
II	**Complex System:** Structure-building blocks, hierarchy, interfaces; complex system structure-environment, interactions, complexity; system development process–life cycle, evolutionary characteristics; systems engineering method; systems testing throughout development	08
III	**System Development:** Managing systems development, risks, work breakdown structure (WBS), systems engineering management plan (SEMP) Systems risk management, organising for systems engineering; Need analysis – originating, operations, functional and feasibility Need validation, systems operations requirement, system requirements development, performance requirements	06
IV	**Modelling and Implementation:** Implementing concept exploration, validating requirements; concept definition – selection and validation, functional analysis and allocation; systems architecture, system modeling languages, Model-Based Systems Engg (MBSE) decision making, modeling for decisions; simulation, trade-off analysis	08
V	**Engineering Development:** Engineering development stage – program risk reduction, prototype development for risk mitigation, development testing, risk reduction; revision of functional analysis and design; overview of probability data analysis; hypothesis testing	05

VI	**Engineering Design – Implementation:** Engineering design – implementing system building blocks, component design; design validation, change management; concepts of reliability, redundancy; concepts of maintainability, availability, producibility; user interface design and GUI	06
VII	**System Integration, Testing, Evaluation and Production:** Integration, testing and evaluating total system; test planning and preparation, system integration developmental and operational test and evaluation; engineering for production, transition from development to production operations: installation, maintenance and upgrading; installation testing; in-service support, upgrades and modernisation	06

Self Study:
The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:
Laboratory work will be based on the above syllabus with a minimum of 10 experiments to be incorporated.

Suggest List of Experiments (not restricted to the following):
(Only for information)

Sr. No.	Title of the experiment	Hours
1.	Study of Modelling Language (UML)	06
2.	Model Based System Engineering (MBSE) Design	06
3.	Preparation of System Requirement Sheet	02
4.	Block Level System Integration using Software	06
5.	Test Case Generation	02
6.	White box Testing	02
7.	Black Box Testing	02
8.	Gray Box Testing	02
9.	Over The Air (OTA) System maintenance / Support	02
10.	Virtual Assistant using Cloud	02
11.	Analysis of Complex System	02
12.	Product Life Cycle Methods	02
13.	Documentation: Version management	02
14.	Quality Assurance, Reliability and Risk Analysis, Mitigation	02
15.	System Design Standards: Case Study (Application Specific)	02

Suggested Readings:

1. Kossiakoff, A., Sweet, W.N., Seymour, S.J., and Biemer S.M., Systems Engineering, Wiley
2. Dahai Lui, Systems Engineering: Design Principles and Models, CRC Press
3. Jon Holt, Systems Engineering Demystified: A Practitioner's Handbook for Developing Complex Systems Using a Model-based Approach, Wiley
4. Department of Defence, Systems Engineering Fundamentals, Defence Acquisition University

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. Electronics & Communication Engineering Minor in Systems Engineering (Disciplinary)
Course Code:	
Course Title:	Cyber Physical Systems
Course Type:	Minor Core
Year of Introduction:	2024-2025

L	T	Practical component				C
		LPW	PW	W	S	
3	-	2	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to –

1. apply design principles in cyber-physical systems projects. BL-3
2. analyse the architecture of cyber-physical systems. BL-4
3. evaluate cyber-physical system using hardware and software platforms, such as microcontrollers, sensors, actuators, and communication protocols. BL-5
4. design cyber-physical systems using formal methods. BL-6

Unit No.	Contents	Teaching hours (Total 45)
I	**Introduction to Cyber-Physical Systems:** Cyber-Physical Systems (CPS) in the real world, basic principles of design and validation of CPS, Industry 4.0, AutoSAR, IIOT implications, Building Automation, Medical CPS	05
II	**Platform Components:** CPS HW platforms - processors, sensors, actuators, CPS network – Wireless Hart, CAN, automotive ethernet, CPS software stack - RTOS, scheduling real-time control tasks	06
III	**Principles of Automated Control Design:** Basic control theory, dynamical systems, and stability, controller design techniques, stability analysis: CFLs, MLFs, stability under slow switching, performance under packet drop and noise	08
IV	**CPS Implementation:** Features, software components, mapping software components to ECUs, CPS performance analysis - effect of scheduling, bus latency, sense and actuation faults on control performance, network congestion, control, bus and network scheduling using true-time	07
V	**Formal Methods for Safety Assurance of Cyber-Physical Systems:** Advanced automata-based modeling and analysis, basic introduction and examples, timed and hybrid automata formal analysis, flow pipe construction, reachability analysis, analysis of cps software, weakest pre-conditions, hybrid automata modeling	07
VI	**Secure Deployment of CPS:** Attack models, secure task mapping and partitioning, state estimation for attack detection, case study - vehicle ABS hacking, power distribution, and attacks on smart grids	06

VII	**CPS Case Studies and Tutorials:** Automotive: SW controllers for ABS, ACC, lane departure warning, suspension control, healthcare: artificial pancreas/infusion pump/pacemaker, green buildings: automated lighting, ac control, and agriculture	**06**

Self-Study:
The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work:
Laboratory work will be based on the above syllabus with a minimum of 10 experiments to be incorporated.

Suggest List of Experiments (not restricted to the following):
(Only for information)

Sr. No.	Title of the experiment	Hours
1.	Study and interfacing of Sensors	04
2.	Study and Interfacing of Actuators	04
3.	Study of Control Mechanisms (Degree of Freedoms)	04
4.	PLC Programming	06
5.	System Level Simulation Platforms (MATLAB & Toolboxes)	04
6.	Hybrid Simulation (Analog & Digital Domain: Proteus VSM)	02
7.	Design of CPS System (Requirement / Specification to Prototype)	10
8.	Study of Controlled Area Networking (CAN) standard	02
9.	Automata Theory, Simulation and Applications	04
10.	Real Time Systems Simulation and Applications	04
11.	Cyber Security Algorithms and Analysis	02
12.	Study of CPS Standards	02
13.	CPS Applications: Robotics, Space, Home Automation	02
14.	CPS Applications: UAV: Drones, Space	02
15.	CPS Applications: Biomedical, Industry 4.0 -IIoT	02

Suggested Readings:

1. E.A.Lee, Sanjit Seshia, Introduction to Embedded Systems, A Cyber-Physical Systems Approach, MIT Press
2. Rajeev Alur, Principles of Cyber-Physical Systems, MIT Press
3. Houbing Song, Danda B. Rawat, Sabina Jeschke, and Christian Brecher, Cyber-Physical Systems: Foundations, Principles and Applications, Academic Press
4. Gabor Karsai, Janos Sztipanovits, Akos Ledeczi, Cyber-Physical Systems: A Computational Perspective, CRC Press

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
B.Tech. Electronics & Communication Engineering
Teaching & Examination Scheme

Interdisciplinary Minor in VLSI Design

w.e.f. Academic Year 2024-25

Course Code	Course Title	Teaching Scheme (hours/week)				Examination Scheme			
		L	T	P	C	Duration Hours	Component Weightage		
						SEE	CE	LPW	SEE
Semester 5 Core Courses–I and II									
3EC101IC24	Electronic Circuit Design using CMOS	3	-	2	4	3	0.3	0.3	0.4
3EC201IC24	HDL based Design using Programmable Logic	3	-	2	4	3	0.3	0.3	0.4
Semester 6 Core Course–III									
	Essentials of VLSI design test	3	-	2	4	3	0.3	0.3	0.4
Semester 6 Elective Course-I									
	Signal Processing for VLSI Design	3	1	-	4	3	0.6	-	0.4
	Physical Design for CMOS Technology	3	1	-	4	3	0.6	-	0.4
	Low Power High Speed VLSI circuits	3	1	-	4	3	0.6	-	0.4
Semester 7 Elective Course-II									
	Chip Fabrication Technology	3	1	-	4	3	0.6	-	0.4
	System on Chip	3	1	-	4	3	0.6	-	0.4
	Hardware Software Co-design	3	1	-	4	3	0.6	-	0.4

L: Lectures, P/T: Practicals / Tutorial, C: Credits
LPW/PW: Laboratory / Project Work

SEE: Semester End Examination
CE: Continuous Evaluation

Note: The department will provide relevant learning material in advance to the students of other departments opting interdisciplinary minor, so that they have prerequisite reading prior to initiation of the minor courses.

*Interdisciplinary Minor will be offered to the students of Computer Engineering, Electronics & Instrumentation Engineering and Electrical Engineering IT-NU.

w.e.f. for first year students admitted in 2022-23 and D to D students admitted in 2023-24 onwards

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. Electronics & Communication Engineering Minor in VLSI Design (Inter-disciplinary)
Course Code:	
Course Title:	Electronic Circuit Design using CMOS
Course Type:	Minor Core
Year of Introduction:	2024-25

L	T	Practical component				C
		LPW	PW	W	S	
3	-	2	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, students will be able to-

1. analyse static and dynamic characteristics of CMOS based circuits. BL-4
2. optimise the layout of MOS based analog and digital circuits. BL-4
3. design MOS based combinational and sequential circuits. BL-5
4. build differential amplifier using EDA Software tools BL-6

Unit No.	Contents	Teaching hours (Total 45)
I	**Introduction of VLSI:** Historical perspective, objective and organisation, overview of VLSI design methodologies, VLSI design flow, design hierarchy, concept of regularity, modularity and locality, VLSI design styles, design quality, packaging technology, cad technology	04
II	**MOS Transistors:** Metal Oxide Semiconductor (MOS) structure, MOS system under external bias, structure and operation of MOS transistor, MOSFET operating regions, I-V characteristics of MOSFET, MOSFET scaling, MOSFET capacitance, MOS small signal analysis	10
III	**Static and Switching characteristics of CMOS Inverter:** Introduction to static and switching characteristics, CMOS inverter, CMOS as ideal inverter, MOSFET capacitances, Delay-time definitions, Calculation of Delay times, Inverter design with delay constraints, Estimation of Switching Power Dissipation of CMOS Inverters	10
IV	**MOS Based Digital Circuits:** MOS based combinational circuit design. CMOS based digital circuits, AOI implementation, Layout optimisation using Euler's path, Stick Diagram, Transmission Gate based designs, SR latch circuit, Clocked latch & Flip-flop circuits, CMOS D-latch & Edge-triggered flip-flop	10
V	**Dynamic Logic Circuits:** Introduction, Basic Principles of pass transistor circuits, Synchronous Dynamic Circuit Techniques, CMOS Dynamic Circuit Techniques	03
VI	**MOSFET based Single stage and differential amplifier:** Common source stage, Source follower, Common gate stage, Basic differential amplifier, Common mode response, Differential pair with MOS loads	08

Self Study:

The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Laboratory Work:
Laboratory work will be based on the above syllabus with a minimum of 10 experiments to be incorporated.

Suggest List of Experiments (not restricted to the following):
(Only for information)

Sr. No.	Title of the experiment	Hours
1.	To get acquainted with Microwind Tool for layout design. Experiment with design rule checks for layout design.	02
2.	To design resistive load inverter and prepare the layout of the same. To find values of voltages associated with VTC curve	02
3.	To design inverter with active load and prepare the layout of the same. Find values of voltages associated with VTC curve. Simulate the inverter for finding the transient response, propagation delays, and rise and fall times	02
4.	To design CMOS inverter and prepare the layout of the same. Find values of voltages associated with VTC curve. Simulate the inverter for finding the transient response, propagation delays, and rise and fall times	02
5.	To design CMOS NAND gates and prepare the layout t of the same and find equivalent W/L ratio for series and parallel combinations of MOS transistors also simulate the gates for finding the transient response, propagation delays, and rise and fall times	02
6.	To design CMOS NOR gates and prepare the layout t of the same and find equivalent W/L ratio for series and parallel combinations of MOS transistors also simulate the gates for finding the transient response, propagation delays, and rise and fall times	02
7.	To design and implement CMOS based ring oscillator for given specifications. Prepare the layout for the same and compare the simulated results with the theoretical results	02
8.	To Prepare the layout for D Latch. Simulate the latch to find out transient response, propagation delays, and rise and fall times	02
9.	To Prepare the layout for clocked SR Latch. Simulate the latch to find out transient response, propagation delays, and rise and fall times	02
10.	To experiment with CMOS transmission gate. Simulate the same for the value of resistance with change in voltage across it	02
11.	Design combinational circuit using CMOS Transmission gate	02
12.	Design D flip flop using CMOS Transmission gate	02
13.	To Prepare the layout for two stage combinational circuit using Pre-Charge Evaluate logic.	02
14.	To Prepare the layout for two stage combinational circuit using domino logic	02
15.	To implement pipelining in dynamic CMOS logic circuits	02

Suggested Readings:

1. Sung Mo kang, Yusuf Leblebici, CMOS Digital Integrated circuits – Analysis and Design, Tata McGraw-Hill
2. Behzad Razavi, Design of analog CMOS integrated circuits, Tata McGraw-Hill
3. Pucknell & Eshraghian, Basic VLSI Design, PHI
4. Amar Mukerji, Introduction to nMOS and CMOS VLSI System Design, Prentice Hall
5. Neil H. E. Weste, David Money Harris, CMOS VLSI Design A Circuits and Systems Perspective, Addison – Wesley

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. Electronics & Communication Engineering Minor in VLSI Design (Inter-disciplinary)
Course Code:	
Course Title:	HDL based Design using Programmable Logic
Course Type:	Minor Core
Year of Introduction:	2023-24

L	T	Practical component				C
		LPW	PW	W	S	
3	-	2	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, students will be able to –

1. perform high level synthesis for digital circuits. BL- 3
2. optimise Boolean function using k-map. BL- 4
3. experiment with combinational and sequential digital circuits. BL- 5
4. design digital circuits using Verilog HDL. BL- 6

Unit No.	Contents	Teaching hours (Total 45)
I	**Digital fundamentals:** Overview, SOP and POS terms, AOI and OAI implementation, optimization of Boolean logic, advance k-map, ccombinational logic circuits, design with LSI and MSI logic, ssequential logic, hazards in combinational logic circuits	10
II	**Design of synchronous sequential machines:** Introduction to sequential circuits, basic sequential elements, Mealy and Moore machine, Counter design using sequential Machines, Design of Counters and sequence detectors	10
III	**Programmable Logic Devices:** Architecture of ROM, PROM, PAL and PLA, System controller design using PROM, PAL and PLA, Basic architecture of CPLD and FPGA	08
IV	**Verilog HDL:** Design methodology with Verilog HDL, data types on Verilog, gate level modeling, behavioural, data-flow and Structural modelling styles, synthesis for different modeling style, functions and tasks	10
V	**High Level Synthesis (HLS):** Resource allocation, binding, scheduling, data-path and controller generation, efficient synthesis of c code, hardware efficient c coding, verification of high-level synthesis	07

Self-Study:

The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Laboratory Work:
Laboratory work will be based on the above syllabus with a minimum of 10 experiments to be incorporated.

Suggest List of Experiments (not restricted to the following):
(Only for information)

Sr. No.	Title of the experiment	Hours
1.	Implementation of Boolean function using logic gates	02
2.	Design and implementation of half and full adders and subtractors	02
3.	Design and implementation of multiplexer and Boolean function using multiplexer	02
4.	Design and implementation of an encoder and decoder	02
5.	Design and implementation of flip flops	02
6.	Design of shift register and variants	02
7.	Design and implementation of Counters	02
8.	Digital hardware design flow with Verilog HDL	02
9.	Dataflow style of modelling using Verilog HDL	02
10.	Structural style of modelling using Verilog HDL	02
11.	Behavioural style of modelling using Verilog HDL	02
12.	Design and implementation of flipflops in Verilog HDL	02
13.	Design and implementation of counter in Verilog HDL	02
14.	Design and implementation of arithmetic and logic unit in Verilog HDL	02
15.	Design flow for high level synthesis	02

Suggested Readings:

1. M. Morris Mano, Digital logic and computer Design, PHI
2. Anand Kumar, Fundamentals of Digital Circuits, PHI
3. Samir Palnitkar, Verilog® HDL: A Guide to Digital Design and Synthesis, Prentice Hall
4. Philippe Coussy and Adam Morawiec, High-level Synthesis from Algorithm to Digital Circuit, Springer

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
B.Tech. Electronics & Communication Engineering
Teaching & Examination Scheme

Interdisciplinary Minor in Cyber-Physical System

w.e.f. Academic Year 2024-25

Course Code	Course Title	Teaching Scheme (hours/week)				Examination Scheme			
		L	T	P	C	Duration Hours	Component Weightage		
						SEE	CE	LPW	SEE
Semester 5 Core Courses–I and II									
3EC102IC24	Electronics System Engineering	3	0	2	4	3	0.3	0.3	0.4
3EC704IC24	Introduction to Cyber Physical Systems	3	1	0	4	3	0.6	0.0	0.4
Semester 6 Core Course–III									
	Microcontrollers and Interfacing	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Elective Course-I									
	Control Systems	3	1	0	4	3	0.6	-	0.4
	Communication Techniques	3	1	0	4	3	0.6	-	0.4
	Cyber Security	3	1	0	4	3	0.6	-	0.4
Semester 7 Elective Course-II									
	Single Board Computers	3	0	2	4	3	0.3	0.3	0.4
	Data Analytics	3	0	2	4	3	0.3	0.3	0.4
	Cloud Computing	3	0	2	4	3	0.3	0.3	0.4

L: Lectures, P/T: Practicals / Tutorial, C: Credits
LPW/PW: Laboratory / Project Work
SEE: Semester End Examination
CE: Continuous Evaluation

Note: The department will provide relevant learning material in advance to the students of other departments opting interdisciplinary minor, so that they have prerequisite reading prior to initiation of the minor courses.

*Interdisciplinary Minor will be offered to all the students of IT-NU other than Electronics & Communication Engineering department.

w.e.f. for first year students admitted in 2022-23 and D to D students admitted in 2023-24 onwards

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. Electronics & Communication Engineering Minor in Cyber Physical System (Inter-disciplinary)
Course Code:	
Course Title:	Electronics System Engineering
Course Type:	Minor Core
Year of Introduction:	2024-25

L	T	Practical component				C
		LPW	PW	W	S	
3	-	2	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, students will be able to –

1. articulate the performance parameters of ADC and DAC. BL-3
2. discover the design issues in digital circuit layout, transducers, sensors, and their interfacing. BL-3
3. analyse various AC and DC bridges. BL-4
4. evaluate the measurement errors in instruments. BL-5

Unit No.	Contents	Teaching hours (Total 45)
I	**Analog and mixed signal circuit design issues and techniques:** Passive components, understanding and interpreting data sheets and specifications of various passive and active components, non-ideal behaviour of passive components	06
II	**Data acquisition systems:** Types of ADCs and DACs, characteristics and performance parameters of ADC & DAC, interfacing to microcontrollers, Types of ADC-DAC: Characteristics, Specification, Architecture, Applications	08
III	**Design issues of logic circuit and techniques:** Understanding and interpreting data sheets, specifications of various CMOS & BiCMOS family logic devices, electrical behaviour (steady-state & dynamic) of CMOS & BiCMOS family logic devices, CMOS/TTL interfacing, JTAG/IEEE 1149.1 design considerations, design for testability, estimating digital system reliability	10
IV	**Fundamentals of measurements and instruments:** Measurement errors, accuracy and precision, analog waveform generators, types of instruments, DMM, DSO, logic analyser, pattern generators, spectrum analyser	05
V	**Bridge measurements:** Wheatstone bridge, Kelvin bridge, ac bridge and their applications, Maxwell bridge, Hay's bridge, unbalanced conditions, Wein bridge, Anderson's bridge, De Sauty bridge, Schering bridge	08
VI	**Transducers, sensors and interfacing:** Selection consideration, resistive strain gauge, temperature transducers, platinum type, thermistor, inductive, LVDT, capacitive, load cell, piezoelectric, photoelectric transducer, fiber optic sensors, smart sensors, micro-sensors	08

Self-Study:
The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Laboratory Work:
Laboratory work will be based on the above syllabus with a minimum of 10 experiments to be incorporated.

Suggest List of Experiments (not restricted to the following):
(Only for information)

Sr. No.	Title of the experiment	Hours
1.	Integral nonlinearity (INL) of ADC and DAC	02
2.	Differential nonlinearity (INL) of ADC and DAC	02
3.	Amplitude quantisation error of ADC and DAC	02
4.	Offset and gain error specification of ADC and DAC	02
5.	Demonstrate range extension of an ammeter and a voltmeter	02
6.	Measure medium resistance by Wheatstone bridge method	02
7.	Measure inductance using Maxwell's bridge	02
8.	Measure capacitance using Schering bridge	02
9.	Measure inductance using Hay's bridge	02
10.	Understand the basic concept of CRO and simulate Frequency & Phase measurement using Lissajous Pattern in Virtual Lab	02
11.	Characterise the performance of LVDT	02
12.	Characterise the performance of Thermistor	02
13.	Characterise the performance of Thermocouple	02
14.	Understand the basic concept of Spectrum Analyser	02
15.	Simulate Displacement Transducers using Virtual Lab	02

Suggested Readings:

1. R. Jacob Baker, CMOS Circuit-Design, Layout and Simulation, Wiley
2. John F. Wakerly, Digital Design Principles& Practices, Prentice Hall
3. Albert D. Helfrick and William D. Cooper, Modern electronics Instrumentation and Measurement Techniques, Prentice Hall.
4. B C Nakra K K Chaudhry - Instrumentation, Measurement and Analysis, Tata McGraw-Hill.
5. John F. Wakerly, Digital Design Principles& Practices, Prentice Hall

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. Electronics & Communication Engineering Minor in Cyber Physical Systems (Inter-disciplinary)
Course Code:	
Course Title:	Introduction to Cyber Physical Systems
Course Type:	Minor Core
Year of Introduction:	2024-25

L	T	Practical component				C
		LPW	PW	W	S	
3	1	-	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, students will be able to –

1. articulate the concept of cyber-physical systems. BL-3
2. relate safety measures in the cyber-physical systems. BL-4
3. appraise the concepts of real-time scheduling. BL-5
4. plan synchronous and asynchronous models for CPS. BL-5

Unit No.	Contents	Teaching hours (Total 45)
I	**Introduction to CPS:** Key features of cyber-physical systems, concept of real-time sensing and communication for CPS, examples and case studies of CPS	05
II	**Synchronous model:** Reactive components, properties of components, composing components, communication synchronization, deterministic behaviour, synchronous designs	08
III	**Asynchronous model:** Asynchronous processes, operations on processes, asynchronous design primitives, deadlocks, the concept of shared memory, asynchronous coordination protocols, reliable transmission	08
IV	**Safety assurance in CPS:** Safety specifications, invariants of transmission systems, safety monitors, automated invariants verifications, temporal checking and automata, model checking, run time verification, falsification	08
V	**Real-time scheduling**: Scheduling concept, architecture, components, various methods of scheduling, earliest deadline first (EDF) scheduling, fixed priority scheduling	08
VI	**CPS platform components and case studies**: Sensors and actuators, controllers, concept of feedback systems, case studies on medical, transportation, energy and agriculture applications	08

Self Study:

The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Suggest list of Tutorials (not restricted to the following):
(Only for information)

Sr. No.	Title of the tutorials	Hours
1.	Study of various types of temperature sensors	01
2.	Study of various types of sensors used in IoT applications	01
3.	Study of various types of transducers	01
4.	Study of various types of actuators used in IoT applications	01
5.	Numerical based on synchronous models	01
6.	To study synchronous design	01
7.	Numerical based on asynchronous models	01
8.	Study of various asynchronous communication protocols	01
9.	To study asynchronous design	01
10.	Numerical based on safety in CPS	01
11.	To study real-time scheduling concept	01
12.	Case study: CPS for Smart Energy System	02
13.	Case study: CPS for Health Care Monitoring System	02
14.	Case study: CPS for Transportation System	02
15.	Case study: CPS for Industry Automation System	02

Suggested Readings:

1. A. Lee, Sanjit Seshia, Introduction to Embedded Systems – A Cyber-Physical Systems Approach, MIT Press.
2. Rajeev Alur, Principles of Cyber-Physical Systems, MIT Press
3. P. Tabuada, Verification and control of hybrid systems: A symbolic approach, Springer-Verlag
4. Nonita Sharma, L K Awasthi, Monika Mangla, K P Sharma and Rohit Kumar, Cyber Physical System: A Comprehensive Guide, CRC press

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
B.Tech. Electronics & Communication Engineering
Teaching & Examination Scheme

Interdisciplinary Minor in Electronics Engineering

w.e.f. Academic Year 2024-25

Course Code	Course Title	Teaching Scheme (hours/week)				Examination Scheme			
		L	T	P	C	Duration Hours	Component Weightage		
						SEE	CE	LPW	SEE
Semester 5 Core Courses–I and II									
3EC103IC24	Basic Electronics	3	-	2	4	3	0.3	0.3	0.4
3EC502IC24	Microcontroller & Interfacing	3	-	2	4	3	0.3	0.3	0.4
Semester 6 Core Course–III									
	Signal Processing & Applications	3	-	2	4	3	0.3	0.3	0.4
Semester 6 Elective Course-I									
	Sensors & Actuator Technology	3	1	-	4	3	0.6	-	0.4
	Digital System Design	3	1	-	4	3	0.6	-	0.4
	MATLAB for Engineers	3	1	-	4	3	0.6	-	0.4
	Introduction to VLSI Technology	3	1	-	4	3	0.6	-	0.4
Semester 7 Elective Course-II									
	Human Computer Interaction	3	1	-	4	3	0.6	-	0.4
	Internet of Things	3	1	-	4	3	0.6	-	0.4
	Fundamentals of Image Processing	3	1	-	4	3	0.6	-	0.4

L: Lectures, P/T: Practicals / Tutorial, C: Credits
LPW/PW: Laboratory / Project Work

SEE: Semester End Examination
CE: Continuous Evaluation

Note: The department will provide relevant learning material in advance to the students of other departments opting interdisciplinary minor, so that they have prerequisite reading prior to initiation of the minor courses.

*Interdisciplinary Minor will be offered to the students of Chemical Engineering Mechanical Engineering and Civil Engineering IT-NU.

w.e.f. for first year students admitted in 2022-23 and D to D students admitted in 2023-24 onwards

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. Electronics & Communication Engineering Minor in Electronics Engineering (Inter-disciplinary)
Course Code:	
Course Title:	Basic Electronics
Course Type:	Minor Core
Year of Introduction:	2024-25

L	T	Practical component				C
		LPW	PW	W	S	
3	-	2	-	-	-	4

Course Learning Outcomes (CLOs):
At the end of the course, students will be able to-

1. model the working of electronic devices. BL-3
2. distinguish analog and digital logic circuits. BL-4
3. validate the electronic system design. BL-5
4. compose simple circuits using analog and Digital ICs for practical applications. BL-6

Unit No.	Contents	Teaching hours (Total 45)
I	**Electronic Devices:** Diode, Transistor, LED, Power Transistor, UJT, Relay, Solid State Relay, Solar Cells	06
II	**Thyristor Family:** Working Characteristics of SCR, TRIAC, DIAC	06
III	**Analog Electronic Circuits:** Rectifier, amplifier, transistor as switch, clippers clampers, schmitt triggers, Multivibrators: monostable, astable, bistable, op-amp, buffer	07
IV	**Power Amplifiers and Power Supplies:** Class A, class B, class C amplifier, push-pull amplifier, linear power supply, SMPS	05
V	**Electronics ICs:** 555 timer Integrated Circuit and its applications, 565 timer Integrated Circuit and its applications, Phased Lock Loop, oscillators, different types of amplifiers, audio amplifiers.	07
VI	**Digital Logic and Circuits:** Boolean logic, gates, flipflops, registers, counters, memory, analog-to-digital converter, types of ADC, digital-to-analog converter, types of DACs, digital ICs	07
VII	**Electronics System Design:** PCB, electronics standards, circuit design rules, thermal conductivity, packaging, signal integrity, EMI/EMC	07

Self Study:
The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Laboratory Work:
Laboratory work will be based on the above syllabus with a minimum of 10 experiments to be incorporated.

Suggest List of Experiments (not restricted to the following):
(Only for information)

Sr. No.	Title of the experiment	Hours
1.	Diode clipper circuits	02
2.	Bias stability Techniques for Bipolar Junction Transistor (BJT)	02
3.	Common Emitter (CE) configuration as an amplifier for Bipolar Junction Transistor (BJT)	04
4.	Design, construct and test RC phase shift oscillator for a given frequency.	04
5.	Design construct and test the LC oscillator	04
6.	Design, construct and test Class B power amplifiers for different Load Resistances	04
7.	Design, construct and test common source amplifier using FET for given specifications	04
8.	Design DC voltage Regulator using discrete components and using voltage regulator IC and determine line and load regulation in both cases	02
9.	Design, construct and test tuned amplifier for given specifications.	02
10.	Design, construct and test an Oscillator using 555 timer as an astable multivibrator	02
11.	Design a circuit to realize the given boolean function using fundamental gates	04
12.	Design Half adder and Full adder	04
13.	Verify the truth table of various flip flops	04
14.	Design and construct counter using Flipflops	02
15.	Hardware project of real-life application	06

Suggested Readings:

1. Boylestead & Nashelsky , Electronics Devices and Circuits Theory, PHI
2. David A. Bell, Electronic Devices and Circuits, Oxford University press
3. Millman & Halkias , Electronic Devices and Circuits, Tata McGraw-Hill
4. AnandKumar, Fundamentals of Digital Circuits, PHI

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. Electronics & Communication Engineering Minor in Electronics Engineering (Inter-disciplinary)
Course Code:	
Course Title:	Microcontroller and Interfacing
Course Type:	Minor Core
Year of Introduction:	2024-25

L	T	Practical component				C
		LPW	PW	W	S	
3	-	2	-	-	-	4

Course Outcomes (CO):

At the end of the course, students will be able to –

1. Experiment with AVR microcontroller. BL- 3
2. compare various language programming for the microcontroller. BL- 4
3. develop interface logic for interconnection of peripheral devices with microcontroller. BL- 5
4. design microcontroller-based system for given applications. BL- 6

Unit No.	Contents	Teaching hours (Total 45)
I	**Introduction to Computing:** Numbering and coding systems, Digital primer, Internal organization of computer	06
II	**Architecture of AVR Microcontroller:** Introduction of Microprocessors and Microcontrollers, Architecture of microcontroller pin signals, I/O ports interrupts, timer	07
III	**Programming of Microcontroller:** Instruction set, Addressing modes, Assembly directives, simple programming and programming of I/O ports, timer	05
IV	**Serial Communication:** Basics of serial communication, Asynchronous serial communication and data framing, Serial port programming. Serial data transfer schemes, UART.	08
V	**IO Interfacing and Programming:** LED, push-button switch, Hex keypad, Seven-segment display, LCDs, ADCs, DACs, Sensors, External memory	07
VI	**Interfacing Standards:** On board Communication Interfaces-12C Bus, SPI Bus, RS-232 , RS-422, RS-485	07
VII	**Motor Control** Interfacing of DC and Stepper motor, PWM for motor speed control, Relays	05

Self-Study:

The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Laboratory Work:

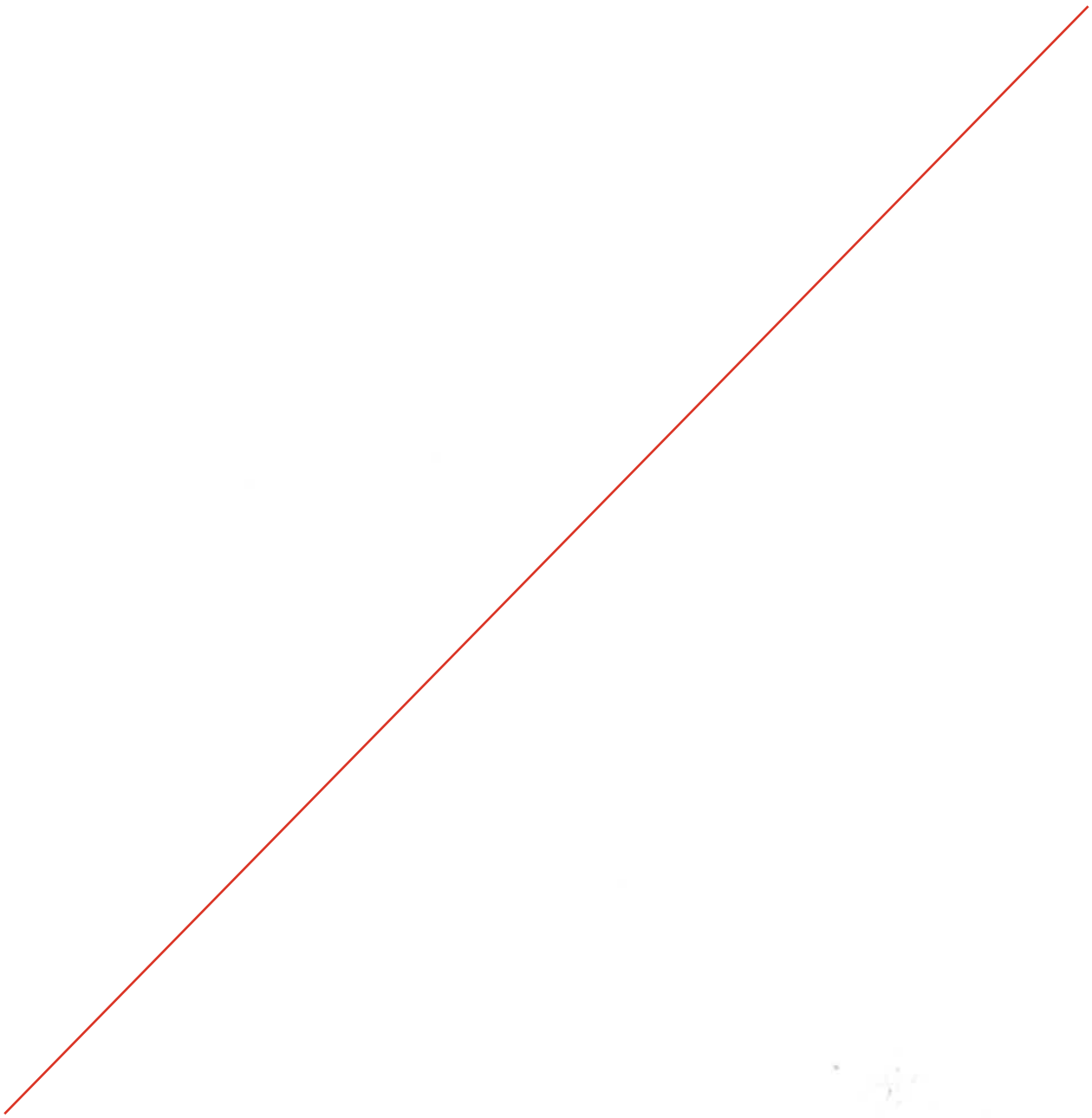
Laboratory work will be based on the above syllabus with a minimum of 10 experiments to be incorporated.

Suggest List of Experiments (not restricted to the following):
(Only for information)

Sr. No	Title of the experiment	Hours
1.	Write programs to examine the C data types for the 8051	01
2.	Write programs based on arithmetic operations – Addition, subtraction, multiplication, and division – 3 programming exercises	01
3.	Write and execute programs for IO port programming – 2 to 3 programming exercises	01
4.	Write and execute programs for interrupt programming and application – 3 programming exercises	02
5.	Write and execute programs for serial communication programming and application – 3 programming exercises	02
6.	Write and execute programs based on timer programming and applications – 3 programming exercises	02
7.	Write a program to interface the Push button and Hex keypad.	02
8.	Interfacing of 7-segment display with the controller.	01
9.	Write a program to display a string on LCD. – 2 programming exercise	02
10.	Interfacing of 8-bit ADC with the controller	01
11.	Interfacing of 8-bit DAC with the controller	01
12.	Speed control of DC motor	02
13.	Interfacing of different sensors	02
14.	Implementation of serial communication between two controller boards.	01
15.	Implementation of the data acquisition system	02

Suggested Readings:

1. M. A. Mazidi, J. C. Mazidi and R.D.Mckinlay, The 8051 Microcontroller and Embedded System, Pearson Education
2. Muhammad Ali Mazidi, Sarmad Naimi and Sepehr Naimi, The AVR Microcontroller and Embedded Systems: Using Assembly and C, Pearson Education
3. Simon Monk, Programming Arduino Getting Started with Sketches, Tata McGraw- Hill
4. Jeremy Blum, Exploring Arduino: Tools and Techniques for Engineering Wizardry, Wiley



NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
Teaching & Examination Scheme
Interdisciplinary Minor in Electric Vehicles*

w. e. f. Academic Year 2024-25

Course Code	Course Title	Teaching Scheme (hours/week)				Examination Scheme			
		L	T	P	C	Duration Hours	Component Weightage		
						SEE	CE	LPW	SEE
Semester 5 Core Course-I and II under Minor									
3EE303IC24	Electric Vehicle Architecture and Storage Systems	3	1	0	4	3	0.6	-	0.4
3EE304IC24	Automotive Electronics	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Core Course-III under Minor									
	Power Converters, Motors and Drives	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Elective Course-I under Minor									
	Vehicular Control Systems and Instrumentation	3	0	2	4	3	0.3	0.3	0.4
	Automotive Embedded Systems and Communication Protocols	3	0	2	4		0.3	0.3	0.4
Semester 7 Elective Course-II under Minor									
	Battery Management and Charging System	3	0	2	4	3	0.3	0.3	0.4
	Advanced Electric Drive Systems	3	1	0	4		0.6	-	0.4

L: Lectures, P/T: Practicals / Tutorial, C: Credits
LPW/PW: Laboratory / Project Work

SEE: Semester End Examination
CE: Continuous Evaluation

Note: The department will provide relevant learning material in advance to the students of other departments opting interdisciplinary minor, so that they have prerequisite reading prior to initiation of the minor courses.

*Interdisciplinary Minor will be offered for the students of departments other than Electrical Engineering, IT-NU.

w.e.f. for first year students admitted in 2022-23 and D to D students admitted in 2023-24 onwards

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
Teaching & Examination Scheme
Interdisciplinary Minor in Energy Systems Design and Economics*

w. e. f. Academic Year 2024-25

Course Code	Course Title	Teaching Scheme (hours/week)				Examination Scheme			
		L	T	P	C	Duration Hours	Component Weightage		
						SEE	CE	LPW	SEE
Semester 5 Core Course I and II under Minor									
3EE203IC24	Electrical Power Utilization and Safety	3	1	0	4	3	0.6	-	0.4
3EE204IC24	Design, Estimation and Costing of Electrical Systems	3	1	0	4	3	0.6	-	0.4
Semester 6 Core Course–III under Minor									
	Energy Management and Audit	3	1	0	4	3	0.6	-	0.4
Semester 6 Elective Course-I under Minor									
	Electrical Energy Markets	3	1	0	4	3	0.6	-	0.4
	Basics of Electric Power Generation	3	1	0			0.6	-	0.4
Semester 7 Elective Course-II under Minor									
	Introduction to Smart grid	3	1	0	4	3	0.6	-	0.4
	Design of Electrical Power Transmission and Distribution Systems	3	1	0			0.6	-	0.4

L: Lectures, P/T: Practicals / Tutorial, C: Credits
LPW/PW: Laboratory / Project Work
SEE: Semester End Examination
CE: Continuous Evaluation

Note: The department will provide relevant learning material in advance to the students of other departments opting interdisciplinary minor, so that they have prerequisite reading prior to initiation of the minor courses.

*Interdisciplinary Minor will be offered for the students of departments other than Electrical Engineering, IT-NU.

w.e.f. for first year students admitted in 2022-23 and D to D students admitted in 2023-24 onwards

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
Teaching & Examination Scheme
Disciplinary Minor in Electric Mobility*

w. e. f. Academic Year 2024-25

Course Code	Course Title	Course Type	Teaching Scheme (hours/week)				Examination Scheme			
							Duration Hours	Component Weightage		
			L	T	P	C	SEE	CE	LPW	SEE
Semester 5 Core Courses–I and II under Minor										
3EE305DC24	Electric Vehicle Architecture and Battery storage	Core	3	0	2	4	3	0.3	0.3	0.4
3EE103DC24	Automotive Motors for propulsion	Core	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Core Course–III under Minor										
	Power Electronics for e-Mobility	Core	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Elective Course-I under Minor										
	Vehicle Dynamics and Control	Elective 1	3	1	0	4	3	0.6	-	0.4
	IoT for Automotive Systems	Elective 1	3	0	2			0.3	0.3	0.4
Semester 7 Elective Course-II under Minor										
	Controllers for EV Applications	Elective 2	3	0	2	4	3	0.3	0.3	0.4
	Computer Aided Design of Vehicular Motors	Elective 2	3	1	0			0.6	-	0.4

L: Lectures, P/T: Practical / Tutorial, C: Credits
LPW/PW: Laboratory / Project Work

SEE: Semester End Examination
CE: Continuous Evaluation

*Disciplinary Minor will be offered for the students of Electrical Engineering Department, IT-NU.

w.e.f. for the first-year students admitted in 2022-23 and D to D students admitted in 2023-24 onwards

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
Teaching & Examination Scheme
Disciplinary Minor in Renewable Sources and Power Systems*

w. e. f. Academic Year 2024-25

Course Code	Course Title	Course Type	Teaching Scheme (hours/week)				Examination Scheme			
			L	T	P	C	Duration Hours	Component Weightage		
							SEE	CE	LPW	SEE
Semester 5 Core Courses–I and II under Minor										
3EE205DC24	Renewable Energy Sources	Core	3	0	2	4	3	0.3	0.3	0.4
3EE206DC24	Power System Design	Core	3	1	0	4	3	0.6	-	0.4
Semester 6 Core Course–III under Minor										
	Applications of AI in Power Systems and Renewables	Core	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Elective Course-I under Minor										
	AC/DC Microgrid	Elective 1	3	0	2	4	3	0.3	0.3	0.4
	Modeling and Control of Grid-connected Renewable Sources	Elective 1	3	1	0	4	3	0.6	-	0.4
Semester 7 Elective Course-II under Minor										
	Advanced Power System Analysis	Elective 2	3	0	2	4	3	0.3	0.3	0.4
	Energy Audit and policy	Elective 2	3	1	0	4		0.6	-	0.4

L: Lectures, P/T: Practical / Tutorial, C: Credits
LPW/PW: Laboratory / Project Work

SEE: Semester End Examination
CE: Continuous Evaluation

*Disciplinary Minor will be offered for the students of Electrical Engineering Department, IT-NU.

w.e.f. for the first-year students admitted in 2022-23 and D to D students admitted in 2023-24 onwards

NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B. Tech.**
Semester:	**V**
Course Code:	3EE303IC24
Course Title:	**Electric Vehicle Architecture and Storage Systems**
Course Type:	**Core Course-I under Minor (Interdisciplinary)**
Year of Introduction:	**2024 – 25**

L	T	Practical component				C
		LPW	PW	W	S	
3	1	0	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to –

1. correlate electric vehicles with fossil fuel driven vehicles and apply the concept of Electric vehicle powertrain and drivetrain **(BL3)**
2. comprehend hybrid electric vehicles and examine energy management strategies **(BL3)**
3. select appropriate energy storage system **(BL4)**
4. analyse battery parameters, characteristics and apply the concept of battery management systems **(BL4)**

Contents: **Teaching hours: 45**

Unit-I **Electric Vehicle Fundamentals** **06**

Introduction, electric vehicle development-past, present and future, electric vehicles and environment, comparison with internal combustion engine driven vehicle, components of electric vehicles, overview of various OEM platforms.

Unit-II **Electric Vehicle Powertrain and Drivetrain** **07**

Concept & types of powertrain, powertrain components, concept & different types of drive train, transmission efficiency

Unit-III **Hybrid Electric Vehicles** **08**

Hybrid Electric vehicles – Classification – Micro, Mild, Full, Plug-in, Types–series, parallel and series-parallel configurations, hybrid drive train topologies, analysis and control of Hybrid Electric vehicle systems

Unit-IV **Energy Management Strategies** **06**

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies

Unit-V	**Fundamentals of storage systems** Principles of operation of cells and batteries, electrochemical principles and reactions, types of batteries, fuel cells, supercapacitors, selection and application of energy storage systems for electric vehicle systems	**07**
Unit-VI	**Batteries for EV** Advanced lead-acid, Ni-based, lithium ion and sodium ion batteries, battery performance parameters, battery sizing, battery design, battery assembly, testing, failure analysis, safety issues, battery pack performance, drive cycle analysis and safety testing standards, Selection of battery for EV, requirement of battery monitoring, battery state of charge estimation methods, battery cell equalization problem and solution, components of battery management system	**11**

Self-Study:
The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Tutorial:
This shall consist of at least 6 tutorials based on the above Contents.

Suggested Readings:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, John Wiley & Sons.
2. Iqbal Husain, Electric and Hybrid Vehicles Design Fundamentals, CRC Press, Taylor and Francis Group.
3. Sandeep Dharmeja, Electric Vehicle Battery Systems, Newnes.
4. K. T. Chau, Zheng Wang, Chaos in Electrical Drive Systems: Analysis, Control & Applications, John Wiley and Sons.
5. Chung Chow Chan, K. T. Chau, Modern Electric Vehicle Technology, Oxford University Press.
6. Michael H Westbrrok, The Electric Car - Development and Future of Battery, Hybrid and Fuel Cell Cars, IEE Power and Energy Series 38, The Institution of Electrical Engineers.
7. International standards in use, relevant research papers and articles.

L = Lecture, T = Tutorial, P = Practical, C = Credit

w.e.f. academic year 2024 - 25 and onwards

Nirma University

Institute:	**Institute of Technology**
Name of Programme:	**B.Tech.**
Semester:	**V**
Course Code:	3EE304IC24
Course Title:	**Automotive Electronics**
Course Type:	**Core Course-II under Minor (Interdisciplinary)**
Year of Introduction:	**2024 – 2025**

L	T	Practical component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, students will be able to –

1.analyse constructional and operational aspects of electronic devices - **(BL3)**

2.design appropriate logic using digital circuit for EV - **(BL5)**

3.identify the sensor for electric vehicle application - **(BL4)**

4.evaluate performance parameters of automotive circuits - **(BL5)**

Contents: **Teaching hours: 45**

Unit-I **Analog circuits** **15**

Introduction to transistor biasing, design of conventional CE amplifier, the evolution of differential amplifier from the conventional amplifier, input-output characteristics of the differential amplifier, differential amplifier circuit configurations, current mirror and level translator, timer and signal generator circuits, various applications of the operational amplifier, timer circuits, specific applications of analog circuits to the automotive domain.

Unit II **Digital circuits** **10**

Introduction to digital circuits, combinational circuits – multiplexer, demultiplexer, adder and subtractors, sequential circuits – flip-flop circuits, counters, timers, analog to digital converters, digital to analog converter

Unit-III **Vehicular sensors and actuators** **07**

Temperature sensor, speed sensor, acceleration sensor, linear and angle position sensors, pressure sensor, proximity sensor, magnetic actuators, torque motors, bimetallic strips, stepper motors, servo motors.

Unit-IV **Automotive Systems** **13**

Engine management system, electronic control units, interfacing of lighting and signalling circuits, starting, lighting and ignition circuits, LED and laser lighting, wiper control, signalling circuits like flasher, brake, indicator etc. electric horn, central locking and electric windows, vehicle safety and comfort systems, security and anti-theft system, airbag circuits, audio interfacing, the concept of onboard diagnostic (OBD)

Self-Study:

The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Laboratory Work:

This shall consist of at least 10 laboratory experiments / simulations based on the Contents.

Suggested Reading:

1. R. Boylestad and L. Nashelsky, Textbook of Electronics Devices & Circuit Theory, PHI Publication.
2. William B. Ribbens, Understanding Automotive Electronics: An Engineering Perspective, Elsevier.
3. R. Gayakwad, Textbook of Operational Amplifiers and Linear Integrated Circuits, PHI Publication.
4. James D. Halderman, Automotive Electricity and Electronics, Pearson publisher
5. Ronald K. Jurgen, Automotive Electronics Handbook, Mcgraw-Hill
6. Tom Denton, Automobile Electric and Electronic Systems, SAE International
7. Robert Bosch (GmbH), Bosch Automotive Electrics and Automotive Electronics: Systems and Components, Networking and Hybrid Drive, Springer-Verlag
8. Konrad Reif, Automotive Mechatronics: Automotive Networking, Driving Stability Systems, Electronics, Springer-Verlag
9. Robert Bosch (GmbH), Automotive Handbook, Springer-Verlag

Suggested List of Experiments (not restricted to the following):
(Only for Information)

	Title of Experiments	Hrs.
1.	Performance of BJT characteristics and CE amplifier	2
2.	Performance of Differential amplifier	2
3.	Simulation and analysis of Op-amp as an amplifier	2
4.	Performance of Op-amp as an adder, subtractor	2
5.	Simulation of Op-amp as Integrator and differentiator	2
6.	Performance of timer IC as a pulse generator	2
7.	Performance of digital circuits – Adder, subtractor	2
8.	Simulation Analysis of asynchronous and synchronous counters	2
9.	Performance of digital to analog converter	2
10.	Simulation analysis of analog to digital converter	2
11.	Demonstration of voltage, current and temperature sensor	
12.	Demonstration of automotive actuator	

L = Lecture, T = Tutorial, P = Practical, C = Credit

w.e.f. academic year 2024 - 25 and onwards

NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B. Tech.**
Semester:	**V**
Course Code:	3EE203IC24
Course Title:	**Electrical Power Utilisation and Safety**
Course Type:	**Core Course-I under Minor (Interdisciplinary)**
Year of Introduction:	**2024 – 25**

L	T	Practical component				C
		LPW	PW	W	S	
3	1	0	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to –

1. apply suitable techniques for electric heating and welding system. **(BL3)**
2. select proper refrigeration/ air – conditioning system for a specific purpose. **(BL4)**
3. design and analyse illumination scheme and electrification for various applications. **(BL4)**
4. appraise the earthing system, electrical safety and protective devices. **(BL3)**

Contents: **Teaching Hours: 45**

Unit I **Electric Heating and Welding** **08**

Advantages of electric heating, resistance heating, types of furnaces, induction heating, types of induction furnaces, dielectric heating, types of welding- arc and resistance

Unit II **Refrigeration and Air Conditioning** **07**

Introduction to refrigeration and air-conditioning, principles of a refrigerator, domestic refrigerator, electrical circuit of refrigerator, need of voltage regulator, water cooler, air conditioner, thermo-electric refrigeration, air purification, central air conditioning systems

Unit III **Illumination Scheme** **10**

Types of light sources and lighting arrangements, terms and definitions, lumen depreciation, product lifespan, maintenance schedule, lighting schemes, light fixtures, factors affecting lighting installation, energy efficiency in lamps and illumination, street light design, smart street lighting, flood lighting, mobile light unit, factory lighting

Unit-IV	**Power Factor** Effects of power factor, causes of low power factor, disadvantages of low power factor, methods of improving power factor, most economical power factor	**07**
Unit-V	**Electrical Safety, Earthing System and Protective Devices** Electrical shock mechanisms, factors influencing the electric shock, body current thresholds (tolerable body current limit), Thevenin's concepts and accidental equivalent circuits (step and touch potentials), protection against electric shock, purpose of earthing, IS rules for earthing of electrical installations, factors governing the resistance of earth electrode, methods of earthing, measurement of earth resistance, methods of reducing earth resistance, fuse, miniature circuit breakers (MCB), earth leakage circuit breakers (ELCB), residual current circuit breaker (RCCB).	**13**

Self-Study:
The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Tutorial Work:

This shall consist of at least 6 tutorials based on the above syllabus.

Suggested Readings:

1. S. Sivanagaraju, M. Balasubba Reddy and D. Srilatha, Generation and Utilization of Electrical Energy, Pearson.
2. H. Partab, Art and Science of Utilisation of Electrical Energy, Dhanpat Rai & Co.
3. B. Ram and D. N. Vishwakarma, Power System Protection and Switchgear, Tata McGraw Hill.
4. B. A. Oza, N. C. Nair, R. P. Mehta and V. H. Makwana, Power System Protection and Switchgear, Tata McGraw Hill.
5. J. B. Gupta, Utilization of Electric Power and Electric Traction, S. K. Kataria & Sons, New Delhi.
6. G. C. Garg, Utilization of Electric Power and Electric Traction, Khanna Publishers, Delhi.
7. R. K. Rajput, Utilisation of Electrical Power, Laxmi Publications (P) Ltd., New Delhi.
8. N. V. Suyranarayana, Utilisation of Electric Power Including Electric Drives and Electric Traction, New Age Publishers, New Delhi.

L = Lecture, T = Tutorial, P = Practical, C = Credit

w.e.f. academic year 2024-25 and onwards

NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B. Tech.**
Semester:	**V**
Course Code:	3EE204IC24
Course Title:	**Design, Estimation, and Costing of Electrical Systems**
Course Type:	**Core Course-II under Minor (Interdisciplinary)**
Year of Introduction:	**2024 – 25**

L	T	Practical component				C
		LPW	PW	W	S	
3	1	0	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, the student will be able to –

1. analyse the electric wiring and the associated protection **(BL4)**
2. estimate costing of residential, commercial & industrial electrical installations **(BL5)**
3. develop the skill to install rotating machines in workshops **(BL5)**
4. apply design principles for solar PV installation **(BL5)**

Contents: **Teaching Hours: 45**

Unit I **Electrical System Installations** **05**

Electrical symbols, types of electrical diagram (schematic, wiring and pictorial), general rules of electrical system design, statutory regulations, quality and safety of electrical installation, estimation and qualities of good estimator, overview of testing, types of testing, electrical safety rules, on-site electrical safety, lockout/ tagging, shock treatment, design of electric panelboard, protection equipment, control components

Unit II **Wiring Systems** **08**

Electric supply system, three phase three wire and three phase four wire distribution system, types of wiring in residential and commercial premises, light and power circuits, sub circuits, load assessment, permissible voltage drop, size of wires, protection: fuse, relays, contactors, circuit breaker, miniature circuit breaker, residual current circuit breaker, Indian electricity rules relating to supply and use of energy, precautions to be adopted in mines and oilfields

Unit III	**Residential, Commercial and Industrial Electrical Systems** Selection of network, local isolation, isolation of incoming supply, installation drawing, service connection to independent house, service connection to a residential apartment and commercial buildings, schedule of material and cost, earthing requirements, schedule of rates for skilled and unskilled manpower, electrical estimation and costing of residential building, commercial buildings, hospitals, recreational and assembly buildings, cinema theaters, small industries, electrical aspects of lifts, escalators services	**15**
Unit IV	**Commissioning, Testing and Maintenance of Rotating Machines** Planning and preparation, location and layout diagram, mounting, alignment, electrical connection, cooling and ventilation, drying, visual inspection, commissioning, maintenance, periodical checks, nature of failures in motors, insulation resistance measurement, maintenance test equipment, motor starting current, starters, cable size, conduit size, fuse rating, motor control circuits - start, stop & reverse, duty cycle, motor protection, case studies of motor installation in workshops, estimation and costing, maintenance of DG sets	**07**
Unit IV	**Solar System Design** Solar energy scenario of India, solar map of India, various schemes and initiatives in the field of solar energy, types of PV cells, PV cell characteristics, effect of temperature on PV cell, PV cell efficiency, fill factor, series and parallel connection of PV cell, solar radiation geometry and its terminology, air mass, solar thermal design with flat plate, parabolic collectors, sizing of PV system without battery, PV system design with battery, MPPT techniques, input impedance model of power converters for MPPT, direct PV and battery connection, charge controller, battery charger design, multi axes solar trackers, stand-alone PV system, inverter sizing, capacitor, conductor sizing, maximum and continuous PV currents, system grounding, testing of PV system, challenges in grid connection, charging infrastructure for EV	**10**

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Tutorial Work:

This shall consist of at least 06 tutorials based on the above syllabus.

Suggested Readings:

1. N Alagappan,S Ekambaram, Electrical estimating and Costing, McGraw-Hill.
2. Hemant Joshi, Residential, Commercial and Industrial Electrical Systems, Vol. 2, Tata McGraw-Hill.
3. K.B. Raina, S.K. Bhattacharya, Electrical Design, Estimating and Costing, New Age International (p) Ltd. Publishers, New Delhi.
4. Surjit Singh. Electrical Estimating and Costing, Dhanpat Rai & Co.,Delhi.
5. J.B. Gupta, Electrical Installation Estimating and Costing, Kataria, S. K., & Sons.
6. G. Ramamurthy, Handbook of Electrical Power Distribution, Universities Press (India) Private Ltd., New Delhi.
7. Narang K.L., A Textbook of Electrical Engineering Drawing, Tech India Publications.
8. IS, National Electrical Code, Bureau of Indian Standard Publications.

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w.e.f. academic year 2024 – 25 and onwards

NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B. Tech.**
Semester:	**V**
Course Code:	3EE305DC24
Course Title:	**Electric Vehicle Architecture and Battery Storage**
Course Type:	**Core Course-I under Minor (Interdisciplinary)**
Year of Introduction:	**2024 – 25**

L	T	Practical component				C
		LPW	PW	W	S	
3	1	0	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to –

1. correlate electric vehicles with fossil fuel driven vehicles and apply the concept of Electric vehicle powertrain and drivetrain **(BL3)**
2. comprehend hybrid electric vehicles and examine energy management strategies **(BL3)**
3. select appropriate energy storage system **(BL4)**
4. analyse battery parameters, characteristics and apply the concept of battery management systems **(BL4)**

Contents: **Teaching hours: 45**

Unit-I **Electric Vehicle Fundamentals** **06**

Introduction, electric vehicle development-past, present and future, electric vehicles and environment, comparison with internal combustion engine driven vehicle, components of electric vehicles, overview of various OEM platforms.

Unit-II **Electric Vehicle Powertrain and Drivetrain** **07**

Concept & types of powertrain, powertrain components, concept & different types of drive train, transmission efficiency

Unit-III **Hybrid Electric Vehicles** **08**

Hybrid Electric vehicles – Classification – Micro, Mild, Full, Plug-in, Types–series, parallel and series-parallel configurations, hybrid drive train topologies, analysis and control of Hybrid Electric vehicle systems

Unit-IV	**Energy Management Strategies** Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies	**06**
Unit-V	**Fundamentals of storage systems** Principles of operation of cells and batteries, electrochemical principles and reactions, types of batteries, fuel cells, supercapacitors, selection and application of energy storage systems for electric vehicle systems	**07**
Unit-VI	**Batteries for EV** Advanced lead-acid, Ni-based, lithium ion and sodium ion batteries, battery performance parameters, battery sizing, battery design, battery assembly, testing, failure analysis, safety issues, battery pack performance, drive cycle analysis and safety testing standards, Selection of battery for EV, requirement of battery monitoring, battery state of charge estimation methods, battery cell equalization problem and solution, components of battery management system	**11**

Self-Study:
The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Tutorial:
This shall consist of at least 6 tutorials based on the above Contents.

Suggested Readings:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, John Wiley & Sons.
2. Iqbal Husain, Electric and Hybrid Vehicles Design Fundamentals, CRC Press, Taylor and Francis Group.
3. Sandeep Dharmeja, Electric Vehicle Battery Systems, Newnes.
4. K. T. Chau, Zheng Wang, Chaos in Electrical Drive Systems: Analysis, Control & Applications, John Wiley and Sons.
5. Chung Chow Chan, K. T. Chau, Modern Electric Vehicle Technology, Oxford University Press.
6. Michael H Westbrrok, The Electric Car - Development and Future of Battery, Hybrid and Fuel Cell Cars, IEE Power and Energy Series 38, The Institution of Electrical Engineers.
7. International standards in use, relevant research papers and articles.

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w.e.f. academic year 2024 - 25 and onwards

Nirma University

Institute:	**Institute of Technology**
Name of Programme:	**B.Tech.**
Semester:	**V**
Course Code:	**3EE103DC243**
Course Title:	**Automotive Motors for Populsion**
Course Type:	**Core Course-II under Minor (Interdisciplinary)**
Year of Introduction:	**2024 – 2025**

L	T	Practical component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, students will be able to –

1. analyse constructional and operational aspects of electronic devices **(BL3)**
2. design appropriate logic using digital circuit for EV **(BL5)**
3. identify the sensor for electric vehicle application **(BL4)**
4. evaluate performance parameters of automotive circuits **(BL5)**

Contents: **Teaching hours: 45**

Unit-I **Analog circuits** **15**

Introduction to transistor biasing, design of conventional CE amplifier, the evolution of differential amplifier from the conventional amplifier, input-output characteristics of the differential amplifier, differential amplifier circuit configurations, current mirror and level translator, timer and signal generator circuits, various applications of the operational amplifier, timer circuits, specific applications of analog circuits to the automotive domain.

Unit II **Digital circuits** **10**

Introduction to digital circuits, combinational circuits – multiplexer, demultiplexer, adder and subtractors, sequential circuits – flip-flop circuits, counters, timers, analog to digital converters, digital to analog converter

Unit-III **Vehicular sensors and actuators** **07**

Temperature sensor, speed sensor, acceleration sensor, linear and angle position sensors, pressure sensor, proximity sensor, magnetic actuators, torque motors, bimetallic strips, stepper motors, servo motors.

Unit-IV **Automotive Systems** **13**

Engine management system, electronic control units, interfacing of lighting and signalling circuits, starting, lighting and ignition circuits, LED and laser lighting, wiper control, signalling circuits like flasher, brake, indicator etc. electric horn, central locking and electric windows, vehicle safety and comfort systems, security and anti-theft system, airbag circuits, audio interfacing, the concept of onboard diagnostic (OBD)

Self-Study:

The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Laboratory Work:

This shall consist of at least 10 laboratory experiments / simulations based on the Contents.

Suggested Reading:

1. R. Boylestad and L. Nashelsky, Textbook of Electronics Devices & Circuit Theory, PHI Publication.
2. William B. Ribbens, Understanding Automotive Electronics: An Engineering Perspective, Elsevier.
3. R. Gayakwad, Textbook of Operational Amplifiers and Linear Integrated Circuits, PHI Publication.
4. James D. Halderman, Automotive Electricity and Electronics, Pearson publisher
5. Ronald K. Jurgen, Automotive Electronics Handbook, Mcgraw-Hill
6. Tom Denton, Automobile Electric and Electronic Systems, SAE International
7. Robert Bosch (GmbH), Bosch Automotive Electrics and Automotive Electronics: Systems and Components, Networking and Hybrid Drive, Springer-Verlag
8. Konrad Reif, Automotive Mechatronics: Automotive Networking, Driving Stability Systems, Electronics, Springer-Verlag
9. Robert Bosch (GmbH), Automotive Handbook, Springer-Verlag

Suggested List of Experiments (not restricted to the following):
(Only for Information)

Title of Experiments	Hrs.
13. Performance of BJT characteristics and CE amplifier	2
14. Performance of Differential amplifier	2
15. Simulation and analysis of Op-amp as an amplifier	2
16. Performance of Op-amp as an adder, subtractor	2
17. Simulation of Op-amp as Integrator and differentiator	2
18. Performance of timer IC as a pulse generator	2
19. Performance of digital circuits – Adder, subtractor	2
20. Simulation Analysis of asynchronous and synchronous counters	2
21. Performance of digital to analog converter	2
22. Simulation analysis of analog to digital converter	2
23. Demonstration of voltage, current and temperature sensor	
24. Demonstration of automotive actuator	

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w.e.f. academic year 2024 - 25 and onwards

NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B. Tech. in Electrical Engineering**
Semester:	**V**
Course Code:	**3EE205DC24**
Course Title:	**Renewable Energy Sources**
Course Type:	**Core Course-I under Minor (Disciplinary)**
Year of Introduction:	**2024 – 25**

L	T	Practical component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to –

1. apply the concepts of renewable energy sources for electricity generation **(BL3)**
2. infer the operational and control aspects of solar and wind energy system **(BL2)**
3. analyse issues and challenges of renewable energy sources in grid integration **(BL4)**
4. appraise the various technologies of hybrid power generation **(BL3)**

Contents: **Teaching Hours: 45**

Unit-I **Energy Sources** **04**

Conventional, non-conventional, renewable and non-renewable sources, statistics of resources and data on different sources in the world and in India, the significance of renewable sources and their exploitation, techno–commercial aspects of various renewable technologies, traditional energy systems, life cycle costing of various energy sources.

Unit-II **Solar Energy** **13**

Solar radiation, radiation measurement, insolation with and without atmospheric conditions, heat transfer concept: Radiation, conduction, convection, mass transport, solar thermal power plants: concentrating solar plants: parabolic trough system, solar tower system, parabolic dish system, applications: crop drying, distillation, solar chimney, water heating, rooftop solar system, etc.

Unit-III **Wind Energy** **13**

History, classification, components and operating characteristics of windmills, wind power generation, types of wind power generators, limitations of constant speed wind generators, variable speed wind energy generators, control of isolated and grid-connected wind energy generators, onshore and offshore wind farms, power system stability issues related to wind farms.

Unit-IV	**Small Hydro Electric power plant** Introduction, operating principle and site selection of mini and micro hydropower plants, case study of pico hydel plant.	**03**
Unit-V	**Biofuel Energy** Biomass characteristics and their availability, bioenergy extraction methods: anaerobic digestion, gasification, liquefication, biomethane, biohydrogen, alcoholic fermentation, biodiesel, microbial fuel cell, biomass-based steam power plant, combined cycle power plant, cogeneration plant, case studies.	**05**
Unit-VI	**Tidal Energy, Wave Energy, Geothermal Energy, Hybrid Systems** Tide generation, energy calculation in the tide, OTEC, estimation of power associated with waves, challenges with wave energy, wave energy collecting devices, geothermal resources, exploration of geothermal energy, geothermal systems, concepts of hybrid system: PV-wind system, PV-hydro system, Biomass-PV-Diesel system, PV-solar thermal-grid connected system.	**07**

Self-Study:
The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work:
This shall consist of at least 10 practical / simulations based on the above Contents.

Suggested Readings:

1. J. Twidell, T Weir, Renewable Energy Sources, Taylor and Francis
2. G. M. Masters, Renewable and Efficient Electric Power System, Wiley-IEEE
3. S. P. Sukhatme, Solar Energy - Principles of thermal collection and storage, Tata McGraw Hill, New Delhi
4. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, John Wiley, New York
5. S. N. Bhadra, D. Kastha, S. Banerjee, Wind Electrical Systems, Oxford publications
6. G. D. Rai, Non-conventional energy sources, Khanna Publishers.
7. B. H. Khan, Non-Conventional Energy Resources, Tata McGraw Hill.
8. G. S. Sawhney, Non-Conventional Energy Resources, PHI learning.
9. Joshua Earnest, Wind Power Technology, PHI learning.
10. Chetansingh Solanki, Solar Photo Voltaics: Fundamentals, Technologies and Applications, PHI learning.

Suggested List of Experiments (not restricted to the following):
(Only for Information)

S. No.	Title of Experiments	Hrs.
1.	Demonstration of standalone PV system and wind energy conversion system with terminologies used for performance evaluation.	4
2.	Simulation of PV module and plot I-V and P-V characteristics of PV module.	2
3.	Analyse the effect of radiation, temperature and tilt angle on the I-V and P-V characteristics of PV module.	2
4.	Analyse the effect of series-parallel connection of PV module on I-V and P-V characteristics.	2
5.	To evaluate power flow of standalone PV system with AC/DC load with battery.	4
6.	To derive the efficiency of charge controller for standalone wind energy system	2
7.	To estimate the cut-in-speed and tip speed ratio (TSR) of wind turbine.	2
8.	Simulate the reachability of various types of dc to dc converter under varying load conditions	2
9.	Overview of tidal energy conversion system.	2
10.	Overview of wave energy conversion system.	2

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NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B. Tech. in Electrical Engineering**
Semester:	**V**
Course Code:	**3EE206DC24**
Course Title:	**Power System Design**
Course Type:	**Core Course-II under Minor (Disciplinary)**
Year of Introduction:	**2024-25**

L	T	Practical component				C
		LPW	PW	W	S	
3	1	0	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, the student will be able to –

1. outline general power plant design aspects **(BL2)**
2. apply the design practices associated with transmission lines **(BL3)**
3. infer the fundamentals of substation design **(BL4)**
4. appraise the concepts involved in distribution system design **(BL5)**

Contents: **Teaching Hours: 45**

Unit I **Power Plant Design** **08**

Design philosophy, economic consideration, environmental consideration, water supply, fuel supply, soil investigation, site development, safety considerations, generator types and selection, excitation, switchyards, transformer, grounding, battery, emergency AC systems, motor sizing for auxiliaries, intra-plant communication, control and instrumentation, heating, ventilation and air conditioning systems for operation areas and service areas, thermal insulation, fire protection

Unit II **Transmission Line Design** **14**

Role of EHV AC transmission, selection of voltages, choice of conductors, conductor spacing, insulators, mechanical design, corona, effect of electrostatic field and magnetic field, lightning protection, overvoltages due to switching operations, EHV cable transmission, HVDC transmission system, design considerations in UHV transmission line

Unit III **Substation Design** **15**

Protective relays, discrimination by time, current and time–current, earth fault and instantaneous protection schemes, fuses, substation grounding, need for grounding, various methods of neutral grounding, equipment grounding permissible Body current limits, tolerable voltages, step and touch potentials, substation ground grid design criteria, selection of electrodes and conductors for grounding system, design of gantry and earth wire, lightning stroke protection, lightning parameters, fire protection objectives and philosophies, fire Hazards, typical fire protection measures, design of gas insulated substation

Unit IV	**Distribution System Design** Distribution system structures, feeder configuration, transformer connection and sizing, feeder loading, selection of voltage and current, protection equipment rating, layout design, underground cable design, network reconfiguration and sectionalizing switch design	**08**

Self-Study:
The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Tutorial Work:
This shall consist of at least 06 tutorials based on the above Contents.

Suggested Readings:

1. J. D. McDonald (Ed)., Electric Power Substations Engineering, CRC Press.
2. P. K. Nag, Power Plant Engineering, McGraw-Hill.
3. M. V. Deshpande, Electrical Power System Design, Tata McGraw-Hill.
4. Turan Gonen, Electric Power Distribution System Engineering, CRC Press.
5. Abdelhay A. Sallam, Om P. Malik, Electric Distribution Systems, Wiley-IEEE Press
6. R. D. Begamudre, High Voltage Engineering Problems and Solution, New Age International Publishers.
7. R. D. Begamudre, Extra High Voltage AC Transmission Engineering, New Age International Publishers.
8. R. S. Dahiya, Substation Engineering, Design, Concepts and Computer Applications.

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w.e.f. academic year 2024 – 25 and onwards

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
Department of Mechanical Engineering
Teaching & Examination Scheme
Disciplinary Minor in Energy Systems Engineering*

w. e. f. Academic Year 2024-25

Course Code	Course Name	Teaching Scheme (hours/week)				Examination Scheme			
		L	T	P	C	Duration Hours	Component Weightage		
						SEE	CE	LPW	SEE
Semester 5 Core Courses–I and II									
3ME401DC24	Design of Fluid Flow Machines	3	0	2	4	3	0.3	0.3	0.4
3ME402DC24	Modelling and Optimization of Energy Systems	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Core Course–III									
	Design of Heat Transfer Equipment	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Elective Course-I									
	Thermal , Hydro and Nuclear Power Generation Technology	3	0	2	4	3	0.3	0.3	0.4
	Alternate Fuel and Technology for Transportation	3	0	2	4	3	0.3	0.3	0.4
Semester 7 Elective Course-II									
	Solar, Wind and Bio-energy Systems	3	0	2	4	3	0.3	0.3	0.4
	Energy Economics and Management	3	1	0	4	3	0.6	-	0.4

L: Lectures, P/T: Practical / Tutorial, C: Credits
LPW/PW: Laboratory / Project Work

SEE: Semester End Examination
CE: Continuous Evaluation

*Disciplinary Minor will be offered for the students of Mechanical Engineering Department, IT-NU.

w.e.f. for the first-year students admitted in 2022-23 and D to D students admitted in 2023-24 onwards

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. in Mechanical Engineering
Course Code:	3ME401DC24
Course Title:	Design of Fluid Flow Machines
Course Type:	Core Course –I under Minor
Year of Introduction:	2024-25

L	T	Practical component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLOs):

After successful completion of the course, the student will be able to –

1	apply the fundamentals of impact of jet to fluid flow machines,	(BL3)
2	evaluate performance characteristics of hydro turbines,	(BL5)
3	examine the working principles of hydraulic pumps,	(BL4)
4	analyse the performance of different compressors,	(BL4)
5	explain the construction and working of electrical machines.	(BL2)

Unit	Contents	Teaching Hours (Total 45)
Unit I	**Introduction to Fluid Flow Machines** Fluid flow machines – basic principle, types, impulse-momentum principle, impact of jet on fixed and moving flat and curved vanes, series of vanes.	04
Unit II	**Hydraulic Turbines** Hydropower plants: types, layout, major equipment, classification of hydro turbines, operation of Pelton wheel, Francis and Kaplan turbines, velocity triangles, hydraulic design aspects, governing, specific speed, characteristic curves, cavitation.	10
Unit III	**Pumps** Reciprocating pump: construction, working principle, characteristic curves. Centrifugal pump: constructional features, basic theory, velocity triangles, design concepts, pressure rise through impeller, characteristics curves, priming, similarity relations, specific speed. Working of rotary pumps. Applications of CFD in fluid flow machines.	11
Unit IV	**Compressors** Reciprocating compressors: single stage compression without and with clearance, power requirement and condition for minimum work, free air delivery, need for multi staging, and condition of minimum work for multi-staging, inter-stage cooling. Centrifugal compressor: construction and operation, ideal energy transfer,	14

	velocity diagram, design criteria, isentropic efficiency, static and total temperatures, power input factor, slip and slip factor, surging and choking. Axial flow compressor: construction and operation, velocity diagram and work done factor, pressure ratio, static pressure rise, degree of reaction. Rotary compressors – Types, salient features, applications.	
Unit V	**Electrical Machines** AC Electric motors – Types and working, motor starting methods, Direct-on-line (DOL) starter, star-delta, soft starters, VFD, basic motor control and protection. Synchronous generator – Basic principles, types, specifications and characteristics, techniques and methods to enhance the energy efficiency of electrical machines.	06

Self – Study: The self-study content will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study content.

Laboratory Work: Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated

Suggested Readings/References:

1. Cengel Y., John Cimbala J., Fluid Mechanics, Tata McGraw Hill Publishing Co. Ltd.
2. Gerhart P. M. and Wright T., Fluid Machinery- Application, Selection and Design, CRC Press.
3. Dixon S. L and Hall C. A., Fluid mechanics and Thermodynamics of Turbomachinery, Elsevier.
4. Som S. K, Biswas G., Chakraborty S., Introduction to Fluid Mechanics and Fluid Machines, McGraw Hill Publications.
5. Ojha C. S. P., Chandramouli P. N., Berndtsson R., Fluid Mechanics and Machinery, Oxford University Press.
6. Chapman S., Electric Machinery Fundamentals, McGraw Hill.

Suggested list of experiments (not restricted to the following)

Sr. No.	Title	Hours
1.	To study various hydropower plants.	02
2.	To find force coefficient for semi-circular vane.	02
3.	To study the governing of hydro turbines.	02
4.	To conduct the performance analysis of impulse turbine.	02
5.	To conduct the performance analysis of reaction turbine.	02
6.	To conduct the performance analysis of positive displacement pump.	02
7.	To draw performance characteristic curves for centrifugal pump.	02
8.	To study the positive displacement pumps and compressors.	02
9.	To find volumetric efficiency of two stage reciprocating compressor.	02
10.	To conduct the performance analysis of centrifugal compressor.	02
11.	To study the performance characteristics of electrical motors.	02
12.	To study the performance characteristics of electrical generators.	02
13.	To demonstrate the commercial Computational Fluid Dynamics (CFD) software for design of fluid flow machines.	02

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. in Mechanical Engineering
Course Code:	3ME402DC24
Course Title:	Modelling and Optimization of Energy Systems
Course Type:	Core Course –II under Minor
Year of Introduction:	2024-25

L	T	Practical component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLOs):

After successful completion of the course, the student will be able to –

1	develop mathematical model of energy systems,	(BL3)
2	apply system simulation technique to study performance of energy system,	(BL3)
3	build regression model for energy system simulation and optimization,	(BL3)
4	apply various optimization methods to energy system problems based on linear programming, non-linear programming and stochastic programming,	(BL3)
5	analyse energy system problems using non-traditional optimization techniques.	(BL4)

Unit	Contents	Teaching Hours (Total 45)
Unit I	**Modelling of Energy Systems** Importance of modelling in design, basic feature of modelling, steps in model development, examples of models.	05
Unit II	**System Simulation** Some uses of simulation, different classes of simulation, information flow diagram, techniques for system simulation – successive substitution method, Newton-Raphson method, Gauss Seidel method – examples of system simulation for energy system problems.	08
Unit III	**Regression and Curve Fitting** Introduction, exact fit and its types – polynomial interpolation, Lagrange interpolation, best fit, strategies for best fit - least square regression theory, examples from linear regression with one and more unknowns – examples, power law forms - examples.	10
Unit IV	**Optimization** Introduction, design analysis through a flow chart, optimization, analysis and design, workable system and optimum system. Classical optimization techniques – objectives/constraints, problem formulation, unconstrained problems – necessary & sufficiency conditions, constrained optimization – Lagrange multipliers,	12

	constrained variations, Kuhn-Tucker conditions, linear programming – simplex tableau, pivoting, sensitivity analysis, search techniques-univariate/multivariate. Case studies of optimization in energy systems problems.	
Unit V	**Non-traditional Optimization Techniques** Genetic Algorithm (GA) – Basics features, principle and robustness of GA, particle swarm optimization, simulated annealing, artificial neural networks.	10

Self – Study: The self-study content will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study content.

Laboratory Work: Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated

Suggested Readings/References:

1. Stoecker W. F., Design of Thermal Systems, McGraw Hill.
2. Rao S. S., Optimization Theory and Applications, Wiley Eastern.
3. Balaji C., Essentials of Thermal System Design and Optimization, Ane Books Pvt Ltd.
4. Jaluria Y., Design and Optimization of Thermal Systems, CRC Press.

Suggested list of experiments (not restricted to the following)

Sr. No.	Title	Hours
1.	Development of mathematical model to analyse the energy system.	02
2.	Analysis of an energy system parameters using successive substitution method.	02
3.	Analysis of an energy system parameters using Newton-Raphson method.	02
4.	Analysis of an energy system problem using Lagrange polynomial.	02
5.	Build a regression model for an energy system.	02
6.	Solve unconstrained and constrained optimization problem using calculus method.	04
7.	Solve unconstrained and constrained optimization problem using search method.	04
8.	Solve an optimization problem using simplex method.	02
9.	Solve an optimization problem using genetic algorithm.	04
10.	Solve an optimization problem using simulated annealing.	04
11.	Solve an optimization problem using Artificial Neural Network (ANN).	02

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
Department of Mechanical Engineering
Teaching & Examination Scheme
Disciplinary Minor in Computer Integrated Manufacturing (CIM)*

w. e. f. Academic Year 2024-25

Course Code	Course Name	Teaching Scheme (hours/week)				Examination Scheme			
		L	T	P	C	Duration Hours	Component Weightage		
						SEE	CE	LPW	SEE
Semester 5 Core Courses–I and II									
3ME102DC24	Computer Aided Manufacturing	3	0	2	4	3	0.3	0.3	0.4
3ME704DC24	Manufacturing Automation	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Core Course–III									
	Computer Aided Production Planning & Control	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Elective Course-I									
	Automatic Measurement & Quality Control	3	1	0	4	3	0.6	-	0.4
	Product Design and Development	3	1	0	4	3	0.6	-	0.4
Semester 7 Elective Course-II									
	Cyber Physical Production Systems	3	0	2	4	3	0.3	0.3	0.4
	Micro and Nano Finishing Processes	3	1	0	4	3	0.6	-	0.4

L: Lectures, P/T: Practical / Tutorial, C: Credits
LPW/PW: Laboratory / Project Work

SEE: Semester End Examination
CE: Continuous Evaluation

*Disciplinary Minor will be offered for the students of Mechanical Engineering Department, IT-NU.

w.e.f. for the first-year students admitted in 2022-23 and D to D students admitted in 2023-24 onwards

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. in Mechanical Engineering
Course Code:	3ME102DC24
Course Title:	Computer Aided Manufacturing
Course Type:	Core Course –I under Minor
Year of introduction:	2023-24

L	T	Practical component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLOs):

After successful completion of the course, student will be able to –

1 create part programs for practical applications of computer numerical control machine, (BL6)

2 explain the use of flexible manufacturing systems for manufacturing process on a shop floor, (BL2)

3 appraise the use of computer aided production management for a shop floor, (BL5)

4 test integration of CAD and CAM software for a production system. (BL6)

Unit	Contents	Teaching Hours (Total 45)
Unit I	**Introduction to Numerical Control** Merits and demerits, NC, CNC, DNC, NC machine tools, classification, axes, types of controls, components, their functions and features, tooling for NC machines.	05
Unit II	**CNC part programming: turning operations** CNC turning centre, ISO code, formats, manual and computer assisted programming, part programs for drilling, step turning, facing, grooving, threading, step turning cycle,	10
Unit III	**CNC part programming: milling operations** CNC machining centre, CNC machining centre operations and programing, multiple repetitive cycle; profile milling, face milling, pocketing, fixed cycles for drilling, boring, reaming.	10
Unit IV	**Group Technology and Flexible Manufacturing System** Part families, part classification and coding, machine cells, benefits of group technology, Introduction to Flexible Manufacturing System, Classification; Material handling equipment, pallets and automatic guided vehicles; Automated Storage and Retrieval System, Computer Integrated Manufacturing.	08

Unit V	**Computer Aided Production Management and Introduction to robotics** Problems with traditional PPC, use of computer in PPC, such as CAPP, Material Requirements Planning, robot elements of a robot and controls, programming and teaching robots, specification, application and safety aspects.	07
Unit VI	**CAD-CAM integration, Artificial Intelligence and Expert system** Activities involved in CAD-CAM integration process, commonly used readymade software packages and their uses in area of CAD/CAM/CAE, Knowledge representation and inference process, AI in manufacturing, expert system.	05

Self – Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work: Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated.

Suggested Readings/References:

1. Zimmer and Groover, CAD/CAM ,Pearson
2. Peter Smith,CNC Part Programming , Industrial Press Inc.
3. Lynch Mike. Parametric programming for Computer Numerical Control Machine tools and touch probes, Society of Manufacturing Engineers.
4. Rao P.N.,CAD/CAM ,Tata Mc Graw Hill Education

Suggested list of experiments: (not restricted to the following)

Sr. No.	Title	Hours
1.	To simulate drilling operation using a CAM software.	02
2.	To perform simulation of volume milling and face milling using a CAM software.	02
3.	To develop a part program for pocketing and profile milling using a CAM software.	02
4.	To perform simulation of step turning and profile turning using a CAM software.	02
5.	To study a Vertical Machining Center (VMC).	02
6.	To prepare and execute a part program to perform drilling on VMC.	02
7.	To execute the developed part program to perform face milling and pocketing on VMC	02
8.	To prepare and execute a part program to perform slotting on VMC.	02
9.	To study a CNC Lathe machine.	02
10.	To develop and execute a part program to perform step turning on CNC Lathe.	02
11.	To write the manual part program and execute it to perform profile turning and grooving on CNC Lathe.	02
12.	To prepare and execute a part program to perform threading on CNC Lathe	02

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. in Mechanical Engineering
Course Code:	3ME704DC24
Course Title:	Manufacturing Automation
Course Type:	Core Course –II under Minor
Year of Introduction:	2024-25

L	T	Practical Component				C
		LPW	PW	W	S	
3	-	2	-	-	-	4

Course Learning Outcomes (CLOs):

After successful completion of the course, student will be able to-

1	demonstrate use of hard automation for industrial application,	(BL2)
2	interpret the hydraulic and pneumatic systems,	(BL5)
3	choose an appropriate automation system for industrial automation,	(BL5)
4	design an automatic system for manufacturing automation.	(BL6)

Unit	Contetns	Teaching Hours (Total 45)
Unit I	**Introduction** Automation in production system, Principles and strategies of automation, Basic elements of an automated system, Advanced automation functions, Levels of automations. Production economics: Methods of evaluating investment alternatives, Costs in manufacturing, Break-even analysis, Unit cost of production, Cost of manufacturing lead time and work-in-process, Industry 4.0.	10
Unit II	**Automation in Production Lines** Automated flow lines, Methods of workpart transport, Transfer mechanism, buffer storage, Control functions, and automation for machining operations, Design and fabrication considerations, Analysis of automated flow lines: General terminology and analysis, Analysis of transfer lines without storage, Partial automation, Automated flow lines with storage buffers, Computer Simulation of Automated Flow Lines.	11
Unit III	**Flow line Performance Analysis** Average production time and production rate, Mean time per cycle when machine breakdown occurs, Flow line Performance Analysis, Line efficiency, Cost per item produced, Partial automation, Reasons for using, Advantages and drawbacks, Production and throughput, Effect of machine jamming, Component quality control, Choice of assembly methods, Cost, Production rate, Availability of labour, Market life of the product, Advantages of automatic assembly, Design for automated assembly, Components of automatic assembly machines.	12

Unit IV	**Control Systems for Automation** Introduction to servo system, Components of electrical controls- Push button switches, Pressure switches, Limit switches, Temperature switches, Solenoids, Relays, Timers, Electro–hydraulic and electro-pneumatic circuits, Microelectronics controls- Use of PLCs and Microprocessors in automation construction, Difference between PLCs and Microprocessors.	12

Self - Study The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work: Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated.

Suggested Readings:

1. Groover, M. P. Automation, production systems, and computer-integrated manufacturing. Pearson Education India.
2. Kant, K. Computer-based Industrial Control. PHI.
3. Webb, J. W., & Reis, R. A. Programmable logic controllers: principles and applications. Prentice Hall PTR.
4. Chang, T. C., & Wysk, R. A. An introduction to automated process planning systems. Prentice Hall Professional Technical Reference.
5. Amber, G. H., & Amber, P. S. Anatomy of automation. Prentice-Hall.

Suggested list of experiments: (not restricted to the following)

Sr. No	Title	Hrs
1.	To prepare programme for 2-wheel drive line follower robot – Qubot.	02
2.	To develop path planning and navigation of 2-wheel drive Turtlebot.	02
3.	To develop path planning and navigation of 4-wheel Omni drive robot.	02
4.	To develop programme for humanoid robot for various applications.	04
5.	To design a hydraulic circuit using hydraulic trainer kit.	02
6.	To design a pneumatic circuit using pneumatic trainer kit.	02
7.	To test PLC programme using trainer kit.	02
8.	To simulate PLC programming using Automation Studio software.	02
9.	To design and simulate hydraulic circuit using Automation studio software.	02
10.	To design and simulate pneumatic circuit using Automation Studio software.	02
11.	To detect the object using Matlab Image processing toolbox.	02
12.	To implement SLAM using LIDAR scanner.	02
13.	To make use of Neural Network for various applications.	02
14.	To simulate PID control of DC motors.	02
15.	To analyse system response using Matlab Simulink.	02

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
Department of Mechanical Engineering
Teaching & Examination Scheme
Inter-disciplinary Minor in Robotics and Automation *

w. e. f. Academic Year 2024-25

Course Code	Course Name	Teaching Scheme (hours/week)				Examination Scheme			
		L	T	P	C	Duration Hours	Component Weightage		
						SEE	CE	LPW	SEE
Semester 5 Core Courses–I and II									
3ME501IC24	Mechanisms and Manipulators	3	0	2	4	3	0.3	0.3	0.4
3ME703IC24	Wheeled and Legged Robot	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Core Course–III									
	Industrial Automation	3	1	0	4	3	0.6	-	0.4
Semester 6 Elective Course-I									
	Aerial Robotics	3	1	0	4	3	0.6	-	0.4
	Sensors and Actuators	3	0	2	4	3	0.3	0.3	0.4
Semester 7 Elective Course-II									
	Multibody Dynamics	3	0	2	4	3	0.3	0.3	0.4
	Underwater Robotics	3	1	0	4	3	0.6	-	0.4

L: Lectures, P/T: Practicals / Tutorial, C: Credits
LPW/PW: Laboratory / Project Work

SEE: Semester End Examination
CE: Continuous Evaluation

Note: The department will provide relevant learning material in advance to the students of other departments opting interdisciplinary minor, so that they have prerequisite reading prior to initiation of the minor courses.

*Interdisciplinary Minor will be offered for the students of departments other than Mechanical Engineering, IT-NU.

w.e.f. for first year students admitted in 2022-23 and D to D students admitted in 2023-24 onwards

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. in Mechanical Engineering
Course Code:	3ME501IC24
Course Title:	Mechanisms and Manipulators
Course Type:	Core Course –I under Minor
Year of introduction:	2024-25

L	T	Practical component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLOs):

After successful completion of the course, student will be able to –

1	develop the kinematic model of planar mechanisms,	(BL3)
2	apply the concepts of coordinate transformation to analyse relative motions	(BL2)
3	formulate the mathematical relations for kinematic analysis of robotic manipulator	(BL5)
4	plan the trajectory and perform dynamic analysis of manipulators,	(BL6)
5	design end effectors for robotic manipulator.	(BL6)

Unit	Contents	Teaching Hours (Total 45)
Unit I	**Kinematics and Dynamics of Planar Mechanism** Links- kinematics pairs, Degrees of freedom concept, higher and lower pairs, constraints, mechanisms. Velocity and acceleration in machine parts, and simple kinematic Mechanisms like four bar and Slider crank, Static Force Analysis, Dynamic Force Analysis (analytical Approach). Kinematic Synthesis: Function generation, path generation and rigid body guidance. Graphical and analytical techniques of synthesis.	14
Unit II	**Co-ordinate Transformation** Fundamentals of Robot technology, classification, applications, basic components, control system, economical and societal aspects related to robotics. Concept of transformation matrices, homogeneous transformation matrix and its applications to robotics, Co-ordinate transformation, transform arithmetic, inverse of transformation matrix, Denavit-Hartenber (DH) parameters.	07
Unit III	**Forward and Inverse kinematics** Forward kinematics, solutions for joint variables, development of end effector transformation matrix for various types of manipulaotrs. Inverse kinematics solutions for robot arm and its methodology. Derivation of joint and link parameters for various configuration od robots.	11

Unit IV	**Trajectory, Dynamics and Gripper Design** Robot motion consideration, trajectory generation for criteria, joint interpolation for calculation of the position of joint, different interpolations for joint of a robot, Lagrange-Euler formulation, calculation of kinetic and potential energy, dynamic model of robotic arm. **Gripper Design:** End effectors, Classification, Force analysis and Gripper design.	13

Self – Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work: Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated

Suggested Readings/References:

1. Uicker,J. Jr, Gordon R. Pennock and Joseph E. Shigley, Theory of Machines and Mechanisms, Cambridge University Press.
2. Fu. K. S., R C Gonzalez and C S G Lee, Robotics: Control, Sensing, Vision and Intelligence, Mc Graw Hill.
3. Klafter R. D., Thomas A Chmielewski and Michael Negin, Robotics Engineering An integrated approach, Prentice Hall
4. Mittal and Nagrath , Robotics and Control , Tata McGraw-Hill Publishing Company Ltd.
5. Craig John, Introduction to Robotics, mechanics and control, Pearson Education
6. Rattan S. S., Theory of Machines, Tata McGraw Hill Education

Suggested list of experiments: (not restricted to the following)

Sr. No.	Title	Hours
1.	To prepare a robot task, set up tools, Demonstrate the manipulator	02
2.	To demonstrate the interaction of the collaborative robot with external devices, the Controlling conveyor	02
3.	To perform Safety settings, Optimizing, and Programme flow for a manipulator.	02
4.	To develop algorithms for various features like coordinates, waypoints, Force Control, and Palletizing.	02
5.	To prepare algorithm and code for Forward Kinematics.	02
6.	To prepare algorithm and code for Inverse Kinematics.	02
7.	To develop a Dynamic model for a Robotic Manipulator.	04
8.	To simulate robot motion on virtual Robot Modules.	02
9.	To identify the Degrees of Freedom of the different mechanisms.	02
10.	To solve Velocity Analysis of a mechanism and develop its code.	02
11.	To solve Acceleration Analysis of a mechanism and develop its code.	02
12.	To solve Static Force Analysis of a mechanism and develop its code.	02
13.	To solve Dynamic Force Analysis of a mechanism and develop its code.	02
14.	To synthesise a mechanism for pick and place application.	02

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech.
Course Code:	3ME703IC24
Course Title:	Wheeled and Legged Robots
Course Type:	Core Course –II under Minor
Year of introduction:	2024-25

L	T	Practical component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLOs):

After successful completion of the course, the student will be able to –

1 apply the concepts of the locomotion systems for mobile robots, (BL3)
2 formulate the kinematic and dynamic model for wheeled and legged robots, (BL5)
3 estimate the robot localization using on board sensors data, (BL3)
4 decide the path planning of wheeled and legged robots in software environment. (BL5)

Unit	Contents	Teaching Hours (Total 45)
Unit I	**Introduction to locomotion Systems** Introduction, locomotion, legged and wheeled robot, different configurations of mobile robot	05
Unit II	**Kinematics and dynamics of wheeled robots** Kinematic model of wheeled robot, wheel configuration, degree of manoeuvrability, degree of steerability, degree of mobility, workspace, kinematic motion control, Dynamic equation of motion for wheeled robot using Lagrange Euler formulation.	12
Unit III	**Kinematics and dynamics of legged robots** Stability in walking robot, generation of periodic gaits, generation of non periodic gaits, forward and inverse kinematic using DH, dynamic of walking robot, linear inverted pendulum model.	10
Unit IV	**Localization of wheeled robots** Introduction, challenges, Localization based navigation, belief and map representation, probabilistic map-based localization, Markov and Kalman filter algorithms, autonomous map building, SLAM	10
Unit V	**Navigation and Path Planning** Path planning and navigation, planning and reacting, path planning, obstacle avoidance, navigation architecture, control localization and techniques for decomposition.	08

Self – Study:	The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.
Laboratory Work:	Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated
Suggested Readings/References:	1. Roland Siegwart, Illah R Nourbaksh, Davide Scaramuzza, Introduction to Autonomous Mobile Robots, PHI learning Pvt Ltd. 2. D. J. Todd, Walking Machines: An Introduction to Legged Robots, Springer US 3. Peter Corke, Robotics, Vision, and Control: Fundamental Algorithms in MATLAB, Springer Handbook 1. Gregor Klancar, Andrej Zdesar, Saso Blazic, Igor Skrjanc, Wheeled Mobile Robotics: From Fundamentals Towards Autonomous Systems, Elsevier Science

Suggested list of experiments: (not restricted to the following)

Sr. No.	Title	Hours
1.	To carry out the kinematic modelling and simulation of two wheels tank drive robot.	02
2.	To carry out the kinematic modelling and simulation of three wheeled omni-drive robot.	02
3.	To simulate the dynamic motion of wheeled mobile robot.	02
4.	To programme the two wheeled robot for line following motion.	02
5.	To programme the two wheeled tank drive robot for obstacle avoidance.	02
6.	To programme a bipedal robot for stable walking.	02
7.	To develop different motion algorithms for omni-wheeled robots.	02
8.	To perform Localization and Mapping using a Mobile robot platform.	02
9.	To prepare Obstacle avoidance coding for Mobile robot.	02
10.	To develop gait pattern simulation for Continuous gait.	02
11.	To develop gait pattern simulation for Discontinuous gait.	02

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
Department of Mechanical Engineering
Teaching & Examination Scheme
Inter-disciplinary Minor in Industrial Engineering*

w. e. f. Academic Year 2024-25

Course Code	Course Name	Teaching Scheme (hours/week)				Examination Scheme			
		L	T	P	C	Duration Hours	Component Weightage		
						SEE	CE	LPW	SEE
Semester 5 Core Courses–I and II									
3ME202IC24	Production and Industrial Management	3	1	0	4	3	0.6	-	0.4
3ME203IC24	Work System Design	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Core Course–III									
	Decision Modelling	3	1	0	4	3	0.6	-	0.4
Semester 6 Elective Course-I									
	Logistics and Supply Chain Management	3	1	0	4	3	0.6	-	0.4
	Quality Engineering	3	1	0	4	3	0.6	-	0.4
Semester 7 Elective Course-II									
	Advanced Decision Modelling	3	1	0	4	3	0.6	-	0.4
	Total Quality Management	3	1	0	4	3	0.6	-	0.4

L: Lectures, P/T: Practicals / Tutorial, C: Credits
LPW/PW: Laboratory / Project Work

SEE: Semester End Examination
CE: Continuous Evaluation

Note: The department will provide relevant learning material in advance to the students of other departments opting interdisciplinary minor, so that they have prerequisite reading prior to initiation of the minor courses.

*Interdisciplinary Minor will be offered for the students of departments other than Mechanical Engineering, IT-NU.

w.e.f. for first year students admitted in 2022-23 and D to D students admitted in 2023-24 onwards

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. in Mechanical Engineering
Course Code:	3ME202IC24
Course Title:	Production and Industrial Management
Course Type:	Core Course –I under Minor
Year of introduction:	2024-25

L	T	Practical component				C
		LPW	PW	W	S	
3	1	-	-	-	-	4

Course Learning Outcomes (CLOs):

After successful completion of the course, student will be able to –

1	outline the principles of production planning and control,	(BL2)
2	analyze the selection of plant location and layout,	(BL4)
3	solve problems related to budget and costing related to industrial operations,	(BL6)
4	recommend various quality control and assurance techniques for industrial applications.	(BL5)

Unit	Contents	Teaching Hours (Total 45)
Unit I	**Production Planning and Control** Concept of production planning and control, types of production systems and their characteristics, functions and objectives of production planning and control, concept of forecasting, loading and scheduling, sequencing and inventory control.	12
Unit II	**Plant Location and Layout** Plant location: concept and factors governing plant location, location merits and demerits of city, sub-urb, rural areas, plant building design, need for plant layout, different types of plant layout, relative merits & demerits.	06
Unit III	**Purchase management** Function and objective of purchase management, purchase organization, buying techniques, purchase procedure, stores and material control.	05
Unit IV	**Budget and Costing** Elements of budget & budgetary control, types of budgets, objectives of budget, preparation of budget, budgetary control. Costing: Concept of costing and cost accounting, need of costing, types of costs, concept of overheads, types of overheads and allocation of overheads. Break even analysis: concept of break even analysis, profit volume chart, make or buy decision, concept of angle of incidence, margin of safety and contribution.	12

Unit V	**Quality Control and Assurance** Concept of inspection and its function, objective and benefits of inspection, different types of inspection, quality control, principles of quality control, statistical quality control, concepts of variable and attribute data. control charts for variable and attribute data, application and interpretation (analysis) of control charts, process capability, acceptance sampling, sampling plans.	10

Self – Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Suggested Readings/References:

1. Elwood S. Buffa, Rakesh K. Sarin, Modern Production / Operations Management, John Wiley & Sons, Inc.
2. Heizer, Render, Operations Management: Strategies and Tactics, Pearson Education.
3. R. Paneerselvam, Production and Operations Management, Prentice-Hall of India Pvt. Ltd.
4. Samuel Eilon, Elements of Production Planning and Control, Universal Publishing Corporation.
5. Douglas C. Montgomery, Introduction to Statistical Quality Control, Wiley Publications.

Suggested List of Tutorials

1. Solve problems related to single machine scheduling.
2. Solve problems related to flow shop and job shop scheduling.
3. Analysis of historical sales/demand data and determine the sales forecast using various forecasting techniques.
4. Determine the inventory decision parameters by using various inventory management techniques.
5. Design the plant layout using given data.
6. Develop budget information based on given data.
7. Calculate costing of a product from the given information.
8. Application of break-even analysis using given information to make various decisions.
9. Application of statistical process control tools for quality improvement.
10. Use of control charts for variable data.
11. Use of control charts for attribute data.

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. in Mechanical Engineering
Course Code:	3ME203IC24
Course Title:	Work System Design
Course Type:	Core Course –II under Minor
Year of introduction:	2024-25

L	T	Practical component				C
		LPW	PW	W	S	
3	-	2	-	-	-	4

Course Learning Outcomes (CLOs):

After successful completion of the course, student will be able to –

1 appraise the importance of productivity for the organization, (BL5)
2 apply the tools of method and motion study to streamline the production, (BL3)
3 elaborate different techniques of work measurement, (BL6)
4 compare various wage and incentive schemes for the improvement of productivity. (BL5)

Unit	Contents	Teaching Hours (Total 45)
Unit I	**Productivity and Work Study** Concept and importance of work study, introduction and concept of productivity, measurement of productivity, benefits of higher productivity, factors influencing productivity, causes of low productivity, productivity improvement techniques, case study on productivity, productivity and its relation with work study.	05
Unit II	**Work simplification: Method Study** Objective and procedure of method study, selection of job for study, recording techniques charts and diagrams such as outline process charts, flow process charts, multiple activity charts, two handed process chart, string diagram, travel chart; critical examination and questioning techniques.	12
Unit III	**Work simplification: Motion Study** Classification of movements, principle of motion economy, basic elements of motion, therbligs, motion analysis, SIMO charts. Ergonomics: basic concept, industrial ergonomics, psycho physiological data, anthropometry, normal and maximum work areas, location of control knobs, visual display, fatigue in industry, environmental requirements.	10

Unit IV	**Time Study** Objectives and uses of work measurement, work measurement techniques, time study: basic procedure of time study, time study equipment, time study procedure, concept of rating and allowances, concept of qualified worker, standard time. Work sampling, standard data, synthesis, predetermined motion time systems, analytical estimating.	12
Unit V	**Wage and incentive schemes** Concept of wage and incentives, relation between incentives and productivity, characteristics of a good incentive plan, wage and incentive schemes: straight piece rate, differential piece rate and time and piece rate methods, efficiency and premium bonus schemes.	06

Self – Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work: Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated

Suggested Readings/References:

1. Introduction to Work Study: International Labor Office (ILO), Geneva.
2. Barnes R. M., Motion and Time Study Design and Measurement of Work, John Wiley and Sons.
3. Groover M. P., Work Systems and the Methods, Measurement, and Management of Work, Prentice Hall
4. Sandera M and McCormick E, Human Factors in Engineering and design, McGraw-Hill

Suggested list of experiments: (not restricted to the following)

Sr. No.	Title	Hours
1.	To develop an incentive scheme of wage payment.	02
2.	To construct an operation process chart from the given data.	02
3.	To develop a flow process chart from the given data.	02
4.	To construct multiple activity chart from the given data.	02
5.	To construct left hand and right-hand chart from the given data.	02
6.	To apply pin board study for the given operation.	02
7.	To apply the SIMO Chart for the given process.	02
8.	To determine performance rating during walking and dealing of cards.	02
9.	To implement performance rating practice by films.	02
10.	To evaluate time study on a lathe machine and to determine standard time for turning and facing operation.	02
11.	To analyze method to improve the assembly of a bolt, a nut and three washers	02
12.	To apply work sampling and PMTS to establish standard time.	02
13.	To analyze production study of repetitive job.	02
14.	To measure anthropometric data and its analysis.	02
15.	To determine the effect of ergonomically poor designed workspace.	02
16.	To evaluate the variety of manual lifting tasks/ calculation of lifting index during an activity.	02

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
Teaching and Examination Scheme
Inter-disciplinary Minor in Data Science*

w.e.f. Academic Year 2024-25

Course Code	Course Title	Teaching Scheme (hours/week)				Examination Scheme			
		L	T	P	C	Duration Hours	Component Weightage		
						SEE	CE	LPW	SEE
Semester 5 Core Course I and II									
3CS506IC24	Programming for Scientific Computing	3	0	2	4	3	0.3	0.3	0.4
	Data Analysis and Visualization	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Core Course III									
	Machine Learning	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Elective Course I									
	Introduction to Deep Learning**	3	0	2	4	3	0.3	0.3	0.4
	Multimedia Analytics	3	0	2	4	3	0.3	0.3	0.4
	Time Series Analysis	3	0	2	4	3	0.3	0.3	0.4
	Analytics of IoT	3	0	2	4	3	0.3	0.3	0.4
Semester 7 Elective Course II									
	Big Data Systems	3	0	2	4	3	0.3	0.3	0.4
	Cloud Computing	3	0	2	4	3	0.3	0.3	0.4
	Financial Data Security Management	3	0	2	4	3	0.3	0.3	0.4
	Information Retrieval and Systems	3	0	2	4	3	0.3	0.3	0.4

L: Lectures, P/T: Practicals / Tutorial, C: Credits
LPW/PW: Laboratory / Project Work
SEE: Semester End Examination
CE: Continuous Evaluation

*Interdisciplinary Minors will be offered to students other than Computer Science and Engineering and the students of the Institute of Commerce.

** Introduction to Deep Learning will be offered to all the students other than students of the Electronics and Communication Engineering department.

w.e.f. for the first year students admitted in 2022-23, and D to D students admitted in 2023-24 onwards

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. All (other than CSE)
Course Code:	3CS506IC24
Course Title:	Programming for Scientific Computing
Course Type:	Inter-disciplinary Minor-Core
Year of Introduction:	2024-25

L	T	Practical Component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLO):

At the end of the course, students will be able to –

1. develop computational programs at a high level of abstraction (BL3)
2. inspect standard programming constructs like repetition, selection, functions, composition, modules, aggregated data (BL4)
3. evaluate the results of scientific computing problems, using established program libraries (BL5)
4. design software solutions for scientific problems, integrating multiple programming and scientific computing concepts (BL6)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	**Introduction:** Introduction to Computational Science, Applications involving scientific computing, Tools and languages to solve complex scientific problems	02
Unit-II	**Programming in Python:** Interpreter and its environment; Introduction to data types, concepts of mutability, operators and variables; random numbers, user inputs, statements; control structures	06
Unit-III	**Python Data Structures:** Lists, tuples, set, and dictionaries, String manipulation, Indexing and slicing	08
Unit-IV	**Object-Oriented Programming:** Classes and objects, Inheritance, polymorphism, Encapsulation and abstraction	05
Unit-V	Array computing and curve plotting, Vectors and higher-dimensional arrays, Matrices, Functions, File handling, Error handling and exception handling	09
Unit-VI	**Python Data Science Libraries:** NumPy, SciPy and Pandas, Data visualization with Matplotlib	10
Unit-VII	**Scientific computation using Python:** Statistical data analysis, image processing, building web application using Python	05

Self-Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents

Suggested Readings/ References:

1. Hans Petter Langtangen, A Primer on Scientific Programming with Python, Springer
2. Claus Fuhrer, Jan Erik Solem, Olivier Verdier, Scientific Computing with Python 3, Packt Publishing Limited
3. Martin C. Brown, Python: The Complete Reference, McGraw Hill Education
4. Hemant Kumar Mehta, Mastering Python Scientific Computing, Packt Publishing Limited
5. Sergio J. Rojas G., Erik A. Christensen, Francisco J. Blanco-Silva, Learning SciPy for Numerical and Scientific Computing, Packt Publishing Limited.

Suggested List of Experiments:

Sr. No.	Title	Hours
1	a. Install Python, a code editor (like Jupyter Notebook), and relevant libraries (NumPy, SciPy, Pandas, Matplotlib) on your computer. b. Write down a python program which demonstrate the following concepts: • Print statement including Padding & Alignment aspect • Mutable and Immutable Object c. Write a Python program to print "Hello, Nirma" and learn how to run it in the Python interpreter. d. Develop a python program to create variables of different types and make a simple calculator.	04
2	a. Write a python program which generates student grade reports in the console. Take student roll number and marks (out of 100) of 5 courses from the user. Calculate the percentage and display grade of the student. Use appropriate control statements. b. Write a python program that checks whether a number entered by the user is a magic number or not. For example, Consider the number 59. First, find the sum of all digits (5+9=14). Second, find multiplication of all digits (5*9=45). Then find addition of sum and multiplication of all digits (14+45=59). If it is the same as the number itself, then it is a magic number.	02
3	a. Create a program that takes a list of numbers as input and performs the following operations: 1. Find and print the sum of all the numbers in the list. 2. Find and print the largest number in the list. 3. Sort the list in ascending order and print the sorted list.	04

b. Create a program that defines two tuples, one representing the names of fruits and another representing their respective prices. Perform the following operations:
   1. Combine the two tuples to create a dictionary where the fruit names are keys and their prices are values.
   2. Allow the user to input a fruit name and find and print its price from the dictionary.
   3. Add a new fruit and its price to the dictionary and print the updated dictionary.

c. Create two sets - one representing students enrolled in a mathematics course and another representing students enrolled in a physics course. Perform the following operations:
   1. Find and print the set of students who are enrolled in both courses (intersection).
   2. Find and print the set of students who are enrolled in mathematics but not in physics (difference).

4 a. Create a class called BankAccount to represent a bank account with attributes like account number, account holder name, and balance. Implement the following: 04
   1. Encapsulate the attributes by making them private and provide getter and setter methods for accessing and modifying them.
   2. Implement a method for deposit and withdrawal, ensuring that the balance is updated accordingly.
   3. Demonstrate abstraction by providing only essential methods to interact with the bank account, hiding the internal implementation details.

b. Define a base class Person, having attributes name, birthdate and city. Define the class Student that derives from Person class which has attributes like rollno, branch, totalMarks and year as data member. The class should contain the instance method __init__ and the percentage with a pass statement. Define two classes Grad and PostGrad which inherit from the base class Student. Both the classes should define their __init__ method which asks the user to enter totalMarks value and should override the method percentage of the superclass. Note that totalMarks obtained are out of 500 and 300 for Grad and PostGrad classes respectively.

5 a. Write a function that takes two numbers as input parameters and returns True or False depending on whether they are co-primes. Two numbers are said to be co-prime if they do not have any common divisor other than one. 04

b. Write a Python function that takes an input number and returns its square. Use this function to square numbers from 1 to 10 and store the results in a list.

c. Write a menu driven program in Python using user defined function to
   - Check if a string is a palindrome
   - Find length of a string
   - Reverse a string

6 a. Create a text file with some sample data. Write a Python program to read the data from the file, process it (e.g., calculate the sum of numbers), and write the result to another file. 02

b. Write a Python program that prompts the user to enter a number and check whether it is prime or not. Use a try-except block to handle potential exceptions (e.g., ValueError if the user enters a non-numeric input). Inform the user about the error and ask for input again.

7 a. Define two vectors as NumPy arrays and perform vector operations such as addition, subtraction, dot product, and cross product. 02

b. Create a NumPy array representing a 3x3 matrix. Perform matrix operations like matrix multiplication and finding the determinant.

8 a. Generate random data points and fit them to a curve using NumPy's mathematical functions. Then, plot the data points and the fitted curve using Matplotlib. 04

b. Plot a line graph that shows the runs scored between two-wicket fall in a one-day international match between India and England. The runs scored are generated randomly.

Example:

Fall of Wicket	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
India	5	35	24	0	99	1	35	15	27	14
England	10	55	34	21	2	7	118	29	32	10

9 a. Design a python program that generates the 100 random variables and finds out the mean, median and mode for the same using statistical data analysis. 02

		b. Consider a dataset of students in a class stored in a CSV file named "students.csv" and has the following fields 'Name', 'Age', 'Gender', 'Grade', and 'City'. Write a Python program using pandas to perform the following operations. 1. Load the "students.csv" file into a pandas DataFrame named Df. 2. Display the first 3 rows of the DataFrame. 3. Calculate and print the average age of the students. 4. Count and display the number of male and female students. 5. Filter the DataFrame to include only the students with a grade higher than or equal to 80. 6. Sort the DataFrame by the 'Age' in ascending order.	
	10	a. Develop a python program that reads the image, displays matrix representation of an image, creates a histogram of the image and applies the smoothing effect on an image.	02
		b. Create a simple web application using python.	
Suggested Case List:	-NA-		

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. All (Other than CSE)
Course Code:	XXXX
Course Title:	Data Analysis and Visualisation
Course Type:	Inter-disciplinary Minor-Core
Year of Introduction:	2024-25

L	T	Practical Component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLO):

At the end of the course, students will be able to –

1. demonstrate data characteristics using visualisation tools (BL2)
2. identify common data types and corresponding analysis approaches (BL3)
3. analyse the data using various statistical tools (BL4)
4. build data visualisation systems for interdisciplinary problems (BL6)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	**Introduction:** Data Understanding, types of data, information and uncertainty, classes and attributes, interactions among attributes, relative distributions, summary statistics. **Data Quality:** inaccurate data, sparse data, missing data, insufficient data, imbalanced data	10
Unit-II	**Definition, Purpose, Usage, Business Data Visualization:** Features of Business Data, Different Visualization fields. Forms of Business Data Visualization. **Social Challenges:** Data ownership, data security, ethics and privacy	10
Unit-III	**The Data:** Data Examination, Data Visualization Patterns, the Categories of Data Visualization. **Data Visualization using different tools**: Refine data and create, edit, alter, and display their visualizations (x-y graph, bar chart, pie chart, cube etc)	10
Unit-IV	**Data Reduction and Feature Enhancement:** Standardizing data, sampling data, using principal components to eliminate attributes, limitations and pitfalls of principal component analysis (PCA), curse of dimensionality	10
Unit-V	**Showing Complex Data:** Organizational Models, Preattentive Variables, Sorting and Rearranging, Searching and Filtering, Datatips, Data Spotlight, Dynamic Queries, Data Brushing, Local Zooming, Sortable Table, Radial Table, Muti-Y Graphs, Treemap, Small Multiples	05

Self-Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents

Suggested Readings/ References:

1. Jack G. Zheng, Data Visualization for Business Intelligence, Taylor and Fransis
2. Jiahei Han & Micheline Kamber, Data Mining Concepts and Techniques, Morgan Kaufmann
3. Jenifer Tidwell, Designing Interfaces, O'Reilly Media, inc.
4. Edward Tufte, The Visual Display of Quantitative Information, Graphics Press LLC.
5. Ben Fry, Visualizing Data, O'Reilly Media inc.
6. Noab Iliinsky, Julie Steele, Designing Data Visualization, O'reilly Media inc.
7. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson
8. Wes McKinney, Python for Data Analysis, Oreilly
9. S. Nagabhushana, Data Warehousing OLAP and Data Mining, New Age publishers

Suggested List of Experiments:

Sr. No.	Title	Hours
1	(a) Aim: Data Domain selection and Identification of Characteristics of selected Dataset of different formats. 1. What data domain you have selected? 2. What are the information dataset contains? 3. Identify the characteristics of various fields of the dataset. (The distribution, inference etc.) 4. What are the insight (knowledge) we can generate for the selected dataset? 5. What are the pattern available in the dataset? (b) For selected dataset generate Five Number Summary using Python. Also generate mode and midrange, outlier detection using concept of Quartile method and other. Compare the results.	06
2	Case Study for Data visualization using Tableau. Use the dataset selected in practical -1 and design an interactive Dashboard for analysing data for selected KPI.	04
3	Data Preprocessing (Data Quality): Aim: Implement data smoothing and data normalization methods. Redundancy analysis using Pearson correlation and Chi- Square. Discretization by Intuitive Partitioning.	04
4	Data Reduction and Feature Enhancement: Aim: Implement Dimensionality reduction and Feature selection technique with selected dataset.	04
5	Data Analysis and Visualization Aim: Apply Classification Techniques for selected datasets visualize the results.	04

	6	Data Analysis and Visualization Aim: Apply Clustering Techniques for selected datasets and visualize the results.	04
	7	Pattern Analysis and Visualization Aim: Implementation of various classification and regression techniques and visualize the result with selected visualization tool like Tableau.	04
Suggested Case List:	-NA-		

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
Teaching and Examination Scheme
Inter-disciplinary Minor in Computer Science*

w.e.f. Academic Year 2024-25

Course Code	Course Title	Teaching Scheme (hours/week)				Examination Scheme			
		L	T	P	C	Duration Hours	Component Weightage		
						SEE	CE	LPW	SEE
Semester 5 Core Course I and II									
3CS507IC24	Data Structures and Algorithms	3	0	2	4	3	0.3	0.3	0.4
3CS508IC24	Operating Systems	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Core Course III									
	Database Management Systems	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Elective Course I									
	Computer Networks	3	0	2	4	3	0.3	0.3	0.4
	Web Technologies	3	0	2	4	3	0.3	0.3	0.4
	Machine Learning	3	0	2	4	3	0.3	0.3	0.4
Semester 7 Elective Course II									
	Object Oriented Programming	3	0	2	4	3	0.3	0.3	0.4
	Principles of Software Engineering	3	0	2	4	3	0.3	0.3	0.4
	Data Science	3	0	2	4	3	0.3	0.3	0.4

L: Lectures, P/T: Practicals / Tutorial, C: Credits
LPW/PW: Laboratory / Project Work

SEE: Semester End Examination
CE: Continuous Evaluation

*Interdisciplinary Minor will be offered for the students of departments other than Computer Science and Engineering, IT-NU.

w.e.f. for first year students admitted in 2022-23 and D to D students admitted in 2023-24 onwards

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B. Tech. All (Other than CSE)
Course Code:	3CS507IC24
Course Title:	Data Structures and Algorithms
Course Type:	Inter-disciplinary Minor-Core
Year of Introduction:	2024-25

L	T	Practical Component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLO):

At the end of the course, students will be able to –

1. experiment with various techniques for searching and sorting (BL3)
2. analyse various data structures and their applicability (BL4)
3. determine the appropriate data structure to design efficient algorithm for the given application (BL5)
4. estimate trade-offs in the design and implementations of the data structures (BL6)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	**Introduction to Data Structures:** Basic Terminology, Elementary Data Structure Organization, Classification of Data Structures: Primitive and Non-primitive, Linear and Non-linear, Operations on Data structures, Asymptotic notations, Notion of recursive algorithms.	06
Unit-II	**Linear Data Structures:** Introduction, variations, operations and applications of array, queue, stack and linked list	10
Unit-III	**Non-Linear Data Structures:** Concepts and types of trees, tree traversal algorithms, search trees, Priority queue implementation and applications, Representations of Graphs, Graph algorithms i.e., traversals, minimum spanning tree, shortest path, Traveling Salesman Problems	13
Unit-IV	**Indexing structure:** Concepts and implementations of B-Tree, B+ tree-check with DBMS, Modify	08
Unit-V	**Searching and Sorting Algorithms**: Linear search, Binary search, internal and external sorting algorithms, sorting without comparison.	08

Self-Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents

Suggested Readings/ References:

1. Jean-Paul Tremblay and Paul G. Sorenson, An Introduction to Data Structures with Applications, Tata McGraw Hill
2. Tanenbaum, Data Structures using C & C++, PHI
3. Robert L. Kruse, Data Structures and Program Design in C, PHI
4. Mary E.S. Loomis, Data Management and file processing, PHI
5. Narasimha Karumanchi, Data Structures and Algorithms Made Easy, CareerMonk Publications

Suggested List of Experiments:	Sr. No.	Title	Hours
	1	a. An organization has to maintain its employee's details. There is need of accessing details of employees frequently. Taking this information into consideration, use an appropriate data structure to implement system for providing functionality of adding details of new employee, removing employee's detail from the system and listing all employees' details. b. Design anagram game using array. Allow a user to enter N words and store it in an array. Generate a random number between 0 to N-1. Based on the random number generated display the word stored at that index of an array and allow user to enter its anagram. Check whether the word entered by the user is an anagram of displayed number or not and display an appropriate message. [Given a word A and word B. B is said to be an anagram of A if and only if the characters present in B is same as characters present in A, irrespective of their sequence. For ex: "LISTEN" == "SILENT"]	04
	2	a. Write a program to reverse the elements in the stack using recursion. Write a program to convert fully parenthesized infix expression into postfix expression. Show all the intermediate results in the table format.	04
	3	a. Write a program to simulate printer spooler application. Assume maximum 5 users are using this printer. Use appropriate data structure to implement the system. b. Write a program to implement priority queue using 2D array.	02
	4	Write a program to implement doubly linked list where each node consists of integer values. The program should support following functionalities. i. Create a doubly linked list	02

	ii. Delete a node if it is found, otherwise display an appropriate message ii. Search a given integer value in the list Display the doubly linked list	
5	a. Write a program to simulate music player application using suitable data structure. There is no estimation about number of music files to be managed by the music player. Your program should support all the basic music player operations to play and manage the playlist. b. Write a program to perform addition of two polynomial equations using appropriate data structure.	04
6	Write a program to construct a binary tree from the given post-order and in-order traversal sequence.	02
7	Write a program to implement phone book dictionary using Binary Search Tree which provides following operations: i. Add new entry in phone book ii. Remove entry from phone book iii. Search phone number iv. List all entries in ascending order of name v. List all entries in descending order of name.	04
8	Write a program to traverse connected undirected graph using Depth First Search (DFS) traversing technique and give the traversing sequence.	02
9	a. Write a program to implement Selection sort for sorting a given set of integers in ascending order and also calculate time complexity. b. Write a program to implement Quick sort algorithm for sorting a given set of integers in ascending order and also calculate time complexity.	04
10	Implement Binary search technique, which takes a list of unique values sorted in descending order and a value to search for, and returns either the index of the value or None, if the value isn't in the list.	02

Suggested Case List: -NA-

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. All (Other than CSE)
Course Code:	3CS508IC24
Course Title:	Operating Systems
Course Type:	Inter-disciplinary Minor-Core
Year of Introduction:	2024-25

L	T	Practical Component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLO):

At the end of the course, students will be able to –

1. illustrate basic components and services of operating systems (BL2)
2. utilize operating system functions effectively (BL3)
3. analyse the mechanism of operating systems to handle I/O devices and file management (BL4)
4. evaluate the mechanism of operating systems to handle processes and memory (BL5)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	**Introduction to Operating System:** Operating system objectives and functions, evolution of operating systems	04
Unit-II	**Process Description and Control:** Process states, process description, process control, process management, Uni-processor scheduling, multiprocessor and real-time scheduling	14
Unit-III	**Threads and Concurrency:** Processes and Threads, Symmetric Multiprocessing, Micro kernels, Mutual exclusion and synchronization, deadlock and starvation	12
Unit-IV	**Memory Management and Virtual Memory:** Memory management requirements, partitioning, paging, segmentation, virtual memory	08
Unit-V	**I/O Management and Files:** I/O devices, organization of I/O functions, OS design issues, I/O buffering, disk scheduling, disk cache, file management, security aspects in OS	07

Self-Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents

Suggested Readings/ References:

1. William Stallings, Operating Systems, PHI.
2. Silberschiltz, Galvin and Greg Gange, Operating System, Wiley India.
3. Sumitabha Das, Unix Concepts and Applications, TMH Publications.
4. Yashvant Kanetkar, Shell Programming, BPB.
5. A.S.Tanenbaum, Modern Operating Systems, TMH Publications.
6. Kernighan, the UNIX Programming Environment, Pearson
7. Maurice Bach, The Unix Operating System, Prentice Hall

	Sr. No.	Title	Hours
Suggested List of Experiments:	1	a) Getting acquainted with basic UNIX commands. b) Getting acquainted with UNIX filters.	04
	2	Write a shell script for performing the functions of a basic calculator. (Using decision-making, case-control structure, and bc command).	02
	3	a) Write a shell script to compare the contents of two files. b) Write a shell script to generate all the combinations of 1, 2 and 3.	02
	4	(a)Write a shell script to keep on accepting lines of text and write the text into a data file until the user inputs "end". The script should count the number of lines input and display them. (b) Write a shell script which receives two filenames as arguments and compare two files and delete the second file if both files are same	02
	5	Write a shell script that imitates head and tail commands (without using head and tail commands).	02
	6	a) Write a shell script to delete all the lines containing the word entered by the user in the files supplied as arguments to this shell script. b) Write a shell script to concatenate all given file into a single file.	02
	7	Write a shell script for implementing directory management.	04
	8	Write a shell script for performing basic functions related to DBMS.	04
	9	Write a C program to implement a system call using the fork () and Exec () function.	04
	10	Write a C program to implement grep command.	04
Suggested Case List	-NA-		

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
Teaching and Examination Scheme
Inter-disciplinary Minor in Software Engineering*

w.e.f. Academic Year 2024-25

Course Code	Course Title	Teaching Scheme (hours/week)				Examination Scheme			
		L	T	P	C	Duration Hours	Component Weightage		
						SEE	CE	LPW	SEE
Semester 5 Core Course I and II									
3CS509IC24	Principles of Software Engineering	3	0	2	4	3	0.3	0.3	0.4
3CS510IC24	Software Testing and Quality Assurance	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Core Course III									
	Application Development Frameworks	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Elective Course I									
	Software Architectures	3	1	0	4	3	0.6	-	0.4
	Service Oriented Architecture	3	1	0	4	3	0.6	-	0.4
	UI-UX Design	3	1	0	4	3	0.6	-	0.4
Semester 7 Elective Course II									
	Agile Software Development	3	1	0	4	3	0.6	-	0.4
	Secured Software Engineering	3	1	0	4	3	0.6	-	0.4
	Software Project Management	3	1	0	4	3	0.6	-	0.4

L: Lectures, P/T: Practicals / Tutorial, C: Credits SEE: Semester End Examination
LPW/PW: Laboratory / Project Work CE: Continuous Evaluation

*Interdisciplinary Minor will be offered for the students of departments other than Computer Science and Engineering, IT-NU.

w.e.f. for first year students admitted in 2022-23 and D to D students admitted in 2023-24 onwards

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B. Tech All (Other than CSE)
Course Code:	3CS509IC24
Course Title:	Principles of Software Engineering
Course Type:	Inter-disciplinary Minor-Core/Elective
Year of Introduction:	2024-25

L	T	Practical Component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLO):

At the end of the course, students will be able to –

1. explain various phases of software development lifecycle (BL2)
2. analyse and document the requirement specifications for a software project (BL4)
3. evaluate the process model using standard tools and methodologies (BL5)
4. design prototype considering all aspects on SDLC (BL6)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	**Introduction:** Introduction to Software Engineering, Defining Software, Changing Nature of Software, attributes of a good Software, Software Product, Software Development Life Cycle, Software Processes, Software Engineering Practices, Software Myths	05
Unit-II	**Software Process Models:** Generic Process Model (Defining Framework Activity, Identifying Task Set), Waterfall Process Model, Incremental Process Model, Spiral Process Model, Prototyping Software Process Model, Evolutionary Process Model, Component Based Process Model, Introduction to basic concepts of Agile Software Development	10
Unit-III	**Project Management Concepts:** Management activities, Project Planning, Project Scheduling, Overview of Risk handling and management.	03
Unit-IV	**Software requirement engineering:** Software Requirements, Requirement Engineering, Extraction and Specification, Feasibility Study, Requirements Modelling, Object Oriented Analysis.	07
Unit-V	**Design Concepts:** Object oriented design, Architectural Design, Component level Design, User Interface Design, Distributed Systems Architecture, Real Time Software Design, User Interface Design, Pattern Based Design **Coding:** Top-down and bottom-up, structured programming, information hiding, programming style, and internal documentation.	06
Unit-VI	**Software Process &Metrics:** Metrics in the Process and Project Domains, Process metrics, project metrics, Software Measurement Metrics for Software Quality	06

Unit-VII	**Software Testing:** Unit testing, integration testing, black box and white box testing, regression testing, performance testing, object-oriented testing. Verification and validation of Software and Software configuration management: Concepts and examples	08

Self-Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents

Suggested Readings/ References:

1. Ian Sommerville, Software Engineering, Addison – Wesley
2. Roger Pressman, Software Engineering A Practitioner's Approach, McGraw Hill Publication
3. Rajib Mall, Fundamentals of Software Engineering, Prentice Hall of India
4. Ivar Jacobson, Object Oriented Software Engineering A use case Approach, Pearson
5. Shari Lawrence Pfleeger, Joanne M. Atlee, Software Engineering: Theory and Practice, Pearson

Suggested List of Experiments:

Sr. No.	Title	Hours
1	Identify Project scope, Objectives, Problem Statement formulation and requirement identification for project.	02
2	Define functional & non-functional requirements for same. Prepare a SRS document for the project.	02
3	Define modules of the project & design the project plan (Gantt Chart) for the same and identify deliverables with time line.	02
4	Design Use Case Diagrams and Use Case Specifications for your system.	04
5	Construct Activity Diagram for your system.	02
6	Design Class Diagram & CRC index cards for your System.	02
7	Construct Sequence Diagram and Collaboration Diagram for project.	04
8	Construct State Diagram for your project.	04
9	Implement formal specification using Z notation.	04
10	Implement at-least four functional modules of your project. Design test cases for your project and perform testing. Prepare test strategy document.	04

Suggested Case List -NA-

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B. Tech. All (Other than CSE)
Course Code:	3CS510IC24
Course Title:	Software Testing and Quality Assurance
Course Type:	Inter-disciplinary Minor-Core
Year of Introduction:	2024-25

L	T	Practical Component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLO):

At the end of the course, students will be able to –

1. identify different levels and types of testing techniques (BL3)
2. make use of modern software testing strategies in relation to software development (BL3)
3. evaluate quality assurance practices and principles throughout the software development lifecycle (BL5)
4. design project test plans, test cases, and test data to conduct test operations (BL6)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	**Introduction:** Overview of software testing, software quality, role of testing, testing approaches, verification and validation, failure, error, fault and defect, white box and black box testing, test planning and design, monitoring and measuring test execution, test tools and automation, test team organization and management	03
Unit-II	**Unit testing:** Concept of unit testing, defect prevention, mutation testing, debugging, control flow testing, control flow graph, paths in a control flow graph, all-path coverage criterion, statement coverage criterion, branch coverage criterion, examples of test data selection, data flow testing, data flow anomaly, data flow graph, data flow testing criteria, feasible paths and test selection criteria, comparison of testing techniques	12
Unit-III	**Integration testing:** Concept of integration testing, different types of interfaces and interface errors, granularity of system integration testing, system integration techniques, test plan for system integration, functional testing concepts, equivalence class partitioning, boundary value analysis, decision tables, random testing, error guessing	12
Unit-IV	**System Testing:** System test categories, basic tests, functionality tests, robustness tests, interoperability tests, performance tests, scalability tests, stress tests, load and stability tests, reliability tests, regression tests, documentation tests, metrics for tracking system test, defect causal analysis, types of acceptance testing	10
Unit-V	**Software quality:** Five views of software quality, McCall's software quality factors, quality criteria, relationship between quality factors and criteria, components of software quality assurance, software quality, standards and their requirements, software quality metrics, software reliability models, capability maturity model	08

Self-Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents

Suggested Readings/ References:

1. Sagar Naik, Piyu Tripathy, Software Testing and Quality Assurance: Theory and Practice, Wiley.
2. William Perry, Effective Methods for Software Testing, Wiley.
3. Paul C. Jorgensen, Software Testing - A Craftsman's Approach, CRC Press.
4. Srinivasan Desikan and Gopalaswamy Ramesh, Software Testing, Pearson Education.
5. Louis Tamres, Introducing to Software Testing, Addison Wesley Publications.
6. Ron Patton, SAMS Techmedia Indian Edition, Software Testing, Pearson Education.
7. Glenford J. Myers, The Art of Software Testing, John Wiley & Sons.
8. Robert V. Binder, Testing Object-Oriented Systems: Models Patterns and Tools, Addison Wesley.
9. Daniel Galin, Software Quality Assurance, Pearson Education.

Suggested List of Experiments:

Sr. No.	Title	Hours
1	To create test cases based on given requirements for a sample application (e.g., e-commerce app, web page, or mobile app).	02
2	To execute manual test cases and log defects using a bug-tracking tool (e.g., JIRA).	04
3	To study and perform sample tests using Test Link testing tool.	04
4	To study and perform sample tests using JUnit testing tool.	04
5	To create automated test scripts using a tool/framework (e.g., Selenium WebDriver).	04
6	To perform manual mobile application testing, focusing on UI/UX, functionality, and compatibility and automated testing of a mobile app using Appium or a similar tool.	02
7	To conduct load testing on a web application using JMeter or a similar tool.	02
8	To perform testing SOAP Web Services for functionality and fault checking.	02
9	To implement a simple continuous testing pipeline using a tool like Jenkins.	02
10	To identify and document vulnerabilities in a web application and simulate a basic penetration testing scenario to identify security flaws.	04

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
Teaching and Examination Scheme
Disciplinary Minor in Adaptive AI*

w.e.f. Academic Year 2024-25

Course Code	Course Title	Teaching Scheme (hours/week)				Examination Scheme			
		L	T	P	C	Duration Hours	Component Weightage		
						SEE	CE	LPW	SEE
Semester 5 Core Course I and II									
	Computer Vision using Deep Learning	3	0	2	4	3	0.3	0.3	0.4
	Natural Language Computing	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Core Course III									
	Reinforcement Learning	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Elective Course I									
	Soft Computing	3	0	2	4	3	0.3	0.3	0.4
	Federated Learning	3	0	2	4	3	0.3	0.3	0.4
Semester 7 Elective Course II									
	Explainable AI	3	0	2	4	3	0.3	0.3	0.4
	MLOps	3	0	2	4	3	0.3	0.3	0.4
	Securing AI Models	3	0	2	4	3	0.3	0.3	0.4

L: Lectures, P/T: Practical / Tutorial, C: Credits SEE: Semester End Examination
LPW/PW: Laboratory / Project Work CE: Continuous Evaluation

*Disciplinary Minor will be offered only for the students of Computer Science and Engineering Department, IT-NU.

w.e.f. for the first-year students admitted in 2022-23 and D to D students admitted in 2023-24 onwards

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. (CSE)
Course Code:	XXXX
Course Title:	Computer Vision using Deep Learning
Course Type:	Disciplinary Minor-Core
Year of Introduction:	2024-25

L	T	Practical Component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLO):

At the end of the course, students will be able to –

1. explain various image representation stages for digital image processing applications (BL2)
2. identify the deep learning algorithms which are appropriate for different types of learning tasks in various domains (BL3)
3. evaluate deep learning algorithms and solve real-world problems (BL5)
4. elaborate various deep learning models for computer vision applications (BL6)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	**Introduction:** History, Image Formation, Linear Filtering, Image in frequency domain, Image sampling, Edge Detection, From Edges to Blobs and Corners, Feature Detectors: SIFT and Variants, Image Segmentation, Human Visual System	10
Unit-II	**From Traditional Vision to Deep Learning:** Feature Matching, From points to Images, Image Descriptor matching	06
Unit-III	Deep Learning review, Perceptron Learning, Feed Forward Neural Networks, Back-propagation, Unstable Gradient Problem, Limitations of Feed Forward Neural Networks for Computer Vision Problems	06
Unit-IV	**Convolution Neural Network:** Introduction, Convolution & Pooling, Dropout, Batch Normalization, State-of-the-art CNNs, Evolution of CNN Architectures (AlexNet, ZFNet, VGG, InceptionNets, ResNets, DenseNets), CNNs for Recognition and Verification (Siamese Networks, Triple Loss, Contrastive Loss, Ranking Loss), CNNs for Detection and Segmentation (RCNN, Fast R-CNN, Faster R-CNN, YOLO, FCN, SegNet, U-Net, Mask-RCNN)	13
Unit-V	**Recurrent Neural Networks (RNNs):** Recurrent Neural Networks (RNN), Language Modelling, Long-Short Term Memory Network, Gated Recurrent Unit, Bi-directional RNN, Deep RNN, Applications of Sequence Models	07
Unit- VI	Auto encoders and Stacked Auto encoders, Generative Adversarial Networks for computer vision	03
Self-Study:	The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents	

Suggested Readings/ References:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press
2. Michael Nielsen, Neural Networks and Deep Learning, Determination Press
3. Yoshua Bengio, Learning Deep Architectures for AI, now publishers Inc
4. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson education
5. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer
6. Simon Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press
7. David Forsyth, Jean Ponce, Computer Vision: A Modern Approach, Pearson Education India

Suggested List of Experiments:

Sr. No.	Title	Hours
1	Implement linear filters (e.g., mean filter, Gaussian filter) using convolution operations on images. (Analyze the effects of different filter sizes and types on image quality)	02
2	Implement classical edge detection techniques such as Sobel, Prewitt, and Roberts's operators. Compare the performance of these techniques in detecting edges in different types of images.	02
3	Apply a feed-forward neural network to a computer vision dataset (e.g., MNIST). Discuss the challenges and limitations faced by a simple feed-forward network in handling complex visual patterns.	04
4	Explore the Fourier transform and apply it to images for frequency domain analysis. Implement image filtering in the frequency domain and compare results with spatial domain filtering.	02
5	Explore the concept of transfer learning by using pre-trained models (e.g., VGG, ResNet) for computer vision tasks. Discuss how transfer learning can overcome limitations of training deep networks from scratch.	02
6	Implement a Convolutional Neural Network (CNN) for image classification using popular frameworks like TensorFlow or PyTorch. (Experiment with different architectures, hyperparameters, and optimization techniques to observe their impact on performance.)	04
7	Implement a Convolutional Neural Network (CNN) for image segmentation using popular frameworks like TensorFlow or PyTorch.	04

	8	Develop a simple RNN from scratch using Python and a numerical computation library (e.g., NumPy). Train the RNN on a synthetic sequential dataset to understand its basic functioning.	04
	9	Implement a Long-Short Term Memory (LSTM) network using a deep learning framework (e.g., TensorFlow, PyTorch). Compare the performance of the LSTM with the basic RNN on a sequence prediction task.	02
	10	Implement a GAN based network on image dataset.	04
Suggested Case List:		-NA-	

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech.(CSE)
Course Code:	XXXX
Course Title:	Natural Language Computing
Course Type:	Disciplinary Minor-Core
Year of Introduction:	2024-25

L	T	Practical Component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLO):

At the end of the course, students will be able to –

1. infer about major issues and solutions related to natural language computing (BL2)
2. utilize various computational methods to understand language phenomena (BL3)
3. assess the sequence modelling techniques for various use cases (BL5)
4. develop applications with natural language capabilities (BL6)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	**Introduction and Text Classification:** NLP overview, Regular Expressions, Text pre-processing, feature extraction from text, Neural networks for words and characters, Text Mining case study	07
Unit-II	**Language Modelling**: N gram models, Smoothing, Part of speech tagging, Hidden Markov models, Viterbi algorithm, Forward - backward algorithm, EM training, Models for Named Entity Recognition and Part of Speech tagging	18
Unit-III	**Vector Space Models:** Matrix factorization, Word2Vec and Doc2Vec, GloVe, Word - character and sentence embeddings, Topic modelling	06
Unit-IV	**Neural Language Models:** Recurrent Neural Networks and Long Short-term Memory networks, Large Language Models, Generative AI concepts,	07
Unit-V	**Use cases in Sequence Modelling**: Introducing machine translation, Encoder-decoder architecture, Attention mechanism, implementing a conversational chat-bot, Transformers, automatic speech recognition and text to speech synthesis	07

Self-Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents

Suggested Readings/ References:

1. Manning, Christopher D., and Hinrich Schütze. Foundations of Statistical Natural Language Processing. Cambridge, MA: MIT Press
2. Jurafsky, David, and James H. Martin. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition. Upper Saddle River, NJ: Prentice-Hall
3. James Allen. Natural Language Understanding. The

Benajmins/Cummings Publishing Company Inc.
4. Steven Bird, Ewan Klein, and Edward Loper. Natural Language Processing with Python – Analyzing Text with the Natural Language Toolkit
5. Jacob Perkins, Python Text Processing with NLTK 2.0 Cookbook, Packt Publishing

Suggested List of Experiments:

Sr. No.	Title	Hours
1	Basic Regular Expressions hands on and exploring libraries (NLTK, SpaCy, Gensim) for NLP tasks.	04
2	Implementation of feature representation from text data using word embedding models.	02
3	Implementation of PoS Tagging.	02
4	Implementation of Sentiment Analysis on Twitter dataset.	02
5	Virtual labs on Language models and N-gram detection.	02
6	Implementation of Forward algorithm to address the likelihood problem of hidden Markov models.	04
7	Implementation of Viterbi algorithm to address the decoding problem in hidden Markov models.	02
8	Implementation of basic recurrent neural network for sequence learning task.	04
9	Implementation of machine translation.	04
10	Toy implementation of chatbot / Question Answering system.	04

Suggested Case List: -NA-

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
Teaching and Examination Scheme
Disciplinary Minor in Cyber Security*

w.e.f. Academic Year 2024-25

Course Code	Course Name	Teaching Scheme (hours/week)				Examination Scheme			
		L	T	P	C	Duration Hours	Component Weightage		
						SEE	CE	LPW	SEE
Semester 5 Core Course I and II									
	Information and Network Security**	3	0	2	4	3	0.3	0.3	0.4
	Digital Forensics	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Core Course III									
	Secured Application Development	3	0	2	4	3	0.3	0.3	0.4
Semester 6 Elective Course I									
	System and Website Audit	3	0	2	4	3	0.3	0.3	0.4
	Quantum Computing**	3	0	2	4	3	0.3	0.3	0.4
	Blockchain and Cryptocurrency	3	0	2	4	3	0.3	0.3	0.4
	Data Privacy	3	0	2	4	3	0.3	0.3	0.4
Semester 7 Elective Course II									
	Intrusion Detection and Prevention Systems	3	0	2	4	3	0.3	0.3	0.4
	Embedded System Security	3	0	2	4	3	0.3	0.3	0.4
	Surveillance and Analytics	3	0	2	4	3	0.3	0.3	0.4

L: Lectures, P/T: Practical / Tutorial, C: Credits
LPW/PW: Laboratory / Project Work
SEE: Semester End Examination
CE: Continuous Evaluation

*Disciplinary Minor will be offered for the students of Computer Science and Engineering Department, IT-NU.

** Students who have opted for Minor in Cyber Security will not be permitted to select department electives courses such as Quantum Computing and Network Security

w.e.f. for the first-year students admitted in 2022-23 and D to D students admitted in 2023-24 onwards

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech.(CSE)
Course Code:	XXXX
Course Title:	Information and Network Security
Course Type:	Disciplinary Minor-Core
Year of Introduction:	2024-25

L	T	Practical Component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLO):

At the end of the course, students will be able to –

1. illustrate fundamental network security concepts, terminologies, and principles (BL2)
2. analyse common network security threats, vulnerabilities, and attack vectors (BL4)
3. explain the principles of cryptography and apply cryptographic techniques to protect data and communications. (BL5)
4. develop security policies and procedures to ensure compliance with relevant standards and regulations (BL6)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	**Security Overview:** Significance of Information and network security, what are the hurdles in achieving the same, introduction to Cryptography, Concepts and terminology	04
Unit-II	**Information Security:** Classical Encryption Techniques, Block Ciphers and DES, Advanced Encryption Standard (AES), Block Cipher Operations, Pseudo Random Number Generation and Stream Ciphers, Mathematical Background (Fermat's Little Theorem, Euler Totient Function, Euler's Theorem Chinese Remainder Theorem etc.), Public Key Cryptography	12
Unit-III	**Network Security:** Firewall, Secure Socket Layer (SSL) Architecture and working, Transport Level Security (TLS) including HTTPS, HTTPS Use, Secure Shell SSH Protocol, port forwarding, Electronic Mail Security: Email Security Enhancements, Pretty Good Privacy (PGP), S/MIME, IP Security, IPSec, IPSec key management	10
Unit-IV	**Intrusion Detection:** Concepts, Intrusion vs. Extrusion Detection Examples of Intrusion Categories of Intruders Hacker Behaviour, Insider Behaviour, Intrusion Techniques, Password Guessing and Capture Notification Alarms, Types of IDS, Intrusion Detection Systems (IDS) and Intrusion Prevention Systems (IPS)	07

Unit-V	**Network Threats and Defence:** Types of network threats: malware, phishing, DoS, etc., Attack vectors and methods, Understanding firewalls: types, technologies, and configurations, Access control and security policies	06
Unit-VI	Virtual Private Networks (VPNs) and Wireless Network Security, VPN principles and types, VPN protocols and encryption, Wireless network security threats and solutions, Wireless encryption protocols, Wireless Network Security: IEEE 802.11 Architecture IEEE 802.11 Services Wired Equivalent Privacy (WEP)	06

Self-Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents

Suggested Readings/ References:

1. William Stallings, Cryptography and Network Security: Principles and Practice, Pearson
2. D. R. Stinson: Cryptography: Theory and Practice (Discrete Mathematics and Its Applications), CRC Press.
3. B. Schneier: Applied cryptography: protocols, algorithms, and source code in C, John Wiley & Sons.
4. Bernard Menezes: Network Security and Cryptography, 1st Edition, Cengage Learning, Delhi
5. B. Forouzan, D. Mukhopadhyay, Cryptography And Network Security, Mc-Graw Hill

Suggested List of Experiments:

Sr.	Title	Hours
1	Implementation and crypt-analysis of shift-based ciphers- Caesar Cipher, ROT-13 cipher)	02
2	Implementation of Transposition ciphers (Single as well as Multilevel)	02
3	Exploration of various tools to perform encryption and decryption	02
4	Cryptography-implementation using block-cipher DES	04
5	Asymmetric Cryptography- Creation of RSA key, RSA encryption and decryption	04
6	Simulating the Key Distribution Scenario for Symmetric Key Cryptography using the simulator of your choice	04
7	Use of Snort/Wireshark tool for Network Intrusion Detection Systems to monitor network traffic and analyze attack patterns	02
8	Configure and test VPN connections using technologies such as IPsec or OpenVPN	04
9	Perform vulnerability scans using tools like Nessus or OpenVAS to identify potential security weaknesses.	04
10	Set up network security monitoring tools to collect and analyze logs for signs of security incidents.	02

Suggested Case List: -NA-

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech.(CSE)
Course Code:	XXXX
Course Title:	Digital Forensics
Course Type:	Disciplinary Minor-Core
Year of Introduction:	2024-25

L	T	Practical Component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, the student will be able to –

1. illustrate forensic duplication and file system analysis (BL2)
2. identify the need of digital forensic and role of digital evidences (BL3)
3. compare the use of various tools for data recovery (BL4)
4. assess the network forensics to collect digital evidences (BL5)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	**Introduction to Ethical Hacking:** Difference between Hacking and Ethical hacking, Steps of Ethical Hacking, Tools for ethical hacking	05
Unit-II	**Introduction to Cyber Crime:** Types of cybercrime, categories of cybercrime, Computers' roles in crimes, Prevention from cyber-crime, Hackers, Crackers, Phreakers	03
Unit-III	**Digital Forensics and Digital Evidences:** Rules for Digital Forensic, The Need for Digital Forensics, Types of Digital Forensics, Ethics in Digital Forensics, Types of digital evidences and their characteristics, Challenges in digital evidence handling	05
Unit-IV	**Computer Security Incident Response:** Introduction to Computer Security Incident, Goals of Incident response, Incident Response Methodology, Formulating Response Strategy, Incidence Response Process, Data Collection on Unix based systems	07
Unit-V	**Forensic Duplication:** Forensic Image Formats, Traditional Duplication, Live System Duplication, Forensic Duplication tools	05
Unit-VI	**Disk and File System Analysis:** Media Analysis Concepts, File System Abstraction Model, Partition Identification and Recovery, Virtual Machine Disk Images, Forensic Containers Hashing, Carving, Forensic Imaging	06
Unit-VII	**Data Analysis:** Data Analysis Methodology, Investigating Applications, Malware Handling	04

Unit-VIII	**Network Forensics:** Technical Exploits and Password Cracking, Analysing Network Traffic, Collecting Network based evidence, Evidence Handling, Investigating Routers, Handling Router Table Manipulation Incidents, Using Routers as Response Tools	06
Unit-IX	**Forensic Tools:** Need and types of computer forensic tools, tasks performed by computer forensic tools, Study of different tools to acquire, search, analyse and store digital evidence	04

Self-Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents

Suggested Readings/ References:

1. Jason Luttgens, Matthew Pepe, Kevin Mandia, Incident Response and computer forensics, Tata McGraw Hill.
2. Nilakshi Jain, Dhananjay Kalbande, Digital Forensic: The fascinating world of Digital Evidences, Wiley India Pvt Ltd.
3. Cory Altheide, Harlan Carvey, Digital forensics with open-source tools, Syngress Publishing, Inc.
4. Chris McNab, Network Security Assessment, O'Reily.
5. Clint P Garrison, Digital Forensics for Network, Internet, and Cloud Computing A forensic evidence guide for moving targets and data, Syngress Publishing, Inc.
6. Bill Nelson, Amelia Phillips, Christopher Steuart, Guide to Computer Forensics and Investigations, Cengage Learning
7. Debra Littlejohn Shinder Michael Cross Scene of the Cybercrime: Computer Forensics Handbook, Syngress Publishing, Inc.
8. Marjie T. Britz, Computer Forensics and Cyber Crime, Pearson, Preston Galla, How Personal and Internet Security Work, Que Publications

Suggested List of Experiments:

Sr.	Title	Hours
1	Study different data recovery tools.	04
2	Implement experimental analysis of data recovery tools studied in practical 1 on any two different deletion cases and at least two different makes of flash drives.	04
3	Implement photo and multimedia data recovery using open-source tool(s).	04
4	Identifying the types of logs available with different operating systems for forensic investigation. Study different open-source tools for reading logs	04
5	Study different forensic investigation tools and prepare a comparative analysis of the study. Moreover, perform experimentation using open-source digital forensic tools for a given case study.	08
6	Perform penetration testing using appropriate tool(s) and generate a report on different security glitches identified.	06

Suggested Case List: -NA-