CHRIST COLLEGE OF ENGINEERING (AUTONOMOUS), IRINJALAKUDA

Run by

Christ Educational and Charitable Trust

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

SECOND SEMESTER

Sl. No:	Slot	Course Code	Course Type	Course Category	Course Title (Course Name)	Credit Structure				SS	Total Marks		Credits	Hrs./Week
						L	T	P	R		CIE	ESE		
THEORY														
1	A	G25MAT211	BS	GC	Mathematics for Electrical Science-2	3	0	0	0	4.5	40	60	3	3
2	B S1/ S2	G25PYE112 / **G25CYE103**	BS	GC	Physics for Electrical Science / **Chemistry for Electrical Science**	3	0	2	0	5.5	40	60	4	5
3	C	G25MHT204	ES	GC	Engineering Mechanics	3	0	0	0	4.5	40	60	3	3
4	D	G25PCE206	ES	GC	Programming in C	3	0	2	0	5.5	40	60	4	5
5	E	E25MIT207	PC	PC	Measurements and Instrumentation	3	1	0	0	5	40	60	4	4
6	F	A25IPT207	ES	CC	Engineering Entrepreneurship & IPR	3	0	0	0	4.5	60	40	3	3
PRACTICALS														
7	I* S1/S2	A25HWE108 / **A25LSE109**	HM	CC	Health and wellness / **Life Skills and Professional Communication**	1 / 2	0 / 0	1 / 1	0 / 0	0 / 3.5	50 / 100	0 / 0	1	2/3
8	L	G25ITP210	ES	CC	IT Workshop	0	0	2	0	1	50	50	1	2
MANDATORY COURSES														
9	I	A25ILE211	SE	CC	Introduction to Idea Lab and Digital Twin Technology	1	0	2	0	2.5	50	0	2	
10	-		MC	MC	Activity Point Programme $								-	-
Total										**36.5**			**25**	**27/28**

SEMESTER -2

MATHEMATICS FOR ELECTRICAL SCIENCE- 2

Course Code	**G25MAT211**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Basic knowledge in single variable calculus.	**Course Type**	Theory

Course Objectives:

1. To provide a comprehensive understanding of partial derivatives, multiple integrals, and the differentiation and integration of vector-valued functions, emphasizing their applications in engineering contexts.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Limits and continuity, Partial derivatives, Partial derivatives of functions with two variables, Partial derivatives viewed as rate of change and slopes, Partial derivatives of functions with more than two variables, Higher order partial derivatives, Local Linear approximations, Chain rule, Implicit differentiation, Maxima and minima of functions of two variables - relative maxima and minima.	**9**
2	Double integrals, Reversing the order of integration in double integrals, change of coordinates in double integrals (Cartesian to polar), Evaluating areas using Double integrals, Finding volumes using double integration, Triple integrals, Volume calculated as triple integral, Triple integral in Cartesian and cylindrical coordinates.	**9**

3	Vector valued function of single variable - derivative of vector valued function, Concept of scalar and vector fields, Gradient and its properties, Directional derivative, Divergent and curl, Line integrals of vector fields, Work done as line integral, Conservative vector field, independence of path, Potential function (results without proof).	**9**
4	Green's theorem (for simply connected domains, without proof) and applications to evaluating line integrals, finding areas using Greens theorem, Surface integrals over surfaces of the form $z = g(x, y)$, Flux integrals over surfaces of the form $z = g(x, y)$, Divergence theorem (without proof), Using Divergence theorem to find flux, Stokes theorem (without proof)	**9**

Course Assessment Method
(CIE: 40 Marks, ESE: 60 Marks)
Continuous Internal Evaluation Marks (CIE):

Assignment (Activity based)	Internal Examination-I (Written)	Internal Examination-II (Written)	Internal Examination-III (Written)	Total
15*	30	30	30	
	A total of 90 marks will be scaled to 25.			**40**

*One or more assignments should be given, and the total marks should be consolidated and converted to 15 as per revised evaluation guidelines.

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions.

Part A	Part B	Total
● 2 questions from each module. ● Total of 8 questions, each carrying 3 marks **(8 x 3 = 24 Marks)**	● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 sub divisions. **(4 x 9 = 36 Marks)**	**60**

Course Outcomes (Cos)

At the end of the course students should be able to:

CO No.	Description	Blooms Knowledge Level (KL)
CO1	Compute the partial derivatives of multivariable functions and apply second derivative test to find the relative extremas.	3
CO2	Analyse geometrical shapes using multiple integrals to identify and interpret their areas and volumes	4
CO3	Apply differentiation and integration of vector-valued functions to model and analyse curves in three-dimensional space.	3
CO4	Analyse the concepts of surface and volume integrals and to learn their inter-relations and & applications.	4
CO5	Able to develop, analyse and make use of theoretical concepts to solve complex problems and visualize the output	4

Note: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyse, K5 – Evaluate, and K6 - Create

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3									2	3		
CO2	3	3									2	2		
CO3	3	3									2	3		
CO4	3	3				2		2	3		2	2		
CO5	3	3									2	2		

Text Books

Sl. No.	Title of the Book	Name of the Author(s)	Name of the Publisher	Edition and Year
1	Calculus	H. Anton, I. Biven, S. Davis	Wiley	12th Edition, 2024

Reference Books

Sl. No.	Title of the Book	Name of the Author(s)	Name of the Publisher	Edition and Year
1	Thomas' Calculus	Maurice D. Weir, Joel Hass, Christopher Heil, Przemyslaw Bogacki	Pearson	15th Edition, 2023
2	Essential Calculus	J. Stewart	Cengage	2nd Edition, 2017
3	Advanced Engineering Mathematics	Erwing Kreyszig	John Wiley & Sons	10th Edition, 2016
4	Bird's Higher Engineering Mathematics	John Bird	Taylor & Francis	9th Edition, 2021
5	Higher Engineering Mathematics	B. V. Ramana	McGraw-Hill Education	39th Edition, 2023

Video Links (NPTEL, SWAYAM, etc.)

Module No.	Link
1	https://nptel.ac.in/courses/111107108
2	https://nptel.ac.in/courses/111107108
3	https://nptel.ac.in/courses/111107108
4	https://nptel.ac.in/courses/111107108

SEMESTER -2

CHEMISTRY FOR INFORMATION SCIENCE AND ELECTRICAL SCIENCE

Course Code	**G25CYE103**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:2:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1.To equip students with a comprehensive understanding of chemistry concepts that are relevant to engineering applications.

2.To familiarize students with applied topics such as spectroscopy, electrochemistry, and instrumental methods.

3.To raise awareness among students about environmental issues, including climate change, pollution, and waste management, and their impact on the quality of life.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Electrochemistry and Corrosion Science (9 Hours)** **Electrochemical Cell**- Electrode potential- Nernst equation for single electrode and cell (Numerical problems)- Reference electrodes – SHE & Calomel electrode –Construction and Working - Electrochemical series - Applications – Glass Electrode & pH Measurement-Conductivity- Measurement using Digital conductivity meter. Li-ion battery & H_2-O_2 fuel cell (acid electrolyte only) construction and working. **Corrosion** –Electrochemical corrosion mechanism (acidic & alkaline medium) - Galvanic series - Corrosion control methods - Cathodic Protection - Sacrificial anodic protection and impressed current cathodic protection – Electroplating of copper - Electroless plating of copper.	9

2	**Materials for Electronic Applications (9 Hrs)** **Nanomaterials** - Classification based on Dimension & Materials- Synthesis – Sol gel & Chemical Reduction - Applications of nanomaterials – Carbon Nanotubes, Fullerenes, Graphene & Carbon Quantum Dots – structure, properties & application. **Polymers** - Fire Retardant Polymers- Halogenated & Non-halogenated polymers (Examples only)- Conducting Polymers-Classification- Polyaniline & Polypyrrole-synthesis, properties and applications. **Organic electronic materials and devices**- construction, working and applications of Organic Light Emitting Diode (OLED) & Dye-Sensitized Solar Cells (DSSC) Materials used in Quantum computing Technology**,** Super capacitors, Spintronics	**9**
3	**Molecular Spectroscopy and Analytical Techniques (9 Hours)** **Spectroscopy**- Types of spectra- Molecular energy levels - Beer Lambert's law – Numerical problems - Electronic Spectroscopy – Principle, Types of electronic transitions –Role of conjugation in absorption maxima- Instrumentation-Applications – Vibrational spectroscopy – Principle- Number of vibrational modes - Vibrational modes of CO_2 and H_2O – Applications **Thermal Analysis**: Dielectric Thermal Analysis (DETA) of Polymers- Working and Application. **Electron Microscopic Techniques:** SEM - Principle, instrumentation and Applications.	**9**
4	**Environmental Chemistry (9Hrs)** **Water characteristics** - Hardness - Types of hardness- Temporary and Permanent - Disadvantages of hard water -Degree of hardness (Numericals) Water softening methods-Ion exchange process- Principle, procedure and advantages. Reverse osmosis – principle, process and advantages. – Water disinfection methods – chlorination-Break point chlorination, ozone and UV irradiation. Dissolved oxygen (DO), BOD and COD- Definition & Significance.	**9**

	Waste Management: Sewage water treatment- Primary, Secondary and Tertiary - Flow diagram -Trickling filter and UASB process. E Waste, Methods of disposal – recycle, recovery and reuse. Chemistry of climate change- Greenhouse Gases- Ozone Depletion-Sustainable Development- an introduction to Sustainable Development Goals.	

Self Study Topics (NOT TO BE INCLUDED FOR END SEMESTER EXAMINATION):

Construction, working and applications of Lead acid battery, Nickel cadmium battery and Nickel metal hybrid battery.

Course Assessment Method
(CIE: 40 Marks, ESE: 60 Marks)
Continuous Internal Evaluation Marks (CIE):

Continuous Assessment	Internal Examination-I (Written)	Internal Examination-II (Written)	Internal Examination-III (Written)	Lab Examination	Total
10	30	30	30	5	**40**
	A total of 90 marks will be scaled to 25.				

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions.

Part A	Part B	Total
● 2 questions from each module. ● Total of 8 questions, each carrying 3 marks **(8 x 3 = 24 Marks)**	● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 sub divisions. **(4 x 9 = 36 Marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply the basic concepts of Electrochemistry and corrosion to examine their possible applications in various engineering fields for creating clean energy.	**3**
CO2	Illustrate the use of analytical techniques for the synthesis and characterisation of different engineering materials for sustainable consumption and production.	**2**
CO3	Interpret the use of various engineering materials for the production of affordable and clean energy in different industries.	**4**
CO4	Analyse water treatment techniques and waste management methods to ensure the availability of water, a good climate and to maintain a sustainable life below water and on land.	**4**
CO5	Apply scientific principles in an engineering context, training students through hands-on learning.	**3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2			3						3		
CO2	2	2	2			3						3		
CO3	2	2				3						2		
CO4	2	2	2			3						2		
CO5	2	2	2	2	2	2		3	3	3	3	2		

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Engineering Chemistry	B. L. Tembe, Kamaluddin, M. S. Krishnan	NPTEL Web-book	2018
2	Physical Chemistry	P. W. Atkins	Oxford University Press	International Edition-2018
3	Instrumental Methods of Analysis	H. H. Willard, L. L. Merritt	CBS Publishers	7th Edition-2005
4	Engineering Chemistry	Jain & Jain	Dhanpath Rai Publishing Company	17th Edition - 2015

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fundamentals of Molecular Spectroscopy	C. N. Banwell	McGraw-Hill	4th edn., 1995
2	Principles of Physical Chemistry	B. R. Puri, L. R. Sharma, M. S. Pathania	Vishal Publishing Co	47th Edition, 2017
3	Introduction to Spectroscopy	Donald L. Pavia	Cengage Learning India Pvt. Ltd	2015
4	Polymer Chemistry: An Introduction	Raymond B. Seymour, Charles E. Carraher	Marcel Dekker Inc	4th Revised Edition, 1996
5	The Chemistry of Nanomaterials: Synthesis, Properties and Applications	Prof. Dr. C. N. R. Rao, Prof. Dr. h.c. mult. Achim Müller, Prof. Dr. A. K. Cheetham	Wiley-VCH Verlag GmbH & Co. KGaA	2014
6	Organic Electronics Materials and Devices	Shuichiro Ogawa	Springer Tokyo	2024
7	Principles and Applications of Thermal Analysis	Gabbot, P	Oxford: Blackwell Publishing	2008

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/104/106/10410617/ https://archive.nptel.ac.in/courses/113/105/11310512/ https://archive.nptel.ac.in/courses/113/104/11310402/ https://www.youtube.com/watch?v=BeSxFLvk1h0
2	https://archive.nptel.ac.in/courses/113/104/113104102/ https://archive.nptel.ac.in/courses/104/105/104105124/ https://archive.nptel.ac.in/courses/105/104/105104157/

Continuous Assessment (10 Marks)

Continuous assessment evaluations are conducted based on laboratory associated with the theory.

Mark distribution

1. Preparation and Pre-Lab Work (2 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (2 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. Lab Reports and Record Keeping (3 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. Viva Voce (3 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: *The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.*

Evaluation Pattern for Lab Examination (5 Marks)

1. Procedure/Preliminary Work/Conduct of Experiments (2 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

2. **Result (2 Marks)**

- Accuracy of Results: Precision and correctness of the obtained results.

3. **Viva Voce (1 Marks)**

- Proficiency in answering questions related to theoretical and practical aspects of the subject.

List of Experiments

***Minimum 10 Experiments**

Expt. Nos.	Experiment
1	Estimation of iron in iron ore
2	Estimation of copper in brass
3	Determination of cell constant and conductance of solutions
4	Calibration of pH meter and determination of pH of a solution
5	Synthesis of polymers (a) Urea-formaldehyde resin (b) Phenol-formaldehyde resin
6	Determination of wavelength of absorption maximum and colorimetric estimation of Fe^{3+} in solution
7	Determination of molar absorptivity of a compound (KMnO4 or any water-soluble food colorant)
8	Analysis of IR spectra
9	Identification of drugs using TLC
10	Estimation of total hardness of water-EDTA method

11	Estimation of dissolved oxygen by Winkler's method
12	Determination of calorific value using Bomb calorimeter
13	Determination of saponification value of a given vegetable oil
14	Determination of acid value of a given vegetable oil
15	Verification of Nernst equation for electrochemical cell.

SEMESTER -2

ENGINEERING MECHANICS

Course Code	**G25MHT204**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Nil	**Course Type**	Theory

Course Objectives:

1.To enable students to analyze basic mechanics problems and apply a vector-based approach to solve them.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to statics: Introduction to branches of mechanics, concept of rigid body scalars and vectors, vector operations, forces in space. Support reactions of beams (point load and UDL on Simply supported and cantilever beams) Force systems: Rectangular components in 2D and 3D, moment and couple, resultants Equilibrium: system isolation and the free-body diagram, equilibrium conditions 2D and 3D	**10**
2	Friction: -Laws of friction – analysis of blocks and ladder Centroid of composite areas- – moment of inertia- parallel axis and perpendicular axis theorems. Polar moment of inertia, radius of gyration, mass moment of inertia-ring and disc	10
3	Dynamics – Rectilinear translation - equations of motion in kinematics and kinetics – D'Alembert's principle. – motion on horizontal and inclined surfaces, motion of connected bodies. Combined motion of translation and rotation.	**8**

4	Mechanical vibration - Free and forced vibration, degree of freedom. Simple harmonic motion - spring mass model,period, stiffness, frequency, simple numerical problems of single degree of freedom	**8**

Course Assessment Method
(CIE: 40 Marks, ESE: 60 Marks)
Continuous Internal Evaluation Marks (CIE):

Assignment (Activity based)	Internal Examination-I (Written)	Internal Examination-II (Written)	Internal Examination-III (Written)	Total
15*	30	30	30	
	A total of 90 marks will be scaled to 25.			**40**

*One or more assignments should be given, and the total marks should be consolidated and converted to 15 as per revised evaluation guidelines.

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions.

Part A	Part B	Total
● 2 questions from each module. ● Total of 8 questions, each carrying 3 marks **(8 x 3 = 24 Marks)**	● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 sub divisions. **(4 x 9 = 36 Marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand and represent forces, moments, and equilibrium conditions using vector methods	**K2**
CO2	Apply the laws of friction, centroid, and moment of inertia in solving engineering problems	**K3**
CO3	Solve problems related to kinematics and kinetics of particles and rigid	**K3**

	bodies in rectilinear and curvilinear motion.	
CO4	Analyze rotational motion, projectile motion, and rigid body dynamics using appropriate principles	**K3**
CO5	Demonstrate practical application of mechanics principles through activity-based tasks such as lab experiments, model building, case studies, or mini-projects involving friction analysis	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3				2						2		
CO2	3	3				2						2		
CO3	3	3				2	2				2	2		
CO4	3	3				2	2				2	2		
CO5			3	3	2			3			3	2		

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Engineering Mechanics	Timoshenko and Young	McGraw Hill Publishers	5th Edition 2017
	Engineering Mechanics: Combined Statics and Dynamics	Russell C. Hibbeler	Pearson Education	14th Edition 2015
	Engineering Mechanics - Statics and Dynamics	Shames, I. H.	Prentice Hall of India	4th Edition 2008

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Engineering Mechanics Statics	J . L. Meriam, L. G. Kraige	Wiley	9th Edition 2020
2	Engineering Mechanics	Chandramouli	PHI Learning	2011

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/112106286/2
2	https://nptel.ac.in/courses/112106286 3
3	https://nptel.ac.in/courses/112106286 4
4	https://nptel.ac.in/courses/112106286

SEMESTER -2
PROGRAMMING IN C

Course Code	**G25PCE206**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:2:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. To prepare learner to write versatile C programs for solving computational problems that they come across in their professional life.

2. To equip the learner to write efficient C programs using suitable language constructs to solve real world computational problems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**C Fundamentals** - Character Set, Constants, Identifiers, Keywords, Basic Data types, Variables, Operators and its precedence, Bit-wise operators, Expressions; Statements - Input and Output statements; Structure of a C program; Simple programs. **Control Statements** - if, if-else, nested if, switch, while, do-while, for, break & continue, nested loops.	**9**
2	**Arrays** - Single dimensional arrays, Defining an array, Array initialization, Accessing array elements; Enumerated data type; Type Definition; Two-dimensional arrays – Defining a two-dimensional array; Programs for matrix processing; Programs for sequential search; Bubble sort; **Strings** - Declaring a string variable, Reading and displaying strings, String	**9**

	related library functions – Programs for string matching.	
3	**Functions** - Function definition, Function call, Function prototype, Parameter passing; Recursion; Passing array to function; Macros - Defining and calling macros; Command line Arguments. **Structures** - Defining a Structure variable, Accessing members, Array of structures, Passing structure to function; Union. **Storage Class** - Storage Classes associated with variables: automatic, static, external and register.	**9**
4	**Pointers -** Declaration, Operations on pointers, Passing pointer to a function, Accessing array elements using pointers, Processing strings using pointers, Pointer to pointer, Array of pointers, Pointer to function, Pointer to structure, Dynamic Memory Allocation. **Files**- Different types of files in C, Opening & Closing a file, Writing to and Reading from a file, Processing files, Library functions related to file – fseek(), ftell(), fread(), fwrite().	**9**

Course Assessment Method
(CIE: 40 Marks, ESE: 60 Marks)
Continuous Internal Evaluation Marks (CIE):

Assignment (Activity based)	**Internal Examination-I (Written)**	**Internal Examination-II (Written)**	**Internal Examination-III (Written)**	**Total**
15*	30	30	30	
	A total of 90 marks will be scaled to 25.			**40**

*One or more assignments should be given, and the total marks should be consolidated and converted to 15 as per revised evaluation guidelines.

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions.

Part A	Part B	Total
● 2 questions from each module. ● Total of 8 questions, each carrying 3 marks **(8 x 3 = 24 Marks)**	● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 sub divisions. **(4 x 9 = 36 Marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Interpret a given computational problem and construct C programs using basic constructs, including control statements, to demonstrate understanding of fundamental programming concepts	**2**
CO2	Implement C programs that utilize arrays, matrices, and strings to solve computational problems and manipulate data effectively	**3**
CO3	Apply functions to solve computational problems by modularizing them into multiple components and utilizing abstract data types	**3**
CO4	Implement C programs using pointers and file handling for efficient data management.	3
CO5	Analyze, document, and communicate debugging processes and solutions in C programs effectively, producing clear reports and presentations that enhance program reliability and efficiency.	**4**

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Programming with C	Byron S Gottfried	Mc Graw Hill Education	4th Edition July 2018
2	The C Programming Language	Brian W. Kernighan and Dennis Ritchie	Pearson	2nd Edition January 2015
3	C The Complete Reference	Herbert Schildt	Mc Graw Hill Education	4th Edition July 2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Programming In Ansi C	E Balagurusamy	Mc Graw Hill	8th Edition March 2019
2	Programming in C	Kamthane	Pearson	3rd Edition January 2015
3	Let us C	Yashavant Kanetkar	Bpb publishers	19th Edition December 2022
4	Computer Programming in C	V Rajaraman	PHI Learning Private Limited	2nd July 2019

SEMESTER S2
ENGINEERING ENTREPRENEURSHIP AND IPR

Course Code	A25IPT207	**CIE Marks**	40
Teaching Hours/Week (L:T:P:R)	3:0:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. and 30 Mins.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objective:

1. Develop a framework for identifying, curating and validating engineering-based business ideas.
2. Learn essential tools for understanding product-market fit and customer needs.
3. Create a comprehensive business plan for a new venture.
4. Gain foundational knowledge of Intellectual Property Rights (IPR) and their importance for startups.
5. Develop skills for prototyping, stakeholder engagement, and team collaboration

SYLLABUS

Module No.	Description	Contact Hours
1	**Introduction to Ideation, Innovation & Entrepreneurship** What is Ideation? Understanding Innovation, Frameworks for Innovation, The Entrepreneurial Mindset, Starting a Business, types formation statutory compliances, Resources for Aspiring Entrepreneurs **Introduction to Intellectual Property Rights (IPR)** Types of IPR: Patents, trademarks, copyrights, trade secrets, Strategies for protecting intellectual property based on the type of innovation, Role of IPR in securing funding and competitive advantage **Importance of building a strong team** Identifying roles, Skill sets, Team dynamics **Identifying Pain Points and problem statement** Idea Generation Techniques, Developing and Refining Ideas, develop strategies for bringing your innovation to life	9
2	**Problem and solution canvas preparation** Orientation and canvas introduction, Customer needs assessment, Market segmentation, Value proposition, Competitive analysis, Market entry strategy, Market validation, Regulatory and legal considerations **Customer profiling** Review of market research, Customer segmentation, Customer profiling, Persona development, Validation and feedback, Prioritisation and selection, Communication and messaging	9

	Competitor analysis Identify competitors, Competitor profiling, SWOT analysis, Market positioning, Customer feedback and reviews, Pricing analysis, Differentiation strategy, Benchmarking and improvement	
3	**Business plan preparation** Business plan framework, Market analysis, Product/ service description, Marketing and sales strategy, Operations plan, Financial projections, Risk management **Prototype development plan preparation** Prototype requirements analysis, technical specifications, Development approach, Development timeline, Resource allocation, Testing and quality assurance, Iterative development and feedback loop, Documentation and version control	9
4	**Prototype development Stakeholder engagement strategies** Investors, Partners, Customers, Advisors & Mentors	9

Course Assessment Method
(CIE: 60 Marks, ESE: 40 Marks)

Continuous Internal Evaluation Marks (CIE):

Micro Project	Internal Examination-I (Written)	Internal Examination-II (Written)	Internal Examination-III (Written)	Total
40	30	30	30	**60**
	Average of best two and then convert to 20			

Micro project / Comprehensive Business Plan:

The course will be evaluated based on a comprehensive Business Plan Report submitted and prototype development evaluation at the end of the course. The report should integrate learnings and activities from each module, demonstrating a deep understanding of the concepts and your ability to apply them to a chosen engineering venture.

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions.

Part A	Part B	Total
● Minimum 1 and Maximum 2 Questions from each module ● Total of 6 questions, each carrying 2 marks **(6 x 2 = 12 Marks)**	● Each question carries 7 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 sub divisions. **(4 x 7 = 28 Marks)**	**40**

Course Outcomes (Cos)

At the end of the course students should be able to:

CO No.	Description	Blooms Knowledge Level (KL)
CO1	Gain foundational knowledge of Innovation and Entrepreneurship, Intellectual Property Rights (IPR) and their importance for startups	2
CO2	Develop a framework for identifying, curating and validating engineering-based business ideas.	3
CO3	Learn essential tools for understanding product-market fit and customer needs.	3
CO4	Create a comprehensive business plan for a new venture.	6
CO5	Develop skills for prototyping, stakeholder engagement, and team collaboration.	4

Note: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyse, K5 – Evaluate, and K6 – Create

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO2	PSO3
CO1	2		3	3					3			3		
CO2	2	2	3	3	3	3	3	3	3			3	3	2
CO3	2			2	3			3			2		2	3
CO4	3			3			3	3	3	3	2			
CO5	3	3		3			3	3	3	3	2			3

Text Books

Sl. No.	Title of the Book	Name of the Author(s)	Name of the Publisher	Edition and Year
1	The Engineering Handbook	Richard C Dorf	CRC Press	2nd Edition, 2004
2	The Innovator's DNA	Clayton M. Christensenand Jeffrey H. Dyer	Harward Business Review Press	Revised Edition (June 4, 2019)
3	Start with Why	Simon Sinek	Portgolio	Reprint Edition (December 27, 2011)
4	Business Model Generation	Alexander Osterwalder & Yves Pingneur	Wiley	2010
5	The Engineering Entrepreneur: A Practical Guide to Starting	Saibal Gupta and Ashok	Sage Publications	2011

	and Running a Successful Engineering Business in India	Jhunjhunwala		
6	Innovation and Entrepreneurship for Engineers	Bharat Bhushan and Seema Bhushan	CRS Press	2016
7	Indian Patent Law	P. Narayanan	Eastern Book Company	2nd Edition 2020
8	The Law of Copyright and Designs	B.L. Wadehra	Universal Law	5th Edition, 2010
9	Intellectual Property Rights (Including IPR in the Digital Age)	Prabuddha Ganguli	Tata McGraw-Hill Education	2001
10	The Startup India Manifesto: A Guide to the Indian Startup Ecosystem	Rashmi Bansal and Deepinder Goyal	Westland Publications	2020

SEMESTER S2
LIFE SKILLS AND PROFESSIONAL COMMUNICATION

Course Code	G25LST208	**CIE Marks**	100
Teaching Hours/Week (L:T:P:R)	2:0:1:0	**ESE Marks**	0
Credits	1	**Exam Hours**	-
Prerequisites (if any)	None	**Course Type**	Activity-based learning

Course Objective:

1. To foster self-awareness and personal growth, enhance communication and interpersonal connection skills, promote effective participation in groups and teams, develop critical thinking, problem-solving, and decision-making skills, and cultivate the ability to exercise emotional intelligence.
2. To equip students with the necessary skills to listen, read, write & speak, to comprehend and successfully convey any idea, technical or otherwise.
3. To equip students to build their profile in line with the professional requirements and standards.

Continuous Internal Evaluation Marks (CIE):

- Continuous internal evaluation is based on the individual and group activities as detailed in the activity table given below.
- The students should be grouped into groups of size 4 to 6 at the beginning of the semes ter. They should use online collaboration tools for group activities, report/presentation making and work management.
- Activities are to be distributed between 3 class hours (2L+1P) and 3.5 Self-study hours.
- Marks given against each activity should be awarded fully if the students successfully complete the activity.
- Students should maintain a portfolio file with all the reports and other textual materials generated from the activities. Students should also keep a journal related to the activities undertaken.
- Portfolio and journal are mandatory requirements for passing the course, in addition to the minimum marks required.
- The portfolio and journal should be carried forward and displayed during the 7th Semester Seminar course as a part of the experience sharing regarding the skills developed through the HMC courses and Mini project course.
- Self-reflection questionnaire shall be given at the beginning of the semester, in between and at the end of the semester based on the guidelines in the manual of the course.

Table 1: Activity List

Sl. No.	Activity	Class room (L) / Self Study (SS)	Week of completion	Group / Individual (G/I)	Marks	Skills	CO
1.1	Group formation and self-introduction among the group	L	1	G	-	Connecting with	

	members					group members	
1.2	Familiarizing the activities and preparation of the time plan for the activities	L	1	G	-	Time management – Gantt Chart	
1.3	Preparation of Gantt chart based on the time plan	SS	1	G	2		
2.1	Take an online personality development test, self-reflect and report	SS	1	I	2	Self-Awareness writing	CO1
2.2	Role-storming exercise 1: Students assume 2 different roles given below and write about their ● Strengths, ● Areas for improvement, ● Concerns, ● Areas in which he/she hesitates to take advice, ● Goals/Expectations, from the point of view of the following assumed roles i) their parent/guardian/mentor ii) their friend/sibling/cousin	L	1	I	2	Goal setting - Identification of skills and setting goal Self-awareness Discussion in groups Group work- Compiling of ideas Mind mapping	CO1
2.3	Role-storming exercise 2: Students assume the role of their teacher and write about the ● Skills required as a B.Tech graduate ● Attitudes, habits, approaches required and activities to be practised during their B.Tech years, in order to achieve the set goals	SS	1	I	2		CO1`
2.4	Discuss the skills identified through the role-storming exercise by each one within their own group and improvise the list of skills	L	1	G	2		CO1
2.5	Prepare a mind map based on the role-storming exercise and exhibit/present it in class	SS	2	G	2		CO1
3	Prepare a presentation on instances of empathy they have observed in their own life or in others' lives.	L	2 to 4	I	2	Empathy	CO2
4.1	Each student connects and networks with a minimum of 3 professionals from industry/public sector organizations/other agencies/NGOs /academia (at least 1 through LinkedIn)	SS	3	I	2	Workplace awareness · Listening · Communication – interacting with people · Networking	
4.2	Interact with them to understand their workplace details including ● workplace skills required ● their work experience ● activities	SS	3	I	4		CO2

	they have done to enhance their employability during their B.Tech years ● suggestions on the different activities to be done during B.Tech years Prepare a documentation of this					through various media including LinkedIn · Discussion in groups · Report preparation · Creativity Goal setting - Prep aration of action plan	
4.3	Discuss the different workplace details & work readiness activities assimilated by each through the interactions within their group and compile the inputs collected by the individuals Prepare the Minutes of the discussions	SS	3	G	2		CO2
4.4	Report preparation based on the discussions	SS	4	G	3		CO4
4.5	Perform a role-play based on the work place dynamics assimilated through interactions and group discussions	L	5	G	4		CO3
4.6	Identify their own goal and prepare an action plan for their undergraduate journey to achieve the goal	SS	5	I	2		CO1
5.1	Select a real-life problem that requires a technical solution and list the study materials needed	L	6	G	2		CO3
5.2	Listen to TED talks & video lectures from renowned Universities related to the problem and prepare a one-page summary (Each group member should select a different resource)	SS	6	1	2		CO4
5.3	Use any online tech forum to gather ideas for solving the problem chosen	SS	6	G	2		CO5, CO4
5.4	Arrive at a possible solution using six thinking hat exercise	L	7	G	3		CO3
5.5	Prepare a report based on the problem-solving experience	SS	7	G	2		CO4
6.1	Linkedin profile creation	SS	1	I	2	Profile-building	CO6
6.2	Resume preparation	SS	8	I	2		CO6
6.3	Self-introduction video	SS	8	I	3		CO6
7	Prepare a presentation on instances of demonstration of emotional intelligence	SS	9	I	2	Emotional intelligence	CO2
8	Prepare a short video presentation on diversity aspects observed in our society (3 to 5	SS	10	G	3	Diversity	CO2, CO5

	minutes)						
9	Take online Interview skills development sessions like robotic interviews; self-reflect and report	SS	10	I	2	Interview skills	CO6
10	Take an online listening test, self-reflect and report	SS	11	1	2	Listening skills	CO6
11.1	Activities to improve English vocabulary of students	L	8	I/G	4	English vocabulary English language skills Writing Presentation Group work Self-reflection	CO4
11.2	Activities to help students identify errors in English language usage	L	9	I/G	2		CO4
11.3	Activity to help students identify commonly misspelled words, commonly mispronounced words and confusing words	L	10	I/G	2		CO4
11.4	Write a self-reflection report on the improvement in English language communication through this course	SS	12	I	2		CO4
11.5	Presentation by groups on the experience of using online collaboration tools in various group activities and time management experience as per the Gantt chart prepared	L	11 to 12	G	2		
12.1	Each group prepares video content for podcasts on innovative technological interventions/research work tried out in Kerala context by academicians/professionals/Govt. agencies/research institutions/private agencies/NGOs/other agencies	SS	12	G	4	Audio-visual presentations creations with the use of technology tools Effective use of social media platforms Profile building	CO2, CO4, CO5
12.2	Upload the video content to podcasting platforms or YouTube	SS	12	G	1		CO5
12.3	Add the link of the podcast in their LinkedIn profile	SS	12	G	1		CO5

Table 2: Lab hour activities: 24 Marks

Sl. No.	Activity	Marks	Skill	CO
1	Hands-on sessions on day-to-day engineering skills and a self-reflection report on the experience gained: 1. Drilling practice using electric hand drilling machines. 2. Cutting of MS rod and flat using electric hand cutters.	24	Basic Practical engineering skills	3

	3. Filing, finishing and smoothening using electrically operated hand grinders. 4. MS rod cutting using a hacksaw by holding the work in a bench vice. 5. Study and handling of different types of measuring instruments. 6. Welding of MS and SS workpieces. 7. Pipe bending practice (PVC and GI). 8. Water tap fitting. 9. Water taps rubber seal changing practice. 10. Union and valve connection practice in pipes. 11. Foot valve fitting practice. 12. Water pump seal and bearing changing practice.			
2	Language Lab sessions	-	Language Skills	4

Course Outcomes (Cos)

At the end of the course students should be able to:

CO No.	Description	Blooms Knowledge Level (KL)
CO1	Apply self-awareness strategies to demonstrate confidence in one's abilities; implement goal-setting and planning techniques; and practice emotional intelligence, empathy, responsibility, and respect for diversity while working effectively in collaborative environments.	3
CO2	Apply critical thinking, problem-solving, and decision-making techniques to address personal, academic, and professional situations effectively.	3
CO3	Apply listening, reading, writing, and speaking skills to comprehend, interpret, and communicate ideas effectively using textual, audio, and visual modes.	3
CO4	Apply audio-visual and digital tools to develop professional presentations and profiles aligned with industry standards, and actively engage in networking through social media platforms and professional forums.	3
CO5	Apply basic engineering knowledge, systematic problem identification, analytical thinking, and structured investigation techniques to examine a real-life engineering-related problem, explore possible solutions, and document findings using appropriate reports and presentations.	3

Note: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyse, K5 – Evaluate, and K6 – Create

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1							3	3		2	2			
CO2						2	2	2			2			
CO3								2	2					
CO4									3					
CO5	1	3		2	2				3	2	3			

Text Books

Sl. No.	Title of the Book	Name of the Author(s)	Name of the Publisher	Edition and Year
1	Life Skills & Personality Development	Maithry Shinde et.al.	Cambridge University Press	First Edition, 2022
2	Emotional Intelligence: Why it can matter more than IQ	Daniel Goleman	Bloomsbury, Publishing PLC	25th Anniversary Edition December 2020
3	Think Faster, Talk Smarter: How to speak successfully when you are put on the spot	Matt Abrahams	Macmillan Business	September 2023
4	Deep Work: Rules for focused success in a distracted world	Cal Newport	PIATKUS	January 2016
5	Effective Technical Communication	Ashraf Rizvi	McGraw Hill Education	2nd Edition 2017
6	Interchange	Jack C. Richards, With Jonathan Hull, Susan Proctor	Cambridge publishers	5th Edition

Reference Books

Sl. No.	Title of the Book	Name of the Author(s)	Name of the Publisher	Edition and Year
1	Life Skills for Engineers	Remesh S., Vishnu R.G.	Ridhima Publications	First Edition, 2016
2	Soft Skills & Employability Skills	Sabina Pillai and Agna Fernandez	Cambridge University Press	First Edition, 2018
3	Effective Technical Communication	Ashraf Rizvi	McGraw Hill Education	2nd Edition 2017
4	English Grammar in Use	Raymond Murphy,	Cambridge University Press India PVT LTD	5th Edition 2023
5	Guide to writing as an Engineer	David F. Beer and David McMurrey	John Willey. New York	2004

SEMESTER-2
IT WORKSHOP

Course Code	**G25ITP210**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	0:0:2:0	**ESE Marks**	50
Credits	1	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Lab

Course Objectives:

1.To provide a basic understanding about computer hardware, software, and computer network.

2.To familiarize the learner with the web development process using HTML, CSS, and Javascript.

Details of Experiment

Expt. No	Experiment (Minimum 10 Experiments)
1	Practice Computer Hardware – Familiarization CPU Box, Motherboard, CPU & Chip-set, Interface cards, Card slots, Hard disk, Cables, SMPS, NIC, Various ports, etc. Computer Peripherals - I/O Devices. Storage devices, Interface cards – Buses – Firmware
2	Familiarization of Boot process
3	Familiarizing installation of Linux and Windows operating systems
4	Familiarizing basic Unix/Linux commands - ls, mkdir, cp, mv, grep, rmdir, chmod, useradd, passwd, history, dmesg, cpuinfo, uname, du, time, write, fdisk
5	Familiarizing networking hardware - RJ45, UTP, fibre, switch, NIC, router, Wireless Access Point (WAP), modem
6	Familiarizing basic networking commands - ifconfig, ping, traceroute, nslookup, ssh, scp, telnet, ftp
7	View network traffic using Wireshark/Packet tracer

8	Familiarizing the steps how to configure and establishing a network connecting
9	Shell programming in Linux(bash)
10	Create a web page and deploy on a local web server.
11	Use Javascript to validate forms.
12	Create an image slider using HTML, CSS, and JavaScript. Allow users to navigate between images using previous and next buttons.
13	Familiarisation of LaTeX - Basic only
14	Familiarisation of Development Environments - Visual studio code, Sublime Text, Atom
15	Introducing Repositories - Git / Bitbucket

Course Assessment Method (CIE: 50 Marks, ESE 50 Marks)

Continuous Internal Evaluation Marks (CIE):

Preparation/Pre-Lab Work, experiments, Viva and Timely completion of Lab Reports / Record. (Continuous Assessment)	**Total**
50	**50**

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	**Conduct of experiment/ Execution of work/ troubleshooting/ Programming**	**Result with valid inference/ Quality of Output**	**Viva voce**	**Record**	**Total**
10	**20**	**5**	**10**	**5**	**50**

Mandatory requirements for ESE:

- Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.

Course Outcomes (COs)

At the end of the course the student will be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Experiment with the fundamental hardware components of a computer and how to interface them with software systems.	**K3**
CO2	Make use of the command line of Linux operating system and shell programming.	**K3**
CO3	Experiment with the data network communication scenarios using Wireshark.	**K3**
CO4	Develop basic websites using HTML, CSS & JavaScript and manage the versions.	**K3**
CO5	Design and develop a mini-project, such as a dynamic web page or an interactive web application, integrating front-end and back-end technologies.	**K6**

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO2	PSO3
CO1	2	2			2	2					3	2		
CO2	2	3			2	2					3	2		
CO3	2	3			3	2		2			3	2		
CO4	2	2	3	3	3			3			3	2		
CO5	2	3		3	3	3	3	3	3	3	3	2		

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Invitation to Computer Science	G.Michael Schneider, Judith Gersting	Cengage	2/e, 2020
2	LINUX for Developers: Jumpstart Your Linux Programming Skills	William Rothwell	Person	1/e, 2018
3	HTML, CSS, and JavaScript All in One, Sams Teach Yourself	Julie C. Meloni Jennifer Kyrnin	Pearson	1/e, 2018

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	The Architecture of Computer Hardware, Systems Software, & Networking: An Information Technology Approach	Irv Englander	Wiley	5/e, 2014
2	Mastering Git : Attain expert level proficiency with Git for enhanced productivity and efficient collaboration	Jakub Narębski	Packt	1/e, 2016
3	Web Design with HTML, CSS, JavaScript and Jquery	Jon Duckett	Wiley	1/e, 2014

Video Links (NPTEL, SWAYAM…)	
Sl. No.	**Link ID**
1	https://overthewire.org/wargames/bandit/
2	https://www.w3schools.com/

SEMESTER -2
INTRODUCTION TO IDEA LAB AND DIGITAL TWIN TECHNOLOGY
(Common to All Groups)

Course Code	A25ILE211	**CIE Marks**	50
Teaching Hours/Week (L:T:P:R)	1:0:2:0	**ESE Marks**	-
Credits	2	**Exam Hours**	-
Prerequisites (if any)	None	**Course Type**	Theory + Lab

Course Objective:

1. To introduce the fundamentals of innovation, Design Thinking, and the Idea Lab ecosystem.
2. To enable students to translate ideas into functional prototypes using Idea Lab tools.
3. To impart basic concepts, architecture, and applications of Digital Twin Technology.
4. To provide hands-on experience in modelling, simulating, and visualizing a basic Digital Twin.
5. To Empower students to solve real-life problems through Project-Based Learning and present validated prototypes.

SYLLABUS

Module No.	Description	Contact Hours
1	**MODULE I- (6 Hrs) Introduction to Idea Lab & Design Thinking** **Introduction to Idea Lab & Design Thinking** **IDEA Lab:** Objectives, structure, interdisciplinary innovation culture. **Design Thinking Basics:** Empathize → Define → Ideate → Prototype → Test. **Problem Identification:** Observation, need analysis, pain–gain chart. **Lab Activity:** Students (3 per team) identify one problem statement and generate two solution ideas. Familiarization with IDEA Lab Equipment (3D printer, laser cutter, basic electronics bench, IoT kit).	6
2	**MODULE II (6 Hrs): Basic Prototyping in IDEA Lab** Additive Manufacturing: CAD (Computer-Aided Design) basics, 3D printing workflow (Design, Slice, Print). **Lab Activity:** IoT Kit based sensing and control in a physical prototype. 3D Printing based on CAD modelling software. Assignment 1: Build a basic functional or visual prototype using at least two different IDEA Lab tools (e.g., a 3D printed housing with simple sensor circuits).	6
3	**MODULE 3 (6 Hrs):** **Digital Twin Fundamentals:** Definition, DT vs. Simulation, DT Components & Architecture. Types of DTs (Product, Operation, & Process). **Lab Activity: Modelling & Simulation for DT:** Introduction to DT/Simulation tools -MATLAB/Simulink Digital Twin, Any Logic, Node-RED, Unity, Blender, Autodesk Fusion 360 (Any two tools) **Assignment II- Basic DT Simulation: Develop** a basic DT simulation. Task involves creating a virtual model and linking it to mock data to demonstrate state changes (e.g., Virtual object behaviour simulation, or environmental parameter twin).	6

4	**MODULE 4 (6 Hrs): Micro Project** **Project Management & Presentation:** Basics of technical report writing, data visualization, and technical presentation skills for project pitching. Lab Activity: **Micro Project:** The team (3 Members) integrates their Idea Lab prototype with its Digital Twin model. Demonstration of the physical model and the virtual model synchronizing via data.	6

Course Assessment Method
(CIE: 40 Marks, ESE: 60 Marks)
Continuous Internal Evaluation Marks (CIE):

Assignment I (Practical)	Assignment II (Practical)	Internal Lab Examination	Micro Project	Total
10	10	15	15	50

Course Outcomes (Cos)

At the end of the course students should be able to:

CO No.	Description	Blooms Knowledge Level (KL)
CO1	Explain the role of Idea Lab in promoting creativity, design thinking, and interdisciplinary innovation.	2
CO2	Apply structured problem identification, ideation, and concept development methods.	3
CO3	Demonstrate basic prototyping skills using common Idea Lab tool	4
CO4	Understand the architecture, components, and applications of Digital Twin systems.	2
CO5	Develop simple digital models and analyse them through simulations using suitable software.	4
CO6	Create a micro-project combining Idea Lab and Digital Twin concepts.	6

Note: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyse, K5 – Evaluate, and K6 - Create

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2								2	3		
CO2	3	3	2								2	2		
CO3	3	3	2								2	3	3	
CO4	3	3	2			2		2	3		2	2	2	
CO5	3	3	2			2		2	2		2	2	2	
CO6	3	3	2			2		2	2		2	2	2	

Text Books

Sl. No.	Title of the Book	Name of the Author(s)	Name of the Publisher	Edition and Year
1	Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation,	Tim Brown	HarperCollins,	2nd Edition, 2019
2	Digital Twin: A Complete Guide	John Stark	Springer	1st Edition, 2019
3	Digital Twin for Industry 4.0 Applications	Arun Solanki, Parag Kulkarni & Debasis Samanta	CRC Press, 2023.	1st Edition, 2023

Reference Books

Sl. No.	Title of the Book	Name of the Author(s)	Name of the Publisher	Edition and Year
1	Digital Twin Driven Smart Design	Jorge L. Hurtado	Elsevier	1st Edition, 2021
2	Digital Twin Technologies: A Primer for Engineers and Researchers	Saad Albahlal	Wiley	1st Edition, 2022
3	AICTE IDEALAB Handbook		AICTE, New Delhi	2022

Video Links (NPTEL, SWAYAM, etc.)

Module No.	Link
1	Design thinking https://nptel.ac.in/courses/110106124?utm
3	Lec 31: - Digital Twin https://www.youtube.com/watch?v=3cCOB_W1CH0&t=7s Dr. Debabrata Sikdar Dept. of Electronics and Electrical Engineering IIT Guwahati

PROGRAMME CORE 1

SEMESTER -2

MEASUREMENTS AND INSTRUMENTATION

Course Code	**E25MIT207**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Nil	**Course Type**	PC-Theory

Course Objectives:

1. To introduce the concepts of electrical measurement systems and instrumentation.
2. To discuss the principles of operation and construction of basic instruments for measuring circuit parameters, magnetic quantities, and passive parameters using bridge circuits, sensors, and transducers.
3. To introduce modern digital instrumentation systems.

Module No.	Syllabus Description	Contact Hours
1	Functional Elements of Measurements Systems- Block Schematic and brief operation of building blocks Standards of Measurements- Static characteristics (accuracy, precision, linearity, resolution), Need for calibration, Types of errors Instruments- Classification; Operating Forces and Torques: deflecting, controlling and damping torques- Gravity and spring control; air, fluid friction and eddy current damping. Measurement of Voltage and Current- Moving Coil and Moving Iron types., Range Extension – shunts and multipliers (Include simple problems of range extension)	**11**

2	Magnetic Measurement- Flux Meter, Determination of BH Curve - Hysteresis Loop (Method of Reversal). Measurement of Resistance, Wheatstone's Bridge, Kelvin's Double Bridge (Simple Problems), Loss of Charge Method, Measurement of Earth Resistance. Measurement of Inductance- Maxwell's Inductance Bridge, Measurement of Capacitance - Schering's Bridge, Measurement of Frequency- Wien Bridge (Include Simple Problems) Q-meter, LCR Meters (Description only)	**11**
3	Measurement of Power and Energy: Measurement of Power using Dynamometer type wattmeter, Three phase Power Measurement using Two Wattmeter Method (Include Phasor Diagrams and Expressions, Include simple problems of two wattmeter method) Measurement of Energy Using Induction type Energy Meter, Two Element Energy Meter Instrument Transformers-CT and PT- Principle of Operation- Range Extension Basic Principles of Electronic Multimeter, Digital Voltmeter Digital Energy Meter, TOD Meter, Smart Metering, Bidirectional Meters (Description Only)	**11**
4	Block Schematic of electronic instrumentation system – role of sensors and transducers Classification of Temperature transducers- Principle of operation of Thermistors and RTD Classification of flow transducers- Principle of operation of Electromagnetic and ultrasonic types Strain gauge: Basic working principle, types and applications; Measurement of angular speed and luminous intensity Principles of Digital Data Acquisition systems - Role of Signal conditioning systems (Basic Principles only)- Phasor Measurement Unit (Block Schematic and Description Only) CRO, DSO and Harmonic Analyzers: Block Diagram, Basic Principles and applications only Virtual Instrumentation Systems: Block schematic and Description only IOT and Data analytics for Industrial Process- Case study on Smart Grid	**11**

Course Assessment Method
(CIE: 40 Marks, ESE: 60 Marks)
Continuous Internal Evaluation Marks (CIE):

Assignment (Activity based)	**Internal Examination-I (Written)**	**Internal Examination-II (Written)**	**Internal Examination-III (Written)**	**Total**
15*	30	30	30	
	A total of 90 marks will be scaled to 25.			**40**

*One or more assignments should be given, and the total marks should be consolidated and converted to 15 as per revised evaluation guidelines.

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions.

Part A	**Part B**	**Total**
● 2 questions from each module. ● Total of 8 questions, each carrying 3 marks **(8 x 3 = 24 Marks)**	● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 sub divisions. **(4 x 9 = 36 Marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply measurement principles to classify various parameters of instruments and analyze errors to enhance accuracy in energy applications	**K3**
CO2	Select appropriate instruments for measuring electrical and magnetic quantities to optimize energy efficiency and resource utilization in sustainable systems.	**K3**
CO3	Choose and analyze the applications of sensors and transducers for energy-efficient measurement systems, promoting responsible resource consumption.	**K4**
CO4	Carryout system level design of modern digital measurement systems.	**K3**
CO5	Develop and implement a mini-project using transducers for measuring physical quanitites to address sustainability challenges in energy and resource management.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	**3**	**3**										**3**		
CO2	**3**	**3**										**3**		
CO3	**3**	**3**										**3**		
CO4	**3**	**3**										**3**		
CO5	**3**	**3**	**2**	**2**	**3**	**3**		**3**	**3**	**3**	**2**	**3**	**3**	**3**

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	A course in Electrical and Electronic Measurements & Instrumentation	K. Sawhney	Dhanpat Rai & Co.	2023
2	A course in Electrical & Electronic Measurement & Instrumentation	J. B. Gupta	S K Kataria & Sons	14th Ed., 2014
3	Electrical Measurements & Measuring Instruments	Golding E.W and Widdis	Wheeler Pub.	3rd Ed.,2011
4	Electronic Instrumentation	H. S. Kalsi	McGraw Hill, New Delhi	4th Ed., 2019
5	Principles of Electrical Measurement	S Tumanski	Taylor & Francis.	2006

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Modern Electronic Instrumentation and Measurement Techniques	Albert D. Helfrick, Cooper William D	Prentice Hall of India	2016
2	Basic Electrical Measurements	Stout M.B	Prentice Hall	2012
3	Electronic Measurements & Instrumentation	Oliver & Cage	McGraw Hill	2017
4	Doebelin's Measurements Systems	E.O Doebelin and D.N Manik	McGraw Hill Education (India) Pvt. Ltd.	7th Ed., 2019
5	Electrical and Electronics Measurements and Instrumentation	P.Purkait, B.Biswas, S.Das and C. Koley	McGraw Hill Education (India) Pvt. Ltd.,	2013

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/108/105/108105153/ 1
2	https://archive.nptel.ac.in/courses/108/108/108108147/ 2
3	https://archive.nptel.ac.in/courses/108/105/108105153/ https://archive.nptel.ac.in/courses/108/105/108105153/ 3
4	https://archive.nptel.ac.in/courses/108/108/108108147/ 4 https://archive.nptel.ac.in/courses/106/105/106105166/