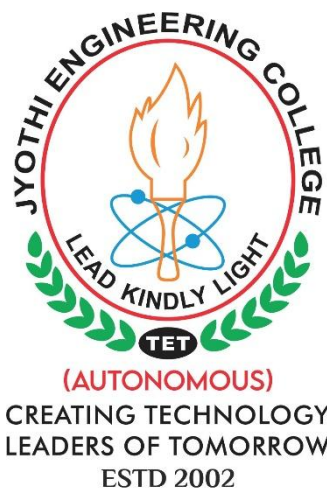


B. TECH SYLLABUS - 2025



Semester I to VIII

Mechatronics Engineering

Branch Code: MR

Syllabus Approved by the Board of Studies Meeting held on 27.08. 2025.

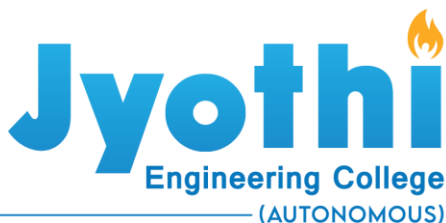
Ref: JEC/MR/2025/BoS/MOM/01 Dated: 27.08.2025



Jyothi
Engineering College
(AUTONOMOUS)

Reaccredited with NAAC (Grade A) and
NBA Programmes* (*CE, CS, EC, EE, ME, MR)
Jyothi Hills, P. O. Vettikkattiri, Cheruthuruthy
Thrissur, Kerala, India, 679531
04884 259000 | info@jecc.ac.in | www.jecc.ac.in

A Centre of Excellence in Science and Technology by the Catholic Archdiocese of Trichur



Reaccredited with NAAC (Grade A) and
NBA Programmes* (*CE, CS, EC, EE, ME, MR)
Jyothi Hills, P. O. Vettikkattiri, Cheruthuruthy
Thrissur, Kerala, India, 679531
04884 259000 | info@jecc.ac.in | www.jecc.ac.in

A Centre of Excellence in Science and Technology by the Catholic Archdiocese of Trichur

VISION & MISSION OF THE INSTITUTE

VISION : Creating eminent and ethical leaders through quality professional education with emphasis on holistic excellence.

MISSION

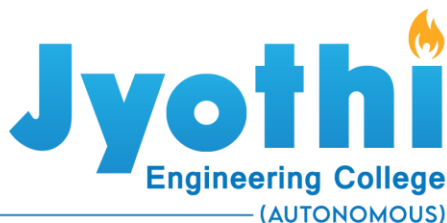
- To emerge as an institution par excellence of global standards by imparting quality engineering and other professional programmes with state-of-the-art facilities.
- To equip the students with appropriate skills for a meaningful career in the global scenario.
- To inculcate ethical values among students and ignite their passion for holistic excellence through social initiatives.
- To participate in the development of society through technology incubation, entrepreneurship and industry interaction.

VISION & MISSION OF THE DEPARTMENT

VISION: Create eminent and ethical leaders committed to profession and society in the field of Mechatronics through quality professional education to excel in industrial automation and innovation.

MISSION

- To impart orientation to meet the challenges of the modern industry and provide motivation for research.
- To provide quality education to create graduates with professional and social commitment.



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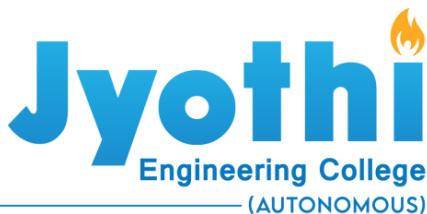
A Centre of Excellence in Science and Technology by the Catholic Archdiocese of Trichur

PROGRAMME EDUCATIONAL OBJECTIVES

- Graduates shall possess fundamental and advanced knowledge in electronics, electrical and mechanical along with fundamental knowledge in mathematics, basic sciences and computer programming to analyze and solve the challenges related to automation.
- Graduates shall have ability to design and create novel solutions with modern tool usage which lead to a lifelong learning or higher qualification, making them experts in their profession.
- Graduates shall have the ability to work in a multidisciplinary environment with good professional and ethical commitment

PROGRAMME SPECIFIC OUTCOMES

- Professional skills: Associate the concepts related to electrical, electronics, Mechanical, Robotics, Control and Instrumentation to solve the challenges of modern industries.
- Problem solving ability: Analyze and design systems with modern tools for the benefit of the society.



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04884 259000 | info@jecc.ac.in | www.jecc.ac.in

A Centre of Excellence in Science and Technology by the Catholic Archdiocese of Trichur

PROGRAMME OUTCOMES

- PO1. Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop the solution of complex engineering problems
- PO2. Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
- PO3. Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
- PO4. Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8)
- PO5. Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
- PO6. The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7)
- PO7. Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
- PO8. Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
- PO9. Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
- PO10. Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
- PO11. Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

SEMESTER 1

MECHATRONICS ENGINEERING

SEMESTER S1
MATHEMATICS FOR ELECTRICAL SCIENCE AND
PHYSICAL SCIENCE - 1

Course Code	25MAT102	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 and matrix operations.	Course Type	Theory

Course Objectives:

1. To provide a comprehensive understanding and basic techniques of matrix theory to analyze linear systems.
2. To offer advanced knowledge and practical skills in solving second-order ordinary differential equations, applying Laplace transforms, and understanding Fourier series, enabling students to analyze and model dynamic systems encountered in engineering disciplines effectively.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Linear systems of equations: Gauss elimination, Row echelon form, Linear Independence: rank of a matrix, Solutions of linear systems: Existence, Uniqueness (without proof), The matrix Eigen Value Problem, Determining Eigen values and Eigen vector, Diagonalization of matrices. (Text 1: Relevant topics from sections 7.3, 7.4, 7.5, 8.1, 8.4)	9

2	Homogeneous linear ODEs of second order, Superposition principle, General solution, Homogeneous linear ODEs of second order with constant coefficients (Method to find general solution, solution of linear Initial Value Problem). Non homogenous ODEs (with constant coefficients) - General solution, Particular solution by the method of undetermined coefficients (Particular solutions for the functions ke^{vx}, kx^n, $k\cos\omega x$, $k\sin\omega x$, $ke^{ax}\cos\omega x$, $ke^{ax}\sin\omega x$), Initial value Problem for Non-Homogeneous Second order linear ODE(with constant coefficients), Solution by variation of parameters (Second Order). (Text 1: Relevant topics from sections 2.1, 2.2, 2.7, 2.10)	9
3	Laplace Transform, Inverse Laplace Transform, Linearity property, First shifting theorem, Transform of derivatives, Solution of Initial value problems by Laplace transform (Second order linear ODE with constant coefficients with initial conditions at $t=0$ only), Unit step function, Second shifting theorem, Dirac delta function and its transform (Initial value problems involving unit step function and Dirac delta function are excluded), Convolution theorem (without proof) and its application to finding inverse Laplace transform of products of functions. (Text 1: Relevant topics from sections 6.1, 6.2, 6.3, 6.4, 6.5)	9
4	Taylor series representation (without proof, assuming the possibility of power series expansion in appropriate domains), Maclaurin series representation, Fourier series, Euler formulas, Convergence of Fourier series (Dirichlet's conditions), Fourier series of 2π periodic functions, Fourier series of $2l$ periodic functions, Half range sine series expansion, Half range cosine series expansion. (Text 1: Relevant topics from sections 11.1, 11.2, Text 2: Relevant topics from section 10.8)	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	• 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. (4x9 = 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	Solve systems of linear equations and diagonalize matrices.	K3
CO2	Solve homogeneous and non-homogeneous linear differential equation with constant coefficients.	K3
CO3	Compute Laplace transform and apply it to solve ODEs arising in engineering.	K3
CO4	Determine the Taylor series and evaluate Fourier series expansion for different periodic functions.	K3

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

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	2	-	-	-	-	-	-	-	2
CO2	3	3	-	2	-	-	-	-	-	-	-	2
CO3	3	3	-	2	-	-	-	-	-	-	-	2
CO4	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	Advanced Engineering Mathematics	Erwin Kreyszig	John Wiley & Sons	10 th edition, 2016
2	Calculus	H.Anton, I.Biven, S.Davis	Wiley	12 th 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	15 th edition, 2023
2	Essential Calculus	J. Stewart	Cengage	2 nd edition, 2017
3	Elementary Linear Algebra	Howard Anton, ChrisRorres	Wiley	11 th edition, 2019
4	Bird's Higher Engineering Mathematics	John Bird	Taylor & Francis	9 th edition, 2021
5	Higher Engineering Mathematics	B. V. Ramana	McGraw-Hill Education	39 th edition, 2023
6	Calculus	H. Anton, I. Biven, S.Davis	Wiley	12 th edition, 2024
7	Signals and Systems	Simon Haykin, Barry Van Veen	Wiley	2 nd edition, 2002

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/111/107/111107164/
2	https://archive.nptel.ac.in/courses/111/104/111104031/
3	https://archive.nptel.ac.in/courses/111/106/111106139/
4	https://archive.nptel.ac.in/courses/111/101/111101164/

SEMESTER S1/S2
PHYSICS FOR PHYSICAL SCIENCE AND LIFE SCIENCE

Course Code	25PHT103	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 + Lab

Course Objectives:

1. To provide students with a solid background in the fundamentals of Physics and impart this knowledge in Physical Science and Life Science disciplines.
2. To develop scientific attitudes and enable students to correlate Physics concepts with their core programs.
3. To equip students with practical knowledge that complements their theoretical studies and develop their ability to create practical applications and solutions in engineering based on their understanding of Physics.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Laser & Fibre Optics Optical processes – Absorption-Spontaneous emission and stimulated emission, Principle of laser - conditions for sustained lasing – Population inversion- Pumping- Metastable states, Basic components of laser - Active medium - Optical resonant cavity, Construction and working of Ruby laser and CO₂ laser, Construction and working Semiconductor laser (qualitative), Properties of laser, Applications of laser. Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres - Multimode and single mode fibers, Acceptance angle, Numerical aperture –Derivation, Applications of optical fibres - Fibre optic communication system (block diagram)	9
2	Interference and Diffraction Introduction, Principle of super position, Constructive and destructive interference, Optical path, Phase difference and path difference, Cosine law- reflected system- Condition for constructive and destructive interference, Colours in thin films, Newton's Rings-Determination of refractive index of transparent liquids and wavelength, Air wedge- Measurement of thickness of thin sheets. Diffraction-types of diffraction, Diffraction due to a single slit, Diffraction grating – Construction - grating equation, Dispersive and Resolving Power (qualitative).	9

3	Quantum Mechanics Introduction, Concept of uncertainty and conjugate observables (qualitative), Uncertainty principle (statement only), Application of uncertainty principle- Absence of electron inside nucleus - Natural line broadening, Wave function – properties - physical interpretation, Formulation of time dependent and time independent Schrodinger equations, Particle in a one- dimensional box - Derivation of energy eigen values and normalized wave function, Quantum Mechanical Tunnelling (qualitative)	9
4	Waves & Acoustics Waves- transverse and longitudinal waves, Concept of frequency, wavelength and time period (no derivation), Transverse vibrations in a stretched string- derivation of velocity and frequency - laws of transverse vibration. Acoustics- Reverberation and echo, Reverberation time and its significance - Sabine's Formula, Factors affecting acoustics of a building. Ultrasonics- Piezoelectric oscillator, Ultrasonic diffractometer, SONAR, NDT-Pulse echo method, medical application-Ultrasound scanning (qualitative)	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Continuous Assessment	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Internal Examination-3 (Lab Examination)	Total
5	10	10	10	5	40

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 (8x3 = 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 subdivisions. (4x9 = 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	Describe the basic principles and properties of laser and optic fibers.	K2
CO2	Describe the phenomena of interference and diffraction of light.	K2
CO3	Describe the behaviour of matter in the atomic and subatomic level through the principles of quantum mechanics.	K2
CO4	Apply the knowledge of waves and acoustics in non-destructive testing and in acoustic design of buildings.	K3
CO5	Apply basic knowledge of principles and theories in physics to conduct experiments.	K3

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

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											3
CO2	3											3
CO3	3											3
CO4	3	3										3
CO5	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	A Textbook of Engineering Physics	M N Avadhanulu, P G Kshirsagar & TVS Arun Murthy	S Chand & Co.	2 nd Edition, 2019
2	Engineering Physics	H K Malik , A.K. Singh,	McGraw Hill Education	2 nd Edition, 2017
3	Optics	Ajoy Ghatak	Mc Graw Hill Education	6 th Edition, 2017

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering Physics	G Vijayakumari	Vikas Publications	8 th Edition, 2014
2	Concepts of Modern Physics	Arthur Beiser	Tata McGraw Hill Publications	6 th Edition 2003
3	Engineering Physics	Aruldas G.	PHI Pvt. Ltd	2 nd Edition, 2015
4	Fiber Optic Communications	Gerd Keiser	Springer	2021
5	A Text Book of Engineering physics	I. Dominic, A. Nahari	OWL Publications	2 nd Edition, 2016
6	Advanced Engineering Physics	Premlet B	Phasor Books	
7	Engineering Physics	Rakesh Dogra	Katson Books	1 st Edition, 2019

Video Links (NPTEL, SWAYAM...)	
Module No	Link ID
1	https://nptel.ac.in/courses/115102124 https://nptel.ac.in/courses/104104085
2	https://nptel.ac.in/courses/115105537
3	https://nptel.ac.in/courses/115102023 https://nptel.ac.in/courses/115101107
4	https://nptel.ac.in/courses/112104212 https://nptel.ac.in/courses/124105004

1. Continuous Assessment (10 Marks)

i. 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.

ii. 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.

iii. 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.

iv. 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,

2. 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.

Experiment List

Experiment No.	Experiments (Minimum 10 Experiments)
1	Optical fiber characteristics- Measurement of Numerical aperture.
2	Determination of wavelength of Laser using diffraction grating.
3	Measure the wavelength of Laser using a millimetre scale as a grating.
4	Determination of wavelength of a monochromatic light using Newton's Rings method.
5	Determination of diameter of wire or thickness of thin sheet using Air wedge method.
6	Determination of slit width (diffraction due to a single slit).
7	Measure wavelength of light source using diffraction grating.

8	Determination of resolving power and dispersive power of grating.
9	Characteristics of LED.
10	CRO basics-Measurement of frequency and amplitude of wave forms.
11	Solar Cell- I V and Intensity Characteristics.
12	Melde's experiment- Frequency calculation in Transverse and Longitudinal Mode.
13	LCR circuit –forced and damped harmonic oscillations.
14	Determination of wavelength and velocity of ultrasonic waves using ultrasonic diffractometer.
15	Determination of particle size of lycopodium powder.

SEMESTER S1/S2

CHEMISTRY FOR PHYSICAL SCIENCE

Course Code	25CHT102	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+ Lab

Course Objectives:

1. To equip students with a thorough understanding of chemistry concepts 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 quality of life.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Engineering Materials Fuels: Calorific value – HCV and LCV – Experimental determination of calorific value of solid fuels. Analysis of coal – Proximate analysis- Octane & Cetane Number. Biofuels- Biodiesel-Green Hydrogen. Lubricants: Classification - Solid, Semisolid and Liquid lubricants. Properties of lubricants - Viscosity Index, Flash point, Fire point, Cloud Point, Pour Point & Aniline Point. Cement: Manufacture of Portland cement – Theory of setting and hardening of cement. Nanomaterials: Classification based on Dimension & Materials- Synthesis – Sol gel & Chemical Reduction - Applications of nanomaterials – Supercapacitor Materials - Carbon Nanotubes, Fullerenes & Graphene – structure, properties & application. Polymers: ABS & Kevlar - Synthesis, properties and applications. Conducting Polymers- Classification – Application.	9

2	Electrochemistry and Corrosion Science 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 & H₂-O₂ 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
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3	Instrumental Methods of Analysis Molecular 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 CO₂ and H₂O –Applications Thermal analysis: –TGA- Principle, instrumentation (block diagram) and applications – TGA of CaC₂O₄.H₂O and polymers. DTA- Principle, instrumentation (block diagram) and applications - DTA of CaC₂O₄.H₂O. Chromatography-Gas Chromatography-Principle-Instrumentation- Application – Analysis of chemical composition of exhaust gases. Electron Microscopic Techniques: SEM - Principle, instrumentation and Applications.	9
4	Environmental Chemistry 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 Waste Management: Air Pollution- Sources & Effects- Greenhouse Gases- Ozone depletion. Control methods. Sewage water treatment- Primary, Secondary and Tertiary - Flow diagram -Trickling filter and UASB process. Solid waste-disposal methods- Composting, Landfill & Incineration.	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Continuous Assessment	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Internal Examination- 3 (Lab Examination)	Total
5	10	10	10	5	40

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 (8x3 = 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 subdivisions. (4x9 = 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	Describe the use of various engineering materials in different industries.	K2
CO2	Explain the Basic Concepts of Electrochemistry and Corrosion to Explore the Possible Applications in Various Engineering Fields.	K2
CO3	Use appropriate analytical techniques for different engineering Materials	K3
CO4	Outline various water treatment and waste management methods	K2

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

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										2
CO2	3	3										2
CO3	3	3										2
CO4	3	3				2	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	17 th 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	4 th 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...)	
Sl No.	Link ID
1	https://archive.nptel.ac.in/courses/104/106/104106137/ https://archive.nptel.ac.in/courses/113/105/113105102/ https://archive.nptel.ac.in/courses/113/104/113104082/ 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.

2. 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 (KMnO_4 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 S1

ENGINEERING MECHANICS

Course Code	25EST106	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)	None	Course Type	Theory

Course Objectives:

1. The course aims to enable students to analyse and solve fundamental mechanics problems

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 only) 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	8

4	Curvilinear translation - equations of kinematics projectile motion (solution starting from differential equations) Rotation – kinematics of rotation- equation of motion for a rigid body rotating about a fixed axis –rotation under a constant moment	8
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Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination- 1(Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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 the vector representation of forces and moments	K2
CO2	Identify and describe the components of system of forces acting on the rigid body	K3
CO3	Apply the conditions of equilibrium to different force system.	K3
CO4	Identify appropriate principles to solve problems of mechanics.	K3
CO5	Develop the understanding of fundamental principles of rigid body dynamics	K3

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

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2										
CO2	3	3										
CO3	3	3										
CO4	3	3										
CO5	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	5 th Edition 2017
2	Engineering Mechanics: Combined Statics and Dynamics	Russell C. Hibbeler	Pearson Education,	14 th Edition 2015
3	Engineering Mechanics - Statics and Dynamics,	Shames, I. H.	Prentice Hall of India.	4 th Edition 2008
4	Textbook of Engineering Mechanics	R. K. Bansal	Laxmi publications pvt ltd.	4 th Edition 2016

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.	Wiley	9 th Edition 2020
2	Engineering Mechanics	Kraige	PHI Learning	2011

Video Links (NPTEL, SWAYAM...)	
	Link ID
1	https://nptel.ac.in/courses/112106286

SEMESTER S1
**INTRODUCTION TO MECHANICAL ENGINEERING & CIVIL
ENGINEERING**

Course Code	25EST107	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	4-0-0-0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Understand thermodynamic cycles and working of IC engines.
2. Understand the refrigeration cycles and psychrometric concepts.
3. Understand the relevance of civil engineering and its various disciplines.
4. Describe the relevance of various building codes and types of buildings as per NBC.
5. Understand different building components and building materials.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
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1	General introduction to Mechanical Engineering: Thermodynamic cycles -Carnot Cycle -Derivation of efficiency (problems on efficiency) Otto, Diesel cycles (no derivation of efficiency and problems). IC Engines: CI & SI Engines, working of 2-Stroke & 4-Stroke engines. Listing the parts of IC Engines. Concept of CRDI, MPFI and hybrid engines. Refrigeration: Unit of refrigeration, reversed Carnot cycle, COP, vapour compression cycle (only description and no problems); Definitions of dry, wet & dew point temperatures, specific humidity and relative humidity, Psychrometric chart, Cooling and dehumidification, Layout of central air conditioning systems.	9
2	Classification of pumps, Description about working with sketches of: Reciprocating pump, Centrifugal pump. Classification of Hydraulic Turbines. Different type of gears and its applications (spur, helical, bevel, worm and worm wheel), List types of clutches and their use, Bearings and their classification (Journal bearing and ball bearing) Manufacturing Process: Sand Casting, Forging, Rolling, Extrusion. Metal Joining Processes: List types of welding, Description with sketches of Arc Welding, SMAW, Soldering and Brazing and their applications. Machining processes: Description and operations performed on Lathe, Drilling machine, Milling machine, CNC machine, 3D printing.	9

3	General Introduction to Civil Engineering: Relevance of Civil Engineering in the overall infrastructural development of the country. Brief introduction to major disciplines of Civil Engineering like Structural Engineering, Geo-technical Engineering, Transportation Engineering, Water Resources Engineering and Environmental Engineering. Introduction to buildings: Types of buildings according to character of occupancy as per NBC, Load bearing and non-load bearing building structures, components of a residential building and their functions (conceptonly). Selection of site for a residential building. Building Area Definitions: Built up area, Plinth area, Floor area, Carpet area and Floor area ratio of a building as per KBR. Building rules and regulations: Relevance of NBC, KBR & CRZ norms (brief discussion of relevance only).	9
4	Conventional construction materials: Brick, stone, sand, cement and timber- Classifications, Qualities, Tests and Uses of construction materials. Cement concrete: Constituent materials, properties and types. Tests on fresh and hardened concrete - slump test, cube compressivestrength as per IS Codes. Steel: Structural steel sections and steel reinforcements – types and uses. Soil-Origin of soil-weathering of rocks, types of weathering	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	• 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. (4x9 = 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 the relevance of mechanical engineering and its various disciplines.	K2
CO2	Learn the applications of thermodynamics through IC engines and refrigeration systems.	K2
CO3	Understand the various manufacturing processes adapted by mechanical engineers.	K2
CO4	Understand the relevance of civil engineering and its various disciplines.	K2
CO5	Describe the relevance of various building codes and types of buildings as per NBC	K2
CO6	Understand different building components and building materials.	K2

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

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3											
CO3	3											2
CO4	3											
CO5	3							2				2
CO6	3											2

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Basic Mechanical Engineering	Pravin Kumar	Pearson Education	1 st Edition, 2013
2	A Textbook of Basic Mechanical Engineering	R.K. Rajput	Laxmi Publications	3 rd Edition, 2017
3	Elements of Mechanical Engineering	K.P. Roy, S.K. Hajra Choudhury, A.K. Hajra Choudhury	Media Promoters & Publishers Pvt. Ltd.	Revised Edition, 2012
4	Fundamentals of Mechanical Engineering	G.S. Sawhney	PHI Learning Pvt. Ltd.	1 st Edition, 2013
5	Essentials of Civil Engineering	Dalal K R	Charotar Publishing house	1 st Edition 2012
6	Engineering Materials (Material Science)	Rangwala S C	Charotar Publishing House Pvt Limited	43 rd Edition 2019
7	Building Materials	Duggal S K	New Age International	5 th Edition 2019

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives	Chris Mi and M. Abul Masrur	John Wiley & Sons	2nd Edition, 2017
2	Automotive Engineering Fundamentals	Richard Stone and Jeffrey K. Ball	SAE International	1 st Edition, 2004
3	Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing	Ian Gibson, David W. Rosen, and Brent Stucker	Springer	2 nd Edition, 2015
4	Heating, Ventilating, and Air Conditioning Analysis and Design	Faye C. McQuiston, Jerald D. Parker, and Jeffrey D. Spitler	John Wiley & Sons	6 th Edition, 2005
5	Materials for Civil and Construction Engineering	Mamlouk, M.S., and Zaniewski, J.P	Pearson Publishers	4 th Edition, 2017
6	Building Construction	Rangwala, S.C and Dalal, KB	Charotar Publishing house	34 th Edition 2022
7	Construction Technology Vol.I to IV	Chudley, R	Longman group, England Course Plan	2 nd Edition 2014
8	Building Construction Volumes 1 to 4	Mckay, W.B. and Mckay, J.K	Pearson India Education Services	5 th Edition
9	Engineering Geology	Duggal S. K., Pandey H.K. and Rawat N,	Mcgraw Hill Education, New Delhi	1 st Edition 2017
10	Latest Building codes and related rules and regulations.			

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://nptel.ac.in/courses/112/105/112105123/ https://nptel.ac.in/courses/112/106/112106133/ https://nptel.ac.in/courses/112/105/112105129/
2	https://nptel.ac.in/courses/112/105/112105171/ https://nptel.ac.in/courses/112/105/112105268/ https://archive.nptel.ac.in/courses/112/107/112107145
3	https://archive.nptel.ac.in/courses/105/106/105106201/
4	https://archive.nptel.ac.in/courses/105/106/105106206/

SEMESTER S1
ALGORITHMIC THINKING WITH PYTHON
(Common to All Branches)

Course Code	25EST105	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 provide students with a thorough understanding of algorithmic thinking and its practical applications in solving real-world problems.
2. To explore various algorithmic paradigms, including brute force, divide-and-conquer, dynamic programming, and heuristics, in addressing and solving complex problems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
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1	PROBLEM-SOLVING STRATEGIES:- Problem-solving strategies defined, Importance of understanding multiple problem-solving strategies, Trial and Error, Heuristics, Means-Ends Analysis, and Backtracking (Working backward). THE PROBLEM-SOLVING PROCESS:- Computer as a model of computation, Understanding the problem, Formulating a model, Developing an algorithm, Writing the program, Testing the program, and Evaluating the solution. ESSENTIALS OF PYTHON PROGRAMMING:- Creating and using variables in Python, Numeric and String data types in Python, Using the math module, Using the Python Standard Library for handling basic I/O - print, input, Python operators and their precedence.	7
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2	ALGORITHM AND PSEUDOCODE REPRESENTATION:- Meaning and Definition of Pseudocode, Reasons for using pseudocode, The main constructs of pseudocode - Sequencing, selection (if-else structure, case structure) and repetition (for, while, repeat-until loops), Sample problems* FLOWCHARTS** :- Symbols used in creating a Flowchart - start and end, arithmetic calculations, input/output operation, decision (selection), module name (call), for loop (Hexagon), flow-lines, on-page connector, off-page connector. * - Evaluate an expression, $d=a+b*c$, find simple interest, determine the larger of two numbers, determine the smallest of three numbers, determine the grade earned by a student based on KTU grade scale (using if-else and case structures), print the numbers from 1 to 50 in descending order, find the sum of n numbers input by the user (using all the three loop variants), factorial of a number, largest of n numbers (Not to be limited to these exercises. More can be worked out if time permits). ** Only for visualizing the control flow of Algorithms. The use of tools like RAPTOR (https://raptor.martincarlisle.com/) is suggested. Flowcharts for the sample problems listed earlier may be discussed	9
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3	SELECTION AND ITERATION USING PYTHON:- if-else, elif, for loop, range, while loop. Sequence data types in Python - list, tuple, set, strings, dictionary, Creating and using Arrays in Python (using <i>Numpy</i> library). DECOMPOSITION AND MODULARIZATION* :- Problem decomposition as a strategy for solving complex problems, Modularization, Motivation for modularization, Defining and using functions in Python, Functions with multiple return values RECURSION:- Recursion Defined, Reasons for using Recursion, The Call Stack, Recursion and the Stack, Avoiding Circularity in Recursion, <i>Sample problems - Finding the nth Fibonacci number, greatest common divisor of two positive integers, the factorial of a positive integer, adding two positive integers, the sum of digits of a positive number</i> **. <i>* The idea should be introduced and demonstrated using Merge sort, the problem of returning the top three integers from a list of $n \geq 3$ integers as examples. (Not to be limited to these two exercises. More can be worked out if time permits).</i> <i>** Not to be limited to these exercises. More can be worked out if time permits</i>	10
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4	COMPUTATIONAL APPROACHES TO PROBLEM-SOLVING (Introductory diagrammatic/algorithmic explanations only. Analysis not required) :- Brute-force Approach - - Example: Padlock, Password guessing Divide-and-conquer Approach - - Example: The Merge Sort Algorithm - Advantages of Divide and Conquer Approach - Disadvantages of Divide and Conquer Approach Dynamic Programming Approach - Example: Fibonacci series - Recursion vs Dynamic Programming Greedy Algorithm Approach - Example: Given an array of positive integers each indicating the completion time for a task, find the maximum number of tasks that can be completed in the limited amount of time that you have. - Motivations for the Greedy Approach - Characteristics of the Greedy Algorithm - Greedy Algorithms vs Dynamic Programming Randomized Approach - Example 1: A company selling jeans gives a coupon for each pair of jeans. There are n different coupons. Collecting n different coupons would give you free jeans. How many jeans do you expect to buy before getting a free one? - Example 2: n people go to a party and drop off their hats to a hat-check person. When the party is over, a different hat-check person is on duty and returns the n hats randomly back to each person. What is the expected number of people who get back their hats - Motivations for the Randomized Approach	10
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Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Continuous Assessment (Accurate Execution of Programming Tasks)	Internal Examination-1 (Written Examination)	Internal Examination-2 (Written Examination)	Internal Examination-3 (Lab Examination)	Total
5	5	10	10	10	40

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 (8x3 =24marks)	• 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. (4x9 = 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	Utilize computing as a model for solving real-world problems.	K2
CO2	Articulate a problem before attempting to solve it and prepare a clear and accurate model to represent the problem.	K3
CO3	Use effective algorithms to solve the formulated models and translate algorithms into executable programs.	K3
CO4	Interpret the problem-solving strategies, a systematic approach to solving computational problems, and essential Python programming skills	K2

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

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3									3
CO2	3	3	3									3
CO3	3	3	3									3
CO4	3	3	3									3

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Problem solving & programming concepts	Maureen Sprankle, Jim Hubbard	Pearson	2012
2	How to Solve It: A New Aspect of Mathematical Method	George Pólya	Princeton University Press	2015
3	Creative Problem Solving: An Introduction	Donald Treffinger., Scott Isaksen, Brian Stead-Doval	Prufrock Press	2005
4	Psychology (Sec.. Problem Solving.)	Spielman, R. M., Dumper, K., Jenkins, W., Lacombe, A., Lovett, M., & Perlmutter, M	H5P Edition	2021
5	Computer Arithmetic Algorithms	Koren, Israel	AK Peters/CRC Press	2018
6	Introduction to Computation and Programming using Python	Gutttag John V	PHI	2/e., 2016
7	Python for Everyone	Cay S. Horstmann, Rance D. Necaise	Wiley	3/e, 2024
8	Computational Thinking: A Primer for Programmers and Data Scientists	G Venkatesh Madhavan Mukund	Mylspot Education Services Pvt Ltd	2020

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://opentextbc.ca/h5pppsychology/chapter/problem-solving/
2	https://onlinecourses.nptel.ac.in/noc21_cs32/preview

1. Continuous Assessment (5 Marks)

Accurate Execution of Programming Tasks

- Correctness and completeness of the program
- Efficient use of programming constructs
- Handling of errors
- Proper testing and debugging

2. Evaluation Pattern for Lab Examination (10 Marks)

1. Algorithm (2 Marks)

Algorithm Development: Correctness and efficiency of the algorithm related to the question.

2. Programming (3 Marks)

Execution: Accurate execution of the programming task.

3. Result (3 Marks)

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

4. Viva Voce (2 Marks)

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

Sample Classroom Exercises:

1. Identify ill-defined problem and well-defined problems
2. How do you differentiate the methods for solving algorithmic problems: introspection, simulation, computer modelling, and experimentation?
3. Use cases for Trial and error, Algorithm, Heuristic and Means-ends analysis can be applied in proffering solution to problems
4. Use a diagram to describe the application of Tower of Hanoi in choosing and analysing an action at a series of smaller steps to move closer to the goal
5. What effect will be generated if the stage that involves program writing is not observed in the problem solving process?
6. What effect will be generated if the stage that involves program writing is not observed in the problem solving process?
7. Evaluate different algorithms based on their efficiency by counting the number of steps.
8. Recursive function that takes a number and returns the sum of all the numbers from zero to that number.
9. Recursive function that takes a number as an input and returns the factorial of that number.
10. Recursive function that takes a number 'n' and returns the nth number of the Fibonacci number.
11. Recursive function that takes an array of numbers as an input and returns the product of all the numbers in the list.

LAB Experiments:

1. Demonstrate about Basics of Python Programming
2. Demonstrate about fundamental Data types in Python Programming. (i.e., int, float, complex, bool and string types)
3. Demonstrate different Arithmetic Operations on numbers in Python.
4. Create, concatenate, and print a string and access a sub-string from a given string.
5. Familiarize time and date in various formats (Eg. "Sun May 29 02:26:23 IST 2017")
6. Write a program to create, append, and remove lists in Python using numPy.
7. Programs to find the largest of three numbers.
8. Convert temperatures to and from Celsius, and Fahrenheit. [Formula: $c/5 = f-32/9$]

9. Program to construct the stars(*) pattern, using a nested for loop
10. Program that prints prime numbers less than 20.

11. Program to find the factorial of a number using Recursion.
12. Recursive function to add two positive numbers.
13. Recursive function to multiply two positive numbers
14. Recursive function to the greatest common divisor of two positive numbers.
15. Program that accepts the lengths of three sides of a triangle as inputs. The program output should indicate whether or not the triangle is a right triangle (Recall from the Pythagorean Theorem that in a right triangle, the square of one side equals the sum of the squares of the other two sides). Implement using functions.
16. Program to define a module to find Fibonacci Numbers and import the module to another program.
17. Program to define a module and import a specific function in that module to another program.
18. Program to check whether the given number is a valid mobile number or not using functions?

Rules:

1. Every number should contain exactly 10 digits.
2. The first digit should be 7 or 8 or 9

SEMESTER S1

ENGINEERING WORKSHOP

Course Code	25ESL108	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0-0-2-0	ESE Marks (Internal only)	50
Credits	1	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Lab

Course Objectives:

1. To enable the student to familiarize various tools, measuring devices, practices and different methods employed in the industry.
2. To enable the students to apply this experience while developing product/project for the benefit of society.

Expt. No.	Experiments (Minimum 12 Exercises)
1	General: Introduction to workshop practice, Safety precautions, Shop floor ethics, and Basic First Aid knowledge. Study of mechanical and measurement tools, components and their applications: (a) Tools: screw drivers, spanners, Allen keys, cutting pliers etc. and accessories (b) bearings, seals, O-rings, circlips, keys etc. (c) Vernier Calipers, Height Gauge, Depth Gauge, Micrometers, Bevel Protractor etc.
2	Carpentry: Understanding carpentry tools and knowledge of at least one model 1. T – Lap joint 2. Cross lap joint 3. Dovetail joint 4. Mortise joints
3	Foundry: Understanding of foundry tools and knowledge of at least one model 1. Bench Moulding 2. Floor Moulding 3. Core making 4. Pattern making
4	Sheet Metal: Understanding sheet metal working tools and knowledge of at least one model 1. Cylindrical shape 2. Conical shape 3. Prismatic shaped job from sheet metal

5	Fitting: Understanding the tools used for fitting and knowledge of at least one model 1. Square Joint 2. V- Joint 3. Male and female fitting
6	Plumbing: - Understanding plumbing tools and pipe joints, along with practicing one exercise on joining pipes using a minimum of three types of pipe joints
7	Smithy: - Understanding the tools used in smithy. Demonstrating the forge-ability of different materials (MS, Al, alloy steel and cast steels) in both cold and hot states. Observing the qualitative difference in the hardness of these materials. One exercise on smithy (Square prism).
8	Welding: Understanding welding equipment and practicing at least one welding technique, such as making joints using electric arc welding. Bead formation in horizontal, vertical and overhead positions
9	Rolling: - Objective of rolling, rolling process, practical on two high rolling mill
10	Electroplating: -Electroplating a given job
11	Metrology: Common measuring instruments used in workshop, experiments to find the angle of a dovetail, angle of a taper and the radius of a circular surface. Introduction to instruments Vernier Bevel Protractor, Vernier Depth Gauge, Vernier Height Gauge.
12	Assembly: Demonstration only Disassembling and assembling of 1. Cylinder and piston assembly 2. Tail stock assembly 3. Bicycle 4. Pump or any other machine
13	Machines: Demonstration of the following machines: Shaping and slotting machine; Milling machine; Grinding Machine; Lathe; Drilling Machine.
14	Modern manufacturing methods (Fab lab/IDEA Lab - Demonstration only): Power tools, CNC machine tools, 3D printing, Soft Materials cutting using special machines
15	Use of proper Personal Protective Equipments. Measurements using Tape, Ruler, Vernier calipers, screw gauge
16	Measuring the area of a plot with an irregular boundary using a chain and cross staff

17	Measuring the area of a building using Distomat
18	Finding the level difference between two points using dumpy level
19	Onsite quality assessment of brick, and cement
20	Construct a 1 and 1 ½ thick brick wall with a height of 50 cm and a minimum length of 60 cm using English bond. Check the verticality of the wall
21	Construct a 1 and 1 ½ thick brick wall with a height of 50 cm and a minimum length of 60 cm using Flemish bond. Check the verticality of the wall
22	Estimate the number of different types of building blocks needed to construct the walls of a room measuring 2m x 3m, accounting for standard-sized doors and windows.
23	Setting out of a two roomed building using thread, tape and water tube levelling.
24	Conduct a market study to understand the types, prices, and general specifications of at least three materials available in the market (such as bricks, cement, aggregates, steel, plumbing items, fixtures, welding rods, fasteners etc.).
25	Studying the tools and testing instruments for electrical works. Wiring a light or a fan circuit using one way and two-way switch.
26	Familiarization/Application of testing instruments and commonly used tools in electronic works. [Multimeter, Soldering iron, De-soldering pump, Pliers, Cutters, Wire strippers, Screw drivers, Tweezers, Crimping tool, Hot air soldering and desoldering station etc.]
Note: Minimum of 12 experiments from among the 26 experiments listed, is to be completed.	

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work, experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Total
5	45	50

End Semester Examination Marks (ESE): (Internal evaluation only)

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	15	10	10	5	50

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

Pass Criteria:

- *A student must score a minimum of 50% overall, combining marks from both Continuous Internal Evaluation (CIE) and End Semester Examination (ESE).*
- *In addition, the student must secure at least 40% in the End Semester Examination (ESE).*

The ESE shall be conducted internally, with evaluation carried out by a panel of faculty members. This panel must include at least one faculty member who was not involved in the Continuous Internal Evaluation (CIE) of the lab course.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify workshop operations and instruments in accordance with the material and objects.	K3
CO2	Understand appropriate tools and instruments with respect to the workshop specializations.	K2
CO3	Apply various tools, measuring devices, practices and different methods employed in the industry.	K3
CO4	Examine the quality of common materials used in the industry.	K3
CO5	Conduct market study of various engineering materials and consumables available in the market.	K3

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

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3									2		2
CO2	3									2		2
CO3	3				2					2		3
CO4	3									2		3
CO5	3								2	3		3

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Mechanical Workshop Practice	K C John	PHI Learning	Edition 2 2010
2	Engineering Materials	S C Rangwala	Charotar Publishing House Pvt Limited	Edition 43 2019
3	Building Materials	S K Duggal	New Age International	Edition 6 2025
4	Indian Practical Civil Engineering Handbook	Khanna P.N,	UBS Publishers Distributors (P) Ltd.	Year 2012
5	Building Construction	Arora S.P and Bindra S.P	Dhanpat Rai Publications	Edition 5 Year 2022

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Elements of Workshop Technology Vol-1- Manufacturing Processes	S K Hajra Choudhury A K Hajra Choudhury Nirjhar Roy	MPP Media Promoters and Publishers	2008

Video Links (NPTEL, SWAYAM...)	
Link ID	
https://archive.nptel.ac.in/courses/105/106/105106206/ https://archive.nptel.ac.in/courses/105/106/105106201/ https://archive.nptel.ac.in/courses/105/104/105104101/ https://archive.nptel.ac.in/courses/117/106/117106108/	

Continuous Assessment (45 Marks)

1. Preparation and Pre-Lab Work (10 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 (15 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 (10 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 (10 Marks)

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

Evaluation Pattern for End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 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.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

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

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

SEMESTER S1/S2
HEALTH AND WELLNESS
(Common to all Groups)

Course Code	25HUT106	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	1:0:1:0	ESE Marks	0
Credits	1	Exam Hours	Nil
Prerequisites (if any)	None	Course Type	

Course Objectives:

1. To provide essential knowledge on physical activity, health, and wellness.
2. To ensure students understand body systems, exercise principles, nutrition, mental health, and disease management.
3. To educate students on the benefits of yoga, the risks of substance abuse and basic first aid skills.
4. To equip students with the ability to lead healthier lifestyles.
5. To enable students to design effective and personalized exercise programs.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Human Body Systems related to Physical activity and its functions: Respiratory System - Cardiovascular System. Musculoskeletal System and the Major Muscle groups of the Human Body. Quantifying Physical Activity Energy Expenditure and Metabolic equivalent of task (MET) Exercise Continuum: Light-intensity physical activity, Moderate - intensity physical activity, Vigorous -intensity physical activity. Defining Physical Activity, Aerobic Physical Activity, Anaerobic Physical Activity, Exercise and Health-Related Physical Fitness. FITT principle to design an Exercise programme Components of Health-related Physical Fitness: - Cardiorespiratory Fitness- Muscular strength- Muscular endurance- Flexibility- Body composition.	4
2	Concept of Health and Wellness: Health and wellness differentiation, Factors affecting health and wellness. Mental health and Factors affecting mental health. Sports and Socialization: Sports and character building - Leadership through Physical Activity and Sports Diet and nutrition: Exploring Micro and Macronutrients: Concept of Balanced diet Carbohydrate & the Glycemic Index Animal & Plant - based Proteins and their Effects on Human Health Dietary Fats & their Effects on Human Health Essential Vitamins and Minerals	2

3	Lifestyle management strategies to prevent / manage common hypokinetic diseases and disorders - Obesity - Cardiovascular diseases (e.g., coronary artery disease, hypertension) - Diabetes - Osteoporosis - Musculoskeletal disorders (e.g., osteoarthritis, Low back pain, Kyphosis, lordosis, flat foot, Knock knee) Meaning, Aims and objectives of yoga - Classification and importance of of Yogic Asanas (Sitting, Standing, lying) Pranayama and Its Types - Active Lifestyle and Stress Management Through Yoga Understanding on substance abuse and addiction - Psychoactive substances & its ill effects- Alcohol- Opioids- Cannabis - Sedative -Cocaine -Other stimulants, including caffeine -Hallucinogens -Tobacco -Volatile solvents.	4
4	First aid and principles of First Aid: Primary survey: ABC (Airway, Breathing, Circulation). Qualities of a Good First Aider First aid measures for: - Cuts and scrapes - Bruises - Sprains - Strains - Fractures - Burns - Nosebleeds. First Aid Procedures: Cardiopulmonary Resuscitation (CPR) - Heimlich Maneuver - Applying a sling Sports injuries: Classification (Soft Tissue Injuries - Abrasion, Contusion, Laceration, Incision, Sprain & Strain)	2

Additional Topics

- Need and Importance of Physical Education and its relevance in interdisciplinary context. Understanding of the Endocrine System
- Developing a fitness profile
- Healthy foods habits for prevention and progression of Lifestyle Diseases. Processed foods and unhealthy eating habits.
- Depression - Anxiety - Stress
- Different ways of carrying an injured person. Usage of Automated external defibrillator

**Course Assessment Method
(CIE: 50 marks)**

Continuous Internal Evaluation Marks (CIE):

Attendance	Case Study/Micro project/Presentation	Activity evaluation	Total
10	20	20	50

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the different human body systems and describe various types of physical activities along with methods to measure and quantify these activities.	K2
CO2	Explain how to maintain or improve health and wellness through psychological practices, dietary habits, and sports activities.	K2
CO3	Discuss about common hypokinetic disorders and musculoskeletal disorders, and describe the importance of leading a healthy lifestyle through the practice of yoga and abstaining from addictive substances.	K2
CO4	Explain the basics of first aid and describe common sports Injuries	K2

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

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				2		3		3	3	2		2
CO2				2		3		2	2			2
CO3						3		3				2
CO4				2		3						2

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Foundations of Nutrition	Bhavana Sabarwal	Commonwealth Publishers	1999
2	Anatomy and physiology in health and illness.	Ross and Wilson	Waugh, A., & Grant, A.	2022

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fit to be Well Essential Concept	Thygerson, A. L., Thygerson, S. M., & Thygerson, J. S.	Jones & Bartlett Learning.	2018
2	Introduction to physical education, fitness, and sport.	Siedentop, D., & Van der Mars, H.	Human kinetics.	2022
3	Substance Use Disorders. Manual for Physicians.	Lal, R., & Ambekar, A. (2005).	National Drug Dependence Treatment Centre, New Delhi	2005
4	The exercise health connection-how to reduce your risk of disease and other illnesses by making exercise your medicine.	Nieman, D. C., & White, J. A	Public Health	1998
5	ACSM's resource manual for guidelines for exercise testing and prescription.	Lippincott Williams & Wilkins.	American College of Sports Medicine.	2012
6	Exercise Physiology: energy, nutrition and human performance.	Katch, F. I., Katch, V. L., & McArdle, W. D.	Lippincott Williams & Wilkins	2010

Continuous Internal Evaluation Marks (CIE): for the Health and wellness course

Students will be evaluated as follows.

Title	Method of Evaluation
Attendance	Students must attend at least 75% of both theory and practical classes. They will receive 10 marks based on their class attendance. Students who do not meet the minimum attendance requirement for a course, as specified in the B. Tech regulations, will not be eligible to proceed to the next criteria.
Assignment / Presentation	Assignments will be given to students to assess their understanding of the subjects taught. Students will be required to make presentations on the subjects taught in class, and their understanding of the subjects will be assessed. Based on the Assignments and Presentations the students will be awarded marks out of 20
Activity Evaluation	The Assignment / Presentation faculty handling the class will use the tests from the Fitness Protocols and Guidelines for ages 18+ to 65 years, as set forth by FIT India. Measurements will be taken for all the tests of the FIT India Fitness Protocol and the evaluation will be based on the benchmark score received for the following tests: 1. V Sit Reach Test 2. Partial Curl Up - 30 seconds 3. Push Ups (Male) and Modified Push Up (Female) 4. Two (2) Km Run/Walk Students who achieve a total benchmark score of 8 across the aforementioned 4 tests will be awarded pass marks for activity evaluation. Students who score better will be awarded a maximum mark of 20.

Activity Evaluation - Special Circumstances	Physically challenged and medically unfit students can opt for an objective test to demonstrate their knowledge of the subjects taught. Based on their performance in the objective test, they will be awarded marks out of 20.
Activity Evaluation - Special Considerations - NCC	Students who enrolled themselves in the NCC during the course period (between the start and end dates of the program) and attended 5 college level parades will be awarded pass marks for activity evaluation. Students who attend more parades will be eligible for a maximum mark of 20 based on their parade attendance.

Tests to evaluated as per Criterion - 2 and Benchmark Scores

V Sit Reach Test

How to Perform:

1. The subject removes their shoes and sits on the floor with the measuring line between their legs and the soles of their feet placed immediately behind the baseline, heels 8-12" apart.
2. The thumbs are clasped so that hands are together, palms facing down and placed on the measuring line.
3. With the legs held flat by a partner, the subject slowly reaches forward as far as possible, keeping the fingers on baseline and feet flexed.
4. After three tries, the student holds the fourth reach for three seconds while that distance is recorded.
5. Make sure there are no jerky movements, and that the fingertips remain level and the legs flat.

Infrastructure/Equipment Required:

1. A tape for marking the ground, marker pen, and ruler.
2. With the tape mark a straight line two feet long on the floor as the baseline, and a measurement line perpendicular to the midpoint of the baseline extending two feet on each side.
3. Use the marker pen to indicate every centimeter and millimeter along the measurement line. The point where the baseline and the measuring line intersect is the zero point.
4. Scoring: The score is recorded in centimeters and millimeters as the distance reached by the

hand, which is the difference between the zero point (where the baseline and measuring line intersect) and the final position

Scoring for V Sit Reach Test for Males

Level	Benchmark Score	Measurement (cm)
1	2	<11
2	4	12-13
3	6	14-17
4	7	18-19
5	8	20-21
6	9	22
7	10	>22

Scoring for V Sit Reach Test for Females

Level	Benchmark Score	Measurement (cm)
1	2	<14
2	4	15-16
3	6	17-19
4	7	20-21
5	8	22
6	9	23
7	10	>23

Partial Curl Up - 30 seconds

How to Perform:

1. The subject lies on a cushioned, flat, clean surface with knees flexed, usually at 90 degrees, with hands straight on the sides (palms facing downwards) closer to the ground, parallel to the body.
2. The subject raises the trunk in a smooth motion, keeping the arms in position, curling up the desired amount (at least 6 inches above/along the ground towards the parallel strip).
3. The trunk is lowered back to the floor so that the shoulder blades or upper back touch the floor.

Infrastructure/Equipment Required:

Flat clean cushioned surface with two parallel strips (6 inches apart), Stopwatch

Scoring: Record the maximum number of Curl ups in a certain time period 30 seconds.

Scoring for Partial Curl Up - 30 seconds Test for Males

Level	Benchmark Score	Numbers
1	2	<25
2	4	25-30
3	6	31-34
4	7	35-38
5	8	39-43
6	9	44-49
7	10	>49

Scoring for Partial Curl Up - 30 seconds Test for Females

Level	Benchmark Score	Numbers
1	2	<18
2	4	18-24
3	6	25-28
4	7	29-32
5	8	33-36
6	9	37-43
7	10	>43

Push Ups for Male/Modified Push Ups for Female**How to Perform:**

1. A standard push up begins with the hands and toes touching the floor, the body and legs in a straight line, feet slightly apart, the arms at shoulder width apart, extended and at a right angle to the body.
2. Keeping the back and knees straight, the subject lowers the body to a predetermined point, to touch some other object, or until there is a 90-degree angle at the elbows, then returns back

to the starting position with the arms extended.

3. This action is repeated, and the test continues until exhaustion, or until they can do no more in rhythm or have reached the target number of push-ups.

4. For Female: push-up technique is with the knees resting on the ground.

Infrastructure/Equipment Required:

Flat clean cushioned surface/Gym mat

Scoring: Record number of correctly completed pushups.

Scoring for Push Ups for Male

Level	Benchmark Score	Numbers
1	2	<4
2	4	04- 10
3	6	11 -18
4	7	19-34
5	8	35-46
6	9	47-56
7	10	>56

Scoring for Modified Push Ups for Female

Level	Benchmark Score	Numbers
1	2	0-1
2	4	2 - 5
3	6	6 -10
4	7	11 - 20
5	8	21-27
6	9	27-35
7	10	>35

2 Km Run/Walk**How to Perform:**

1. Participants are instructed to run or walk 2 kms in the fastest possible pace.
2. The participants begin on signal (Starting point)- “ready, start”. As they cross the finish line, elapsed time should be announced to the participants.
3. Walking is permitted but the objective is to cover the distance in the shortest possible time.

Infrastructure/Equipment Required:

Stopwatch, whistle, marker cone, lime powder, measuring tape, 200 or 400 m with 1.22 m (minimum 1 m) width preferably on a flat and even playground with a marking of starting and finish line. You can also use any application on your mobile phone that tells you the distance.

Scoring: Time taken for completion (Run or Walk) in min, sec.

Scoring for 2Km Run/walk for Male

Level	Benchmark Score	Minutes : Seconds
1	2	> 11:50
2	4	10:42
3	6	09:44
4	7	08:59
5	8	08:33
6	9	07:37
7	10	>07:37

Scoring for 2Km Run/walk for Female

Level	Benchmark Score	Minutes : Seconds
1	2	>13:47
2	4	12:51
3	6	12:00
4	7	11:34
5	8	10:42
6	9	09:45
7	10	>09:45

SEMESTER - S1/S2
LIFE SKILLS AND PROFESSIONAL COMMUNICATION
(Common to all Branches)

Course Code	25HUT107	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 objectives:

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 semester. 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 Table

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 members	L	1	G	-	• Connecting with group members • Time management - Gantt Chart	
1.2	Familiarizing the activities and preparation of the time plan for the activities	L	1	G	-		
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						CO1
	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		
2.4	Discuss the skills identified through 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 other's life	L	2 to 4	I	2	• Empathy	CO2

B. Tech 2025 Scheme - S1-S8 Syllabus

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	
4.2	Interact with them to understand their workplace details including • workplace skills required • their work experience • activities 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	SS	3	I	4	• Networking through various media including LinkedIn • Discussion in groups • Report preparation • Creativity	CO2
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	Goal setting - Preparation of action plan	CO2
4.4	Report preparation based on the discussions	SS	4	G	3		CO4
4.5	Perform a role-play based on the workplace 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	I	2		CO4
5.3	Use any online tech forum to gather ideas for solving the problem chosen	SS	6	G	2		CO5
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 minutes)	SS	10	G	3	Diversity	CO2, CO5
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	I	2	Listening skills	CO6
11.1	Activities to improve English vocabulary of students	L	8	I/G	4	• English vocabulary	CO4
11.2	Activities to help students identify errors in English language usage	L	9	I/G	2	• English language skills • Writing • Presentation • Group work • Self-reflection	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		CO4, CO5
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 (P): 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. 3. Filing, finishing and smoothening using electrically operated hand grinders. 4. MS rod cutting using Hack saw by holding the work in bench wise. 5. Study and handling different types of measuring instruments. 6. Welding of MS, SS work pieces. 7. Pipe bending practice (PVC and GI). 8. Water tap fitting. 9. Water tap rubber seal changing practice. 10. Union and valves connection practice in pipes. 11. Foot valve fitting practice. 12. Water pump seal and bearing changing practice.	24	Basic practical engineering skills	3
2	Language Lab sessions	-	Language Skills	4

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop the ability to know & understand oneself, show confidence in one's potential & capabilities, set goals and develop plans to accomplish tasks	K5
CO2	Develop the ability to communicate and connect with others, participate in groups/teams, empathise, respect diversity, be responsible and understand the need to exercise emotional intelligence	K5
CO3	Develop thinking skills, problem-solving and decision-making skills	K5
CO4	Develop listening, reading, writing & speaking skills, ability to comprehend & successfully convey any idea, and ability to analyze, interpret & effectively summarize textual, audio & visual content	K6
CO5	Develop the ability to create effective presentations through audio-visual mediums with the use of technology tools and initiate effective use of social media platforms & tech forums for content delivery and discussions	K6
CO6	Initiate profile-building exercises in line with the professional requirements, and start networking with professionals/academicians	K6

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	PO12
CO1										1		3
CO2					1			3		3		3
CO3		1	1		1					1		1
CO4					1					1		2
CO5					1	1				1		2
CO6					1					1		

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

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
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SEMESTER 2

MECHATRONICS ENGINEERING

SEMESTER S2
MATHEMATICS FOR ELECTRICAL SCIENCE AND PHYSICAL
SCIENCE – 2

Course Code	25MAT202	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 slope3s, 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 (Text 1: Relevant topics from sections 13.2, 13.3, 13.4, 13.5, 13.8)	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. (Text 1: Relevant topics from section 14.1, 14.2, 14.3, 14.5, 14.6)	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). (Text 1: Relevant topics from section 12.1, 12.2, 13.6, 15.1, 15.2, 15.3)	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) (Text 1: Relevant topics from section 15.4, 15.5, 15.6, 15.7,15.8)	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

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 (8x3 = 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 subdivisions. (4x9 = 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	Compute the partial and total derivatives and maxima and minima of multivariable functions and to apply in engineering problems.	K3
CO2	Understand theoretical idea of multiple integrals and to apply them to find areas and volumes of geometrical shapes.	K3
CO3	Compute the derivatives and line integrals of vector functions and to learn their applications.	K3
CO4	Apply the concepts of surface and volume integrals and to learn their inter-relations and applications.	K3

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

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	2	-	-	-	-	-	-	-	2
CO2	3	3	-	2	-	-	-	-	-	-	-	2
CO3	3	3	-	2	-	-	-	-	-	-	-	2
CO4	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	12 th 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	15 th edition, 2023
2	Essential Calculus	J. Stewart	Cengage	2 nd edition, 2017
3	Advance Engineering Mathematics	Erwin Kreyszig	John Wiley & Sons	10 th edition, 2016
4	Bird's Higher Engineering Mathematics	John Bird	Taylor & Francis	9 th edition, 2021
5	Higher Engineering Mathematics	B. V. Ramana	McGraw-Hill Education	39 th edition, 2023

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
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 S1/S2
PHYSICS FOR PHYSICAL SCIENCE AND LIFE SCIENCE

Course Code	25PHT103	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 + Lab

Course Objectives:

1. To provide students with a solid background in the fundamentals of Physics and impart this knowledge in Physical Science and Life Science disciplines.
2. To develop scientific attitudes and enable students to correlate Physics concepts with their core programs.
3. To equip students with practical knowledge that complements their theoretical studies and develop their ability to create practical applications and solutions in engineering based on their understanding of Physics.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Laser & Fiber Optics Optical processes – Absorption-Spontaneous emission and stimulated emission, Principle of laser - conditions for sustained lasing – Population inversion- Pumping- Metastable states, Basic components of laser - Active medium - Optical resonant cavity, Construction and working of Ruby laser and CO₂ laser, Construction and working Semiconductor laser (qualitative), Properties of laser, Applications of laser. Optic fiber-Principle of propagation of light, Types of fibers-Step index and Graded index fibers - Multimode and single mode fibers, Acceptance angle, Numerical aperture –Derivation, Applications of optical fibers - Fiber optic communication system (block diagram)	9
2	Interference and Diffraction Introduction, Principle of super position, Constructive and destructive interference, Optical path, Phase difference and path difference, Cosine law- reflected system- Condition for constructive and destructive interference, Colours in thin films, Newton's Rings- Determination of refractive index of transparent liquids and wavelength, Air wedge- Measurement of thickness of thin sheets. Diffraction-types of diffraction, Diffraction due to a single slit, Diffraction grating – Construction - grating equation, Dispersive and Resolving Power(qualitative).	9

3	Quantum Mechanics Introduction, Concept of uncertainty and conjugate observables (qualitative), Uncertainty principle (statement only), Application of uncertainty principle- Absence of electron inside nucleus - Natural line broadening, Wave function – properties - physical interpretation, Formulation of time dependent and time independent Schrodinger equations, Particle in a one- dimensional box - Derivation of energy eigen values and normalized wave function, Quantum Mechanical Tunnelling (qualitative)	9
4	Waves & Acoustics Waves- transverse and longitudinal waves, Concept of frequency, wavelength and time period (no derivation), Transverse vibrations in a stretched string- derivation of velocity and frequency - laws of transverse vibration. Acoustics- Reverberation and echo, Reverberation time and its significance - Sabine's Formula, Factors affecting acoustics of a building. Ultrasonics- Piezoelectric oscillator, Ultrasonic diffractometer, SONAR, NDT-Pulse echo method, medical application- Ultrasound scanning (qualitative)	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Continuous Assessment	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Internal Examination- 3 (Lab Examination)	Total
5	10	10	10	5	40

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 (8x3 = 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 subdivisions. (4x9 = 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	Explain the basic principles and properties of laser and optic fibers.	K2
CO2	Describe the phenomena of interference and diffraction of light.	K2
CO3	Explain the behaviour of matter in the atomic and subatomic level through the principles of quantum mechanics.	K2
CO4	Apply the knowledge of waves and acoustics in non-destructive testing and in acoustic design of buildings.	K3
CO5	Apply basic knowledge of principles and theories in physics to conduct experiments.	K3

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

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											3
CO2	3											3
CO3	3											3
CO4	3	3										3
CO5	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	A Textbook of Engineering Physics	M N Avadhanulu, P G Kshirsagar & TVS Arun Murthy	S Chand & Co.	2 nd Edition, 2019
2	Engineering Physics	H K Malik , A.K. Singh,	McGraw Hill Education	2 nd Edition, 2017
3	Optics	Ajoy Ghatak	Mc Graw Hill Education	6 th Edition, 2017

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering Physics	G Vijayakumari	Vikas Publications	8 th Edition, 2014
2	Concepts of Modern Physics	Arthur Beiser	Tata McGraw Hill Publications	6th Edition 2003
3	Engineering Physics	Aruldas G.	PHI Pvt. Ltd	2 nd Edition, 2015
4	Fiber Optic Communications	Gerd Keiser	Springer	2021
5	A Text Book of Engineering physics	I. Dominic, A. Nahari	OWL Publications	2 nd Edition, 2016
6	Advanced Engineering Physics	Premlet B	Phasor Books	
7	Engineering Physics	Rakesh Dogra	Katson Books	1 st Edition, 2019

Video Links (NPTEL, SWAYAM...)	
Module No	Link ID
1	https://nptel.ac.in/courses/115102124 https://nptel.ac.in/courses/104104085
2	https://nptel.ac.in/courses/115105537
3	https://nptel.ac.in/courses/115102023 https://nptel.ac.in/courses/115101107
4	https://nptel.ac.in/courses/112104212 https://nptel.ac.in/courses/124105004

1. **Continuous Assessment (10 Marks)**

i. **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.

ii. **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.

iii. **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.

iv. **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.

2. 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.

Experiment List

Experiment No.	Experiment (Minimum 10 Experiments)
1	Optical fiber characteristics- Measurement of Numerical aperture.
2	Determination of wavelength of Laser using diffraction grating.
3	Measure the wavelength of Laser using a millimetre scale as a grating.
4	Determination of wavelength of a monochromatic light using Newton's Rings method.
5	Determination of diameter of wire or thickness of thin sheet using Air wedge method.
6	Determination of slit width (diffraction due to a single slit).
7	Measure wavelength of light source using diffraction grating.

8	Determination of resolving power and dispersive power of grating.
9	Characteristics of LED.
10	CRO basics-Measurement of frequency and amplitude of wave forms.
11	Solar Cell- I V and Intensity Characteristics.
12	Melde's experiment- Frequency calculation in Transverse and Longitudinal Mode.
13	LCR circuit –forced and damped harmonic oscillations.
14	Determination of wavelength and velocity of ultrasonic waves using ultrasonic diffractometer.
15	Determination of particle size of lycopodium powder.

SEMESTER S1/S2
CHEMISTRY FOR PHYSICAL SCIENCE

Course Code	25CHT102	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 + Lab

Course Objectives:

1. To equip students with a thorough understanding of chemistry concepts 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 quality of life.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Engineering Materials Fuels: Calorific value – HCV and LCV – Experimental determination of calorific value of solid fuels. Analysis of coal – Proximate analysis- Octane & Cetane Number. Biofuels- Biodiesel- Green Hydrogen. Lubricants: Classification - Solid, Semisolid and Liquid lubricants. Properties of lubricants - Viscosity Index, Flash point, Fire point, Cloud Point, Pour Point & Aniline Point. Cement: Manufacture of Portland cement – Theory of setting and hardening of cement.	9

	Nanomaterials: Classification based on Dimension & Materials- Synthesis – Sol gel & Chemical Reduction - Applications of nanomaterials – Supercapacitor Materials - Carbon Nanotubes, Fullerenes & Graphene – structure, properties & application. Polymers: ABS & Kevlar -Synthesis, properties and applications. Conducting Polymers- Classification – Application	
2	Electrochemistry and Corrosion Science 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 & H₂-O₂ fuelcell (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

3	Instrumental Methods of Analysis Molecular 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 CO₂ and H₂O –Applications Thermal analysis: –TGA- Principle, instrumentation (block diagram) and applications – TGA of CaC₂O₄.H₂O and polymers. DTA-Principle, instrumentation (block diagram) and applications - DTA of CaC₂O₄.H₂O. Chromatography- Gas Chromatography- Principle-Instrumentation- Application – Analysis of chemical composition of exhaust gases. Electron Microscopic Techniques: SEM - Principle, instrumentation and Applications.	9
4	Environmental Chemistry 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 Waste Management: Air Pollution- Sources & Effects- Greenhouse Gases- Ozone depletion. Control methods. Sewage water treatment- Primary, Secondary and Tertiary - Flow diagram -Trickling filter and UASB process. Solid waste-disposal methods- Composting, Landfill & Incineration.	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Continuous Assessment	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Internal Examination- 3 (Lab Examination)	Total
5	10	10	10	5	40

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 (8x3 =24marks)	- 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 subdivisions. (4x9 = 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	Describe the use of various engineering materials in different industries.	K2
CO2	Explain the Basic Concepts of Electrochemistry and Corrosion to Explore the Possible Applications in Various Engineering Fields.	K2
CO3	Apply appropriate analytical techniques for different engineering Materials	K3
CO4	Outline various water treatment and waste management methods	K2

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

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										2
CO2	3	3										2
CO3	3	3										2
CO4	3	3				2	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	4 th 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/104/106/104106137/ https://archive.nptel.ac.in/courses/113/105/113105102/ https://archive.nptel.ac.in/courses/113/104/113104082/ 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 (KMnO_4 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 S2
**ENGINEERING GRAPHICS AND COMPUTER AIDED
DRAWING**

Course Code	25EST103	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	2-0-2-0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	CourseType	Theory & Lab

Course Objectives:

1. To learn the principles and techniques of dimensioning and preparation of drawings
2. To develop the ability to accurately interpret engineering drawings
3. To learn the features of CAD software

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction: Relevance of technical drawing in engineering field. Types of lines, Dimensioning, BIS code of practice for technical drawing. (No questions for the end semester examination) Projection of points in different quadrants, Projection of straight lines inclined to one plane and inclined to both planes. Traces of a line. Inclination of lines with reference planes True length and true inclinations of line inclined to both the reference planes.	9
2	Projection of Simple solids such as Triangular, Rectangle, Square, Pentagonal and Hexagonal Prisms, Pyramids, Cone Cylinder and tetrahedron. Projection of solids in simple position including profile view. Projection of solids with axis inclined to one of the reference planes and with axis inclined to both reference planes.	9

3	Sections of Solids: Sections of tetrahedron, Prisms, Pyramids, Cone, Cylinder with axis in vertical position and cut by different section planes. True shape of the sections. (Exclude true shape given problems) Development of Surfaces: Development of surfaces of the solids and solids cut by different section planes. (Exclude problems with through holes)	9
4	Isometric Projection: Isometric scale- Isometric View and Projections of Prisms, Pyramids, Cone, Cylinder, Frustum of Pyramid, Frustum of Cone, Sphere, Hemisphere and their combinations. Computer Aided Drawing (CAD): Introduction, Role of CAD in design and development of new products, Advantages of CAD. Creating two-dimensional drawing with dimensions using suitable software. (CAD, only internal evaluation)	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination -1(Written)	Internal Examination - 2(Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

Student can choose any one full question out of two questions from each module

2 Questions from one module. Total 8 Questions, each question carries 15 marks (15x4 =60marks)	Total
	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 plot the projection of points and lines located in different quadrants	K3
CO2	Prepare Multiview orthographic projections of objects by visualizing them in different positions	K3
CO3	Plot sectional views and develop surfaces of a given object	K3
CO4	Prepare pictorial drawings using the principles of isometric Projection	K3
CO5	Sketch simple drawing using cad tools.	K3

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

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										
CO2	3	2										
CO3	3	2										
CO4	3	2										
CO5	3	2	2		3							

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering Graphics	Varghese, P. I.	V I P Publishers	1st Edition 2012
2	Engineering Graphics,	Benjamin, J.	Pentex Publishers	5 th Edition 2017
3	Engineering Graphics for degree	John, K. C.	Prentice Hall India Publishers	Published in 2011
5	Engineering Graphics,	Anilkumar, K. N.	Adhyuth Narayan Publishers	10 th Edition 2016

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering Graphics with AutoCAD,	Kulkarni, D. M., Rastogi, A. P. and Sarkar, A. K.	Prentice Hall India Publishers	2009
2	Engineering Drawing & Graphics	Venugopal, K.	New Age International Publishers	4 th edition 2007
3	Engineering Drawing	Parthasarathy, N. S., and Murali, V.	Oxford University Press	2015

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/112/102/112102304/
2	https://archive.nptel.ac.in/courses/112/102/112102304/
3	https://archive.nptel.ac.in/courses/112/102/112102304/
4	https://archive.nptel.ac.in/courses/112/102/112102304/

SEMESTER S2

BASIC ELECTRICAL & ELECTRONICS ENGINEERING

Course Code	25EST204	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	4:0:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Apply fundamental concepts and circuit laws to solve simple DC/AC electric circuits
2. Develop an awareness on the fundamentals of electric power generation, transmission and distribution
3. Compare different types of DC and AC motors
4. Describe the fundamental concepts of electronic components and devices
5. Outline the basic principles of an electronic instrumentation system
6. Identify important applications of modern electronics in the contemporary world

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Generation of alternating voltages: - Faradays laws of Electromagnetic induction, Generation of Alternating Voltage, Elementary Generator, Representation of ac voltage and currents, sinusoidal waveforms: frequency, period average, RMS values and form factor of waveform; (Simple numerical problems) DC Circuits: Resistance in Series and Parallel, Ohms Law and Kirchhoff's laws, Voltage and current divider rule (Simple numerical problems)	11

	AC circuits: Purely resistive, inductive and capacitive circuits; Inductive and capacitive reactance, concept of impedance. (Simple numerical problems) Three phase AC systems: Representation of three phase voltages; star and delta connections (balanced only), relation between line and phase voltages, line and phase currents Power in AC circuits – Power factor; active, reactive and apparent power in single phase and three phase system. (Simple numerical problems)	
2	Generation of electrical energy: Conventional Sources: Hydro, thermal, nuclear plants (Block diagram description) Introduction to non-conventional energy sources: solar, wind, small hydroplants, PV system for domestic application. Transformers. Principle of operation, step-up and step-down transformers AC power supply scheme: Single phase and three phase system, Three phase 3 wire and 4 wire systems, Transmission System, Distribution system: Feeder, distributor, service mains Types of Motors – Principle of Operation: Block diagram showing power stages, losses and efficiency (electrical and mechanical and overall efficiency); Simple numerical efficiency Introduction to different types of DC and AC motors. Classification and different type of dc and ac motors, common applications: Principle of operation and applications Earthing: need for earthing, Types of earthing; pipe earthing, plate earthing; Principle of operation of MCB, ELCB/RCCB	11

3	Introduction to Semiconductor devices: Electronic components- Passive and active components - Resistors, Capacitors and Inductors (constructional features not required): types, specifications. Standard values, colour coding. PN Junction diode: - Principle of operation, V-I characteristics. Bipolar Junction Transistors: PNP and NPN structures, Principle of Operation	11
	Digital Electronics: -Binary number system, Boolean algebra and Logic Gates, Universal gates. Basic electronic circuits: - Rectifiers and power supplies: Block diagram description of a dc power supply, working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator. Amplifiers: - Transistor as an amplifier, Block diagram of Public Address system	
4	Electronic Instrumentation: Quality of measurements -accuracy, precision, sensitivity and resolution, Working principle and applications of Sensors – pressure – strain gauge, Bourden gauge, temperature – RTD, thermocouple, proximity – capacitive sensor, ultrasonic sensor and accelerometer. Internet of things (IoT): Introduction, architecture of IoT, Implementation of smart city – street lighting, smart parking.	11

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

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 (8x3 = 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 subdivisions. (4x9 = 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 fundamental concepts and circuit laws to solve simple DC/AC electric circuits	K2
CO2	Develop an awareness on the fundamentals of electric power generation, transmission and distribution	K3
CO3	Compare different types of DC and AC motors	K2
CO4	Describe the fundamental concepts of electronic components and Devices	K2
CO5	Outline the basic principles of an electronic instrumentation System	K2
CO6	Identify important applications of modern electronics in the contemporary world	K2

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

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										2
CO2	3		2			2	1					2
CO3	3					1						2
CO4	3	1										2
CO5	3		1									2
CO6	3					2	1					2

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Basic Electrical Engineering	D P Kothari and I J Nagrath	Tata McGraw Hill	4/e 2019
2	Schaum's Outline of Basic Electrical Engineering	J.J.Cathey and Syed A Nasar	Tata McGraw Hill	
3	Basic Electronics: Principles and Applications	Chinmoy Saha, Arindham Halder and Debarati Ganguly	Cambridge University Press	1/e 2018
4	Basic Electrical and Electronics Engineering	D. P. Kothari and I. J. Nagrath	McGraw Hill	2/e 2020
5	The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World	Michael Miller	QUE	1/e 2015
6	Basic Electronics and Linear Circuits	N N Bhargava D C Kulshreshtha and S. C. Gupta	McGraw Hill	2/e 2017
7	Electronic Communication Systems	Kennedy and Davis	McGraw Hill	6/e 2017

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Basic Electrical Engineering	D C Kulshreshtha	Tata McGraw Hill	2/e 2019
2	Electrical Engineering Fundamentals	Del Toro V	Pearson Education	2/e 2019
3	Basic Electrical Engineering	T. K. Nagsarkar, M. S.Sukhija	Oxford Higher Education	3/e 2017
4	Electronics: A Systems Approach	Neil Storey	Pearson	6e 2017
5	Electronic Devices and Circuit Theory	Robert L. Boylestad Louis Nashelsky	Pearson	11e 2015
6	Principles of Electronic Communication Systems	Frenzel, L. E	McGraw Hill	4e 2016
7	Internet of Things: Architecture and Design Principles	Raj Kamal	McGraw Hill	1/e 2017
8	Electronic Communication	Dennis Roddy and John Coolen	McGraw Hill	4/e 2008
9	Basic Electrical Engineering	D C Kulshreshtha	Tata McGraw Hill	2/e 2019

SEMESTER S2
ENGINEERING ENTREPRENEURSHIP AND IPR
(Common to all Branches)

Course Code	25EST206	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	40
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

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.	Syllabus 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 Competitor analysis • Identify competitors • Competitor profiling • SWOT analysis • Market positioning • Customer feedback and reviews • Pricing analysis • Differentiation strategy	9
	• 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):

Attendance	Micro Project	Internal Ex-1	Internal Ex-2	Total
5	35	10	10	60

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 (6x2 =12 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 subdivisions. Each question carries 7 marks. (4x7 = 28 marks)	40

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Gain foundational knowledge of Innovation and Entrepreneurship, Intellectual Property Rights (IPR) and their importance for startups.	K2
CO2	Develop a framework for identifying, curating and validating engineering-based business ideas.	K3
CO3	Learn essential tools for understanding product-market fit and customer needs.	K3
CO4	Create a comprehensive business plan for a new venture.	K6
CO5	Develop skills for prototyping, stakeholder engagement, and team collaboration.	K4

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

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	3	3	3						
CO2	2	2	3	3	3	3	3	3	3			
CO3	2	2	2	2	2	3	3	3	3	2	2	2
CO4	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	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	2 nd edn, 2004
2	The Innovator's DNA	Clayton M. Christensen and Jeffrey H. Dyer	Harvard Business Review Press;	Revised edition (June 4, 2019)
3	Start with Why	Simon sinek	Portfolio	Reprint edition (December 27, 2011)
4	Business Model Generation	Alexander Osterwalder & Yves Pigneur	Wiley	2010
5	The Engineering Entrepreneur: A Practical Guide to Starting and Running a Successful Engineering Business in India	Saibal Gupta and Ashok Jhunjhunwala	Sage Publications	2011
6	Innovation and Entrepreneurship for Engineers	Bharat Bhushan and Seema Bhushan	CRS Press	2016
7	Indian Patent Law	P. Narayanan	Eastern Book Company	2 nd edn/ 2020
8	The Law of Copyright and Designs	B.L. Wadehra	Universal Law	5 th edn/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 S1/S2
HEALTH AND WELLNESS
(Common to all Groups)

Course Code	25HUT106	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	1:0:1:0	ESE Marks	0
Credits	1	Exam Hours	Nil
Prerequisites (if any)	None	Course Type	

Course Objectives:

1. To provide essential knowledge on physical activity, health, and wellness.
2. To ensure students understand body systems, exercise principles, nutrition, mental health, and disease management.
3. To educate students on the benefits of yoga, the risks of substance abuse and basic first aid skills.
4. To equip students with the ability to lead healthier lifestyles.
5. To enable students to design effective and personalized exercise programs.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Human Body Systems related to Physical activity and its functions: Respiratory System - Cardiovascular System. Musculoskeletal System and the Major Muscle groups of the Human Body. Quantifying Physical Activity Energy Expenditure and Metabolic equivalent of task (MET) Exercise Continuum: Light-intensity physical activity, Moderate - intensity physical activity, Vigorous -intensity physical activity. Defining Physical Activity, Aerobic Physical Activity, Anaerobic Physical Activity, Exercise and Health-Related Physical Fitness. FITT principle to design an Exercise programme Components of Health-related Physical Fitness: - Cardiorespiratory Fitness- Muscular strength- Muscular endurance- Flexibility- Body composition.	4
2	Concept of Health and Wellness: Health and wellness differentiation, Factors affecting health and wellness. Mental health and Factors affecting mental health. Sports and Socialization: Sports and character building - Leadership through Physical Activity and Sports Diet and nutrition: Exploring Micro and Macronutrients: Concept of Balanced diet - Carbohydrate & the Glycemic Index Animal & Plant - based Proteins and their Effects on Human Health Dietary Fats & their Effects on Human Health Essential Vitamins and Minerals	2

3	Lifestyle management strategies to prevent / manage common hypokinetic diseases and disorders - Obesity - Cardiovascular diseases (e.g., coronary artery disease, hypertension) - Diabetes - Osteoporosis - Musculoskeletal disorders (e.g., osteoarthritis, Low back pain, Kyphosis, lordosis, flat foot, Knock knee) Meaning, Aims and objectives of yoga - Classification and importance of of Yogic Asanas (Sitting, Standing, lying) Pranayama and Its Types - Active Lifestyle and Stress Management Through Yoga Understanding on substance abuse and addiction - Psychoactive substances & its ill effects- Alcohol- Opioids- Cannabis -Sedative - Cocaine -Other stimulants, including caffeine - Hallucinogens -Tobacco -Volatile solvents.	4
4	First aid and principles of First Aid: Primary survey: ABC (Airway,Breathing, Circulation). Qualities of a Good First Aider First aid measures for: - Cuts and scrapes - Bruises - Sprains - Strains -Fractures - Burns - Nosebleeds. First Aid Procedures: Cardiopulmonary Resuscitation (CPR) - HeimlichManeuver - Applying a sling Sports injuries: Classification (Soft Tissue Injuries - Abrasion, Contusion, Laceration, Incision, Sprain & Strain)	2

Additional Topics

- Need and Importance of Physical Education and its relevance in interdisciplinary context. Understanding of the Endocrine System
- Developing a fitness profile
- Healthy foods habits for prevention and progression of Lifestyle Diseases. Processed foods and unhealthy eating habits.
- Depression - Anxiety - Stress
- Different ways of carrying an injured person. Usage of Automated external defibrillator

**Course Assessment Method
(CIE: 50 marks)**

Continuous Internal Evaluation Marks (CIE):

Attendance	Case Study/Micro project/Presentation	Activity evaluation	Total
10	20	20	50

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the different human body systems and describe various types of physical activities along with methods to measure and quantify these activities.	K2
CO2	Explain how to maintain or improve health and wellness through psychological practices, dietary habits, and sports activities.	K2
CO3	Discuss about common hypokinetic disorders and musculoskeletal disorders, and describe the importance of leading a healthy lifestyle through the practice of yoga and abstaining from addictive substances.	K2
CO4	Explain the basics of first aid and describe common sports Injuries	K2

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

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				2		3		3	3	2		2
CO2				2		3		2	2			2
CO3						3		3				2
CO4				2		3						2

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Foundations of Nutrition	Bhavana Sabarwal	Commonwealth Publishers	1999
2	Anatomy and physiology in health and illness.	Ross and Wilson	Waugh, A., & Grant, A.	2022

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fit to be Well Essential Concept	Thygerson, A. L., Thygerson, S. M., & Thygerson, J. S.	Jones & Bartlett Learning.	2018
2	Introduction to physical education, fitness, and sport.	Siedentop, D., & Van der Mars, H.	Human kinetics.	2022
3	Substance Use Disorders. Manual for Physicians.	Lal, R., & Ambekar, A.	National Drug Dependence Treatment Centre, New Delhi	2005
4	The exercise health connection-how to reduce your risk of disease and other illnesses by making exercise your medicine.	Nieman, D. C., & White, J. A	Public Health	1998
5	ACSM's resource manual for guidelines for exercise testing and prescription.	Lippincott Williams & Wilkins.	American College of Sports Medicine.	2012

6	Exercise Physiology: energy, nutrition and human performance.	Katch, F. I., Katch, V. L., & McArdle, W. D.	Lippincott Williams & Wilkins	2010
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Continuous Internal Evaluation Marks (CIE): for the Health and wellness course

Students will be evaluated as follows.

Title	Method of Evaluation
Attendance	Students must attend at least 75% of both theory and practical classes. They will receive 10 marks based on their class attendance. Students who do not meet the minimum attendance requirement for a course, as specified in the B. Tech regulations, will not be eligible to proceed to the next criteria.
Assignment / Presentation	Assignments will be given to students to assess their understanding of the subjects taught. Students will be required to make presentations on the subjects taught in class, and their understanding of the subjects will be assessed. Based on the Assignments and Presentations the students will be awarded marks out of 20
Activity Evaluation	The Assignment / Presentation faculty handling the class will use the tests from the Fitness Protocols and Guidelines for ages 18+ to 65 years, as set forth by FIT India. Measurements will be taken for all the tests of the FIT India Fitness Protocol and the evaluation will be based on the benchmark score received for the following tests: 1. V Sit Reach Test 2. Partial Curl Up - 30 seconds 3. Push Ups (Male) and Modified Push Up (Female) 4. Two (2) Km Run/Walk Students who achieve a total benchmark score of 8 across the aforementioned 4 tests will be awarded pass marks for activity evaluation. Students who score better will be awarded a maximum mark of 20.

Activity Evaluation - Special Circumstances	Physically challenged and medically unfit students can opt for an objective test to demonstrate their knowledge of the subjects taught. Based on their performance in the objective test, they will be awarded marks out of 20.
Activity Evaluation - Special Considerations - NCC	Students who enrolled themselves in the NCC during the course period (between the start and end dates of the program) and attended 5 college level parades will be awarded pass marks for activity evaluation. Students who attend more parades will be eligible for a maximum mark of 20 based on their parade attendance.

Tests to evaluated as per Criterion - 2 and Benchmark Scores

V Sit Reach Test

How to Perform:

1. The subject removes their shoes and sits on the floor with the measuring line between their legs and the soles of their feet placed immediately behind the baseline, heels 8-12" apart.
2. The thumbs are clasped so that hands are together, palms facing down and placed on the measuring line.
3. With the legs held flat by a partner, the subject slowly reaches forward as far as possible, keeping the fingers on baseline and feet flexed.
4. After three tries, the student holds the fourth reach for three seconds while that distance is recorded.
5. Make sure there are no jerky movements, and that the fingertips remain level and the legs flat.

Infrastructure/Equipment Required:

1. A tape for marking the ground, marker pen, and ruler.
2. With the tape mark a straight line two feet long on the floor as the baseline, and a measurement line perpendicular to the midpoint of the baseline extending two feet on each side.
3. Use the marker pen to indicate every centimeter and millimeter along the measurement line. The point where the baseline and the measuring line intersect is the zero point.

Scoring: The score is recorded in centimeters and millimeters as the distance reached by the hand, which is the difference between the zero point (where the baseline and measuring line intersect) and the final position.

Scoring for V Sit Reach Test for Males

Level	Benchmark Score	Measurement (cm)
1	2	<11
2	4	12-13
3	6	14-17
4	7	18-19
5	8	20-21
6	9	22
7	10	>22

Scoring for V Sit Reach Test for Females

Level	Benchmark Score	Measurement (cm)
1	2	<14
2	4	15-16
3	6	17-19
4	7	20-21
5	8	22
6	9	23
7	10	>23

Partial Curl Up - 30 seconds

How to Perform:

1. The subject lies on a cushioned, flat, clean surface with knees flexed, usually at 90 degrees, with hands straight on the sides (palms facing downwards) closer to the ground, parallel to the body.
2. The subject raises the trunk in a smooth motion, keeping the arms in position, curling up the desired amount (at least 6 inches above/along the ground towards the parallel strip).
3. The trunk is lowered back to the floor so that the shoulder blades or upper back touch the floor.

Infrastructure/Equipment Required:

Flat clean cushioned surface with two parallel strips (6 inches apart), Stopwatch Scoring:

Record the maximum number of Curl ups in a certain time period 30 seconds. **Scoring**

for Partial Curl Up - 30 seconds Test for Males

Level	Benchmark Score	Numbers
1	2	<25
2	4	25-30
3	6	31-34
4	7	35-38
5	8	39-43
6	9	44-49
7	10	>49

Scoring for Partial Curl Up - 30 seconds Test for Females

Level	Benchmark Score	Numbers
1	2	<18
2	4	18-24
3	6	25-28
4	7	29-32
5	8	33-36
6	9	37-43
7	10	>43

Push Ups for Male/Modified Push Ups for Female**How to Perform:**

1. A standard push up begins with the hands and toes touching the floor, the body and legs in a straight line, feet slightly apart, the arms at shoulder width apart, extended and at a right angle to the body.
2. Keeping the back and knees straight, the subject lowers the body to a predetermined point, to touch some other object, or until there is a 90-degree angle at the elbows, then returns back to

the starting position with the arms extended.

3. This action is repeated, and the test continues until exhaustion, or until they can do no more in rhythm or have reached the target number of push-ups.

4. For Female: push-up technique is with the knees resting on the ground.

Infrastructure/Equipment Required:

Flat clean cushioned surface/Gym mat

Scoring: Record number of correctly completed pushups.

Scoring for Push Ups for Male

Level	Benchmark Score	Numbers
1	2	<4
2	4	04- 10
3	6	11 -18
4	7	19-34
5	8	35-46
6	9	47-56
7	10	>56

Scoring for Modified Push Ups for Female

Level	Benchmark Score	Numbers
1	2	0-1
2	4	2 - 5
3	6	6 -10
4	7	11 - 20
5	8	21-27
6	9	27-35
7	10	>35

2 Km Run/Walk

How to Perform:

1. Participants are instructed to run or walk 2 kms in the fastest possible pace.
2. The participants begin on signal (Starting point)- “ready, start”. As they cross the finish line, elapsed time should be announced to the participants.
3. Walking is permitted but the objective is to cover the distance in the shortest possible time.

Infrastructure/Equipment Required:

Stopwatch, whistle, marker cone, lime powder, measuring tape, 200 or 400 m with 1.22 m (minimum 1 m) width preferably on a flat and even playground with a marking of starting and finish line. You can also use any application on your mobile phone that tells you the distance.

Scoring: Time taken for completion (Run or Walk) in min, sec.

Scoring for 2Km Run/walk for Male

Level	Benchmark Score	Minutes : Seconds
1	2	> 11:50
2	4	10:42
3	6	09:44
4	7	08:59
5	8	08:33
6	9	07:37
7	10	>07:37

Scoring for 2Km Run/walk for Female

Level	Benchmark Score	Minutes: Seconds
1	2	>13:47
2	4	12:51
3	6	12:00
4	7	11:34
5	8	10:42
6	9	09:45
7	10	>09:45

SEMESTER - S1/S2
LIFE SKILLS AND PROFESSIONAL COMMUNICATION
(Common to all Branches)

Course Code	25HUT107	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 objectives:

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 semester. 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 Table

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 members	L	1	G	-	• Connecting with group members • Time management - Gantt Chart	
1.2	Familiarizing the activities and preparation of the time plan for the activities	L	1	G	-		
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-	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	Compiling of ideas • Mind mapping	CO1
2.4	Discuss the skills identified through rolestorming 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 other’s life	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 (atleast 1 through LinkedIn)	SS	3	I	2	• Workplace awareness • Listening • Communication - interacting with people • Networking through various media including LinkedIn • Discussion in groups • Report preparation • Creativity Goal setting - Preparation of action plan	
4.2	Interact with them to understand their workplace details including • workplace skills required • their work experience • activities 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	SS	3	I	4		CO2
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 workplace 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

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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	I	2		CO4
5.3	Use any online tech forum to gather ideas for solving the problem chosen	SS	6	G	2		CO5
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-	SS	7	G	2		CO4

	solving experience						
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 minutes)	SS	10	G	3	Diversity	CO2, CO5
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	I	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		CO4, CO5

B. Tech 2025 Scheme - S1-S8 Syllabus

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
	i) their parent/guardian/mentor ii) their friend/sibling/cousin						
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 practiced during their B.Tech years, in order to achieve the set Goals	SS	1	I	2		CO1
2.4	Discuss the skills identified through 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 other's life	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	

B. Tech 2025 Scheme - S1-S8 Syllabus

4.2	Interact with them to understand their workplace details including • workplace skills required • their work experience • activities 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	SS	3	I	4	• people • Networking through various media including LinkedIn • Discussion in groups • Report preparation • Creativity • Goal setting - Preparation of action plan	CO2
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 workplace dynamics assimilated through interactions and group discussions	L	5	G	4	B. Tech 2025 Scheme - S1-S8 Syllabus	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	I	2		CO4
5.3	Use any online tech forum to gather ideas for solving the problem chosen	SS	6	G	2		CO5
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		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		CO2
8	Prepare a short video presentation on diversity aspects observed in our society (3 to 5 minutes)	SS	10	G	3		CO2, CO5
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	I	2		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		CO4, CO5
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 (P): 24 Marks

SI 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. 3. Filing, finishing and smoothening using electrically operated hand grinders. 4. MS rod cutting using Hack saw by holding the work in bench wise. 5. Study and handling different types of measuring instruments. 6. Welding of MS, SS work pieces. 7. Pipe bending practice (PVC and GI). 8. Water tap fitting. 9. Water tap rubber seal changing practice. 10. Union and valves connection practice in pipes. 11. Foot valve fitting practice. 12. Water pump seal and bearing changing practice.	24	Basic practical engineering skills	3
2	Language Lab sessions	-	Language Skills	4

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop the ability to know & understand oneself, show confidence in one's potential & capabilities, set goals and develop plans to accomplish tasks	K5
CO2	Develop the ability to communicate and connect with others, participate in groups/teams, empathise, respect diversity, be responsible and understand the need to exercise emotional intelligence	K5
CO3	Develop thinking skills, problem-solving and decision-making skills	K5
CO4	Develop listening, reading, writing & speaking skills, ability to comprehend & successfully convey any idea, and ability to analyze, interpret & effectively summarize textual, audio & visual content	K6
CO5	Develop the ability to create effective presentations through audio-visual mediums with the use of technology tools and initiate effective use of social media platforms & tech forums for content delivery and discussions	K6
CO6	Initiate profile-building exercises in line with the professional requirements, and start networking with professionals/academicians	K6

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										1		3
CO2					1			3		3		3
CO3		1	1		1					1		1
CO4					1					1		2
CO5					1	1				1		2
CO6					1					1		

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

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 S2
BASIC ELECTRICAL AND ELECTRONICS ENGINEERING
WORKSHOP

(Common except for Civil Engineering Branch)

Course Code	25ESL107	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:2:0	ESE Marks (Internal only)	50
Credits	1	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Lab

Course Objectives:

1. Demonstrate safety measures against electrical shocks
2. Develop familiarity with transformers, rheostats, batteries and earthing schemes
3. Develop the connection diagram and identify the suitable accessories necessary for wiring simple electric circuits
4. Identify various electronic components
5. Operate various measuring instruments
6. Design simple electronic circuits on breadboard and PCB
7. Build the ability to work in a team with good interpersonal skills.

Expt. No.	Experiments (Minimum of 7 Experiments to be done)
1	a) Demonstrate the precautionary steps adopted in case of Electrical shocks. b) Identify different types of cables, wires, switches, fuses, fuse carriers, MCB, ELCB and MCCB, familiarise the ratings.
2	Wiring of a simple light circuit for light/ fan point (PVC conduit wiring) and a 6A plug socket with individual control.
3	Wiring of light/fan circuit using two-way switches. (Staircase wiring)
4	Wiring of fluorescent lamp and a power plug (16 A) socket with a control switch.

5	Wiring of power distribution arrangement using single phase MCB distribution board with ELCB, main switch and Energy meter.
6	Familiarization of step up and step-down transformers, (use low voltage transformers) Measurement and representation of voltage and waveform to scale in graph sheet with the help of CRO
7	Familiarization of rheostats, measurement of potential across resistance elements and introducing the concept of relative potential using a DC circuit.
8	a) Identify battery specifications using different types of batteries.(Lead acid, Li Ion,NiCd etc.) b) Familiarize different types of earthing (Pipe, Plate Earthing, Mat Schemes) and ground enhancing materials (GEM).
ELECTRONICS WORKSHOP (Minimum of 7 Experiments to be done)	
1	Familiarization/Identification of electronic components with specification (Functionality, type, size, colour coding, package, symbol and cost of -Active, Passive, Electrical, Electronic, Electro-mechanical, Wires, Cables, Connectors, Fuses, Switches, Relays, Crystals, Displays, Fasteners, Heat sink etc.)
2	Drawing of electronic circuit diagrams using BIS/IEEE symbols and Interpret data sheets of discrete components and IC's
3	Familiarization/Application of testing instruments and commonly used tools. - Multimeter, Function generator, Power supply, CRO, DSO. Soldering iron, Desoldering pump, Pliers, Cutters, Wire strippers, Screw drivers, Tweezers, Crimping tool, Hot air soldering and de- soldering station
4	Testing of electronic components using multimeter - Resistor, Capacitor, Diode, Transistor and JFET.
5	Printed circuit boards (PCB) - Types, Single sided, Double sided, PTH, Processing methods. Design and fabrication of a single sided PCB for a simple circuit.
6	Inter-connection methods and soldering practice. Bread board, Wrapping, Crimping, Soldering - types - selection of materials and safety precautions. Soldering practice in connectors and general-purpose PCB, Crimping.

7	Assembling of electronic circuit/system on general purpose PCB, test and show the functioning (Any two)- • Fixed voltage power supply with transformer • Rectifier diode
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	• Capacitor filter • Zener/IC regulator • Square wave generation using IC 555 timer in IC base.
8	Assembling of electronic circuits using SMT (Surface Mount Technology) stations.
9	Introduction to EDA tools (such as KiCad or Xcircuit)

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work, experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Total
5	45	50

End Semester Examination Marks (ESE): (Internal evaluation only)

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	15	10	10	5	50

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

Pass Criteria:

- *A student must score a minimum of 50% overall, combining marks from both Continuous Internal Evaluation (CIE) and End Semester Examination (ESE).*
- *In addition, the student must secure at least 40% in the End Semester Examination (ESE).*

The ESE shall be conducted internally, with evaluation carried out by a panel of

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faculty members. This panel must include at least one faculty member who was not involved in the Continuous Internal Evaluation (CIE) of the lab course.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Demonstrate safety measures against electrical shocks	K2
CO2	Familiarise with transformers, rheostats, batteries and earthing Schemes	K2
CO3	Illustrate the connection diagram and identify the suitable accessories necessary for wiring simple electric circuits	K3
CO4	Identify various electronic components	K2
CO5	Select and Operate various measuring instruments	K3
CO6	Apply the design procedure of simple electronic circuits on breadboard and PCB	K3
CO7	Build the ability to work in a team with good interpersonal skills	K3

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

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						3						2
CO2	1					2	1					2
CO3	2					1						2
CO4	3					2						3
CO5	3				3	2			2			3
CO6	3		3	1	3	2	1		2			3
CO7									3	2		2

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Electrical Design Estimating and Costing	K B Raina and S K Bhattacharya	New Age International Publishers	2/e 2024
2	Electrical Systems Design	M K Giridharan	I K International Publishing House Pvt. Ltd	3/e 2022
3	Basic Electrical Engineering	D P Kothari and I J Nagrath	Tata McGraw Hill	4/e 2019
4	Basic Electronics and Linear Circuits	NN Bhargava, D C Kulshreshtha and S C Gupta	Mc Graw Hill	2/e 2017

Continuous Assessment with equal weightage for both specialisations (45 Marks)

1. Preparation and Pre-Lab Work (10 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 (15 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 (10 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 (10 Marks)

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

Evaluation Pattern for End Semester Examination with equal weightage in both specializations (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 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.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

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

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

PROGRAMME CORE 1

SEMESTER S2
TRANSDUCERS & MEASUREMENTS
(MECHATRONICS ENGINEERING)

Course Code	25MRT205	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)	None	Course Type	Theory

Course Objectives:

1. To provide students with a comprehensive understanding of various types of transducers used in engineering applications, including their principles of operation and characteristics.
2. To familiarize students with different measurement techniques and instruments commonly used in engineering, enabling them to apply these techniques effectively for accurate measurement and analysis in practical scenarios

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to transducers and sensors Definition of sensors and transducers –Mechanical devices as Primary Detectors-Pressure Sensitive Primary Devices- Temperature Detectors- Hydro pneumatic Devices. Electric Transducers. Advantages of Electrical Transducers. Classification of Electrical Transducers- Primary and Secondary Transducers, Active and Passive Transducers, Analog and Digital Transducers. Electrical Phenomena Used in Transducers.	11

2	Resistive Transducers- Potentiometers, Strain gauges-gauge factor- Resistance Thermometers, Thermistors. Capacitance transducers - piezo electric transducers – Inductive transducers: LVDT characteristics-photoelectric sensors – Hall Effect transducers - measuring circuits-calibration- Optical transducers. Ionization transducers. Digital Transducer. Shaft Encoder.	11
3	Measurements and Measurement Systems Measurements- Significance of Measurements- Methods of Measurement: Direct & Indirect Methods-Instruments-Mechanical, Electrical and Electronic instruments- Classification of Instruments- Analog and Digital Modes of Operation-Functions of Instruments and Measurement Systems- Applications of Measurement Systems- Elements of a Generalized Measurement System- Characteristics of Instruments and Measurement Systems: Measurement system Performance- Static Calibration- Static Characteristics- Errors in Measurements-True Value-Static Error- Static Correction -Scale Range and Scale Span- Error Calibration Curve- Reproducibility and Drift- Accuracy and Precision, Linearity. Hysteresis-type of errors- classification of errors	11
4	DC bridges: introduction, sources and detectors-General Equation- Types of bridges: Wheatstone, Kelvin bridge- AC bridges: introduction, sources and detectors-General equation. Maxwell's inductance and Maxwell's inductance -capacitance bridge. Cathode ray oscilloscopes: principles, construction and limitations- Digital storage oscilloscopes: principles- Measurements using CRO s and DSOs- Recording instruments: Strip chart recorder, X-Y Plotter, LCD displays.	11

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

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 (8x3 = 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 subdivisions. (4x9 = 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	Summarize the concepts of sensors, transducers and classify various transducers.	K2
CO2	Apply the principles and functions of various types of Transducers in measuring systems.	K3
CO3	Illustrate the working principles of electronic measuring instruments and identify various types of errors in measuring systems and choose methods for minimization of the errors.	K3
CO4	Explain the concepts of CRO, DSO, various recording devices.	K2
CO5	Understand and utilize various measurement systems, enhancing their capability to apply theoretical knowledge in practical scenarios	K2

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

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3				1							3
CO2	3				1							3
CO3	3	2										3
CO4	2											3
CO5	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 Electronic Measurements and Instrumentation	A. K. Sawhney	Dhanpat Rai & Co.	2015 Edition
2	Electronic Instrumentation and Measurements	David A Bell	Oxford University Press	3rd Edition 2013
3	Electronic Instrument Design	Kim R Fowler	Oxford reprint	2 nd Edition, 2015

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Sensors and Transducers,	D .Patranabis	PHI	2nd edition, 2003
2	Electronic Instrumentation and Measurements	Kalsi HS	Mc Graw hill	4th edition, 2019.
3	Electrical Measurements and Measuring systems	Golding E W and Widdis F C	Wheeler&co	1993

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://www.youtube.com/watch?v=1uPTyJxZzyo
2	https://onlinecourses.nptel.ac.in/noc23_ee105/preview
3	https://nptel.ac.in/courses/112107242
4	https://onlinecourses.nptel.ac.in/noc23_ee112/preview https://www.youtube.com/watch?v=0FVzYLEdSA8

SEMESTER 3

MECHATRONICS ENGINEERING

SEMESTER S3**MATHEMATICS FOR ELECTRICAL SCIENCE AND PHYSICAL SCIENCE – 3**

Course Code	25MRT301	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 complex numbers.	Course Type	Theory

Course Objectives:

1. To introduce the concept and applications of Fourier transforms in various engineering fields.
2. To introduce the basic theory of functions of a complex variable, including residue integration and conformal transformation, and their applications

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Fourier Integral, From Fourier series to Fourier Integral, Fourier Cosine and Sine integrals, Fourier Cosine and Sine Transform, Linearity, Transforms of Derivatives, Fourier Transform and its inverse, Linearity, Transforms of Derivative. (Text 1: Relevant topics from sections 11.7, 11.8, 11.9)	9
2	Complex Function, Limit, Continuity, Derivative, Analytic functions, Cauchy-Riemann Equations (without proof), Laplace's Equations, Harmonic functions, Finding harmonic conjugate, Conformal mapping, Mappings of $w=z^2$, $w=e^z$, $w=\frac{1}{z}$, $w=\sin z$ (Text 1: Relevant topics from sections 13.3, 13.4, 17.1, 17.2, 17.4)	9

3	Complex Integration: Line integrals in the complex plane (Definition & Basic properties), First evaluation method, Second evaluation method, Cauchy's integral theorem (without proof) on simply connected domain, Independence of path, Cauchy integral theorem on multiply connected domain (without proof), Cauchy Integral formula (without proof). (Text 1: Relevant topics from sections 14.1, 14.2, 14.3)	9
4	Taylor series and Maclaurin series, Laurent series (without proof), Singularities and Zeros – Isolated Singularity, Poles, Essential Singularities, Removable singularities, Zeros of Analytic functions – Poles and Zeros, Formulas for Residues, Residue theorem (without proof), Residue Integration- Integral of Rational Functions of $\cos\theta$ and $\sin\theta$. (Text 1: Relevant topics from sections 15.4, 16.1, 16.2, 16.3, 16.4)	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 = 24marks)	- 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. (4x9 = 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	Determine the Fourier transforms of functions and apply them to solve problems arising in engineering.	K3
CO2	Understand the analyticity of complex functions and apply it in conformal mapping.	K3
CO3	Compute complex integrals using Cauchy's integral theorem and Cauchy's integral formula.	K3
CO4	Understand the series expansion of complex function about a singularity and apply residue theorem to compute real integrals.	K3

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

CO-PO Mapping Table:

	PO 1	PO2	PO 3	PO4	PO 5	PO6	PO 7	PO 8	PO9	PO1 0	PO1 1
CO1	3	3	-	2	-	-	-	-	-	-	2
CO2	3	3	-	2	-	-	-	-	-	-	2
CO3	3	3	-	2	-	-	-	-	-	-	2
CO4	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	Advanced Engineering Mathematics	Erwin Kreyszig	John Wiley & Sons	10 th edition, 2016

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Complex Analysis	Dennis G. Zill, Patrick D. Shanahan	Jones & Bartlett	3 rd edition, 2015
2	Higher Engineering Mathematics	B. V. Ramana	McGraw-Hill Education	39 th edition, 2023
3	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	44 th edition, 2018
4	Fast Fourier Transform - Algorithms and Applications	K.R. Rao, Do Nyeon Kim, Jae Jeong Hwang	Springer	1 st edition, 2011

SEMESTER S3**ELECTRICAL MACHINES & DRIVES**

Course Code	25MRT302	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)	None	Course Type	Theory

Course Objectives:

1. This course aims the students to learn about the introduction of basics of electrical machines and basic concept of power electronics and machine drives.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	DC MACHINES & TRANSFORMERS DC MACHINES Essential parts of a DC machine – EMF equation – DC generator – working principle – types of DC generators – no load and load characteristics of DC generators – DC motor – working principle – back emf – types of DC motors – equations for torque and power (simple numerical problems) TRANSFORMERS Working principle - Construction - core and shell type - emf equation – voltage transformation ratio (simple numerical problems) – concept of ideal transformer- transformer on no-load, short circuit and open circuit test on transformer (basic concept only) – losses in transformer	11

2	THREE PHASE & SINGLE PHASE INDUCTION MOTORS THREE PHASE INDUCTION MOTOR Constructional details – operation – concept of rotating magnetic field – slip – torque equation - (simple numerical problems) - torque-slip characteristics – starting methods of 3- pahse induction motors SINGLE PHASE INDUCTION MOTOR Working principle – double revolving field theory – different types – split phase – capacitor start – capacitor start- run	11
3	SPECIAL ELECTRICAL MACHINES & INTRODUCTION POWER ELECTRONICS SPECIAL ELECTRICAL MACHINES Universal motor – stepper motor -different types servomotor (mechanism only) - Synchronous motor INTRODUCTION POWER ELECTRONICS Introduction – SCR -symbol, construction and modes of operation – V-I characteristics- Basic concepts of Rectifier – single phase half-wave controlled rectifier with R load – fully controlled bridge rectifier with R load – basic concept of inverter	11
4	ELECTRICAL DRIVES Electrical Drives – Advantages - Parts of electrical drives - Choice of electric drives - Status of DC and AC drives - Dynamics of Electric drives - Fundamental torque equations – Speed torque conventions and multi-quadrant operation - Components of load torque - Nature and classification of load torque – Steady state stability – load equalization	11

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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	Explain the basic concept of dc generator, motor and transformer	K2
CO2	The basic concepts of 3 phase and 1 phase induction motors.	K2
CO3	The basic concept of special electrical machines & introduction to power electronics	K2
CO4	The basic concept of machine drives	K2

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO 1	PO2	PO 3	PO4	PO 5	PO6	PO7	PO 8	PO9	PO1 0	PO1 1
CO1	3	2	2	-	-	2	1	-	-	-	3
CO2	3	3	2	1	-	2	1	-	-	-	3
CO3	3	3	2	1	-	2	1	-	-	-	3
CO4	3	1	1	1	-	2	1	-	-	-	3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Theory and Performance of Electrical machines	J B Gupta	S K Kataria & sons	First Edition 1967; Fifteenth Edition 2015
2	Power Electronics	P.S. Bimbhra	Khanna Publishers, New Delhi	Fifth Edition 1990
3	Fundamentals of Electrical Drives	Gopal K. Dubey	Narosa Publishing House	Second Edition 2002

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Principles Of Electrical Machines	V.K. Mehta, Rohit Mehta	S Chand Publication	Reprint Edition 2006
2	A Text Book of Electrical Technology, Vol.II "AC & DC Machines"	Theraja B.L., Theraja A.K	publication division of Nirja construction & development (p) Ltd., New Delhi	First Edition 2005
3	Power Electronics Circuits, Devices and Applications	M. H. Rashid	Pearson Education	Fourth Edition 2017
4	Electric Drives, Concepts & Applications	VedamSubrahmanyam ,	Tata McGraw Hill Education Pvt. Ltd, New Delhi	Second Edition 2017

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://nptel.ac.in/courses/108105017
2	https://onlinecourses.nptel.ac.in/noc22_ee06/preview

3	https://nptel.ac.in/courses/108101038
4	https://archive.nptel.ac.in/courses/108/104/108104140/

SEMESTER S3**MECHANICS OF SOLIDS**

Course Code	25MRT303	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)	Engineering Mechanics/ (25EST106)	Course Type	Theory

Course Objectives:

1. This course helps the students to understand the concept of stress and strain in different types of structure/machine under various loading conditions
2. The course also covers simple and compound stresses due to forces, stresses and deflection in beams due to bending, torsion in circular section, strain energy, different theories of failure, stress in thin cylinder and spheres

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Mechanical Properties of materials, stress, strain, Stress–Strain curves of Ductile and Brittle Materials, Poisson’s ratio. Constitutive equations- Hooke’s law, equations for linear elastic isotropic solids in terms of Young’s Modulus and Poisson’s ratio, Hooke’s law for Plane stress and plane strain conditions. Relations between elastic constants E, G, ν and K. Calculation of stress, strain and change in length in axially loaded members with single and composite materials. Effects of thermal loading – thermal stress and thermal strain. Thermal stress on a prismatic bar held between fixed supports.	11

2	Principal planes and principal stress, Mohr's circle for 2D case. Circumferential and Longitudinal stress in a thin cylindrical vessel, stresses in a thin spherical vessel. Elastic strain energy for axial loading, transverse shear, bending and torsional loads. Expressions for strain energy in terms of load, geometry and material properties of the body for axial, shearing, bending and torsional loads.	11
3	Torsional deformation of circular shafts, assumptions for shafts subjected to torsion within elastic deformation range, derivation of torsion formula Torsional rigidity, Polar moment of inertia, basic design of transmission shafts. Simple problems to estimate the stress in solid and hollow shafts. Shear force and bending moment diagrams for cantilever and simply supported beams. Differential equations between load, shear force and bending moment. Normal and shear stress in beams.	11
4	Derivation of flexural formula, section modulus, flexural rigidity, numerical problems to evaluate bending stress, economic sections. Shear stress formula for beams: Derivation, shear stress distribution for a rectangular section. Deflection of beams, Simple problems to find the deflections. (using double integration method) Introduction to Theories of Failure, Rankine's theory for maximum normal stress, Guest's theory for maximum shear stress, Saint-Venant's theory for maximum normal strain, Hencky-von Mises theory for maximum distortion energy, Haigh's theory for maximum strain energy	11

**Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)**

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	3. Each question carries 9 marks. 4. Two questions will be given from each module, out of which 1 question should be answered. 5. Each question can have a maximum of 3 sub divisions. (4x9 = 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	Analyse the strength of materials using stress-strain relationships for structural and thermal loading	K3
CO2	Determine the stresses, strains and displacements of structures using Mohr's circle	K3
CO3	Perform basic design of shafts subjected to torsional loading and analyse beams subjected to bending moments	K3
CO4	Determine the deformation of structures subjected to various loading conditions using strain energy methods	K3
CO5	Estimate the strength of thin cylinders and spherical vessel, and appreciate the theories of failures and its relevance in mechanical design	K3

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO 1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2								3
CO2	3	3	2								2
CO3	3	3	1								2
CO4	3	3	1								2
CO5	3	3	1								2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Mechanics of materials in S.I.units	R .C. Hibbeler	Pearson Higher Education	9e, 2018
2	Advanced Mechanics of Solids	L. S. Srinath	McGraw Hill	3e, 2017
3	Design of Machine Elements,	V. B Bhandari	McGraw Hill	4e, 2017

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Strength of Materials	Surendra Singh	S.K. Kataria & Sons	2011
2	Engineering Mechanics of Solids	Popov E	Pearson	2002
3	Mechanics of Materials S. I. units	Beer, Johnston, Dewolf	McGraw Hills	2017
4	Strength of Materials	Rattan	McGraw Hills	2011

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://onlinecourses.nptel.ac.in/noc23_me140
2	https://onlinecourses.nptel.ac.in/noc23_me140
3	https://onlinecourses.nptel.ac.in/noc23_me140
4	https://onlinecourses.nptel.ac.in/noc23_me140

SEMESTER S3

ANALOG ELECTRONICS

Course Code	25MRZ304	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	3:0:0:1	ESE Marks	40
Credits	4	Exam Hours	2 Hrs 30 Mins
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To enable students to analyse, design and implement different analog circuits for various applications and functionalities

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Analog Electronics; BJT: Operating point of BJT- BJT as amplifier (CE configuration)-input chara- output chara-current amplification factor of BJT; Power amplifier (using Transistor): Class A- Class B- Class AB- Class C- (working, chara, power and efficiency calculation for Class A & Class B, comparison of power amplifiers) FET: Construction and characteristics of JFET & MOSFET –Enhancement & Depletion type-Comparison of BJT & FET UJT: Construction-working and characteristics of UJT- Overview of online & offline UPS- SMPS operation	13

2	Feedback- concept, positive and negative feedback Oscillator: Barkhausen criteria-difference between LC & RC oscillator-classification-working of Hartley and Colpitts Oscillator(using BJT)-analysis of Rc phase shift oscillator (Using BJT) 555 Timer IC: Functional diagram -Astable and Monostable Multivibrator using 555(working & derivation of time period) PLL: Block diagram- PLL IC 565(Pin diagram)-VCO(Analysis)-Capture range, lock in range -Applications of PLL	10
3	OP-Amp: Block diagram of op-amp- Ideal & Practical OP- Amp parameters-frequency response- voltage transfer curve-inverting op-amp-non inverting op-amp-voltage follower-Integrator- Differentiator- comparator-Schmitt trigger-S/H-V to I & I to V converter, Instrumentation Amplifier Active Filters using op-Amp: Difference between active & passive Filters- Active filters: Analysis of First order HPF & LPF-working of Band pass and Band Stop Filters	12
4	Op- Amp Oscillators and Multivibrators: Phase shift and wein bridge oscillator-Triangular and sawtooth waveform generators- Astable and Monostable multivibrators Data convertors: DAC: Specifications-Weighted Resistor type, R-2R ladder type ADC: Specification-Flash type & Successive approximation type	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	30	12.5	12.5	60

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 2 marks (8x2 =16marks)	- Each question carries 6 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 2 sub divisions. (4x6 = 24 marks)	40

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	To understand the functionality and characteristics of different types of active electronics components	K2
CO2	To familiarise with the concept of feedback and to study about different types of oscillators, timers, multivibrators and PLL	K2
CO3	Familiarisation of op-Amp and its applications	K3
CO4	To understand about various types of code converters and to analyse their performance speed.	K2
CO5	Apply the concepts learnt in the course to develop a project and prepare a brief report.	K4

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO 1	PO2	PO 3	PO4	PO 5	PO6	PO7	PO 8	PO9	PO1 0	PO1 1
CO1	3	-	2	-	-	-	-	-	-	-	1
CO2	3	-	1	2	-	-	-	-	-	-	2
CO3	3	-	1	-	-	-	-	-	-	-	2
CO4	3	1	3	2	1	-	-	-	-	-	2
CO5	3	3	3		3			3	3	2	

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Micro Electronic circuits	Sedra A S& K C Smith	Oxford University Press	
2	Linear Integrated circuits	D Roy Choudhury, Shail B Jain	New Age International	
3	Electronic devices and circuit theory	Robert L Boylestad & Louis Nashelsky	Prentice Hall	

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Op-amps and Linear Integrated Circuits	Ramakant A Gayakward	Pearson Education	4 th Edition, 2012
2	Electronics devices and Circuits: An Introduction	Allen Mottershead	Prentice Hall of India	2013
3	Basic Electronics and linear circuits	NN Bhargava, DC Kulshreshtha, SC Gupta	McGraw Hill Education	2 nd Edition 2017
4	Millman's Electronic devices and circuits	Jacob Millman, Christos C Halkias, Satyabrata Jit	McGraw Hill Education	4 th Edition, 2015

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://youtu.be/lpXNCwsnxjM?si=5uFIpXuzt4nbzGL , https://youtu.be/SpvmeG1hs7k?si=teZ0oZ70Q2LB8hQ9
2	https://youtu.be/1Uaz9QuHEVQ?si=-wGb46ZtmuulbsGw , https://youtu.be/WFsPI8_ZKbc?si=breDKci5X8Bk99Qs

PBL Course Elements

L: Lecture (3 Hrs.)	R: Project (1 Hr.), 2 Faculty Members		
	Tutorial	Practical	Presentation
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation / Video Presentation: Students present their results in a 2 to 5 minutes Video

Assessment and Evaluation for Project Activity

Sl. No	Evaluation for	Allotted Marks
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		30

Project Assessment and Evaluation criteria (30 Marks)**1. Project Planning and Proposal (5 Marks)**

- Clarity and feasibility of the project plan
- Research and background understanding
- Defined objectives and methodology

2. Contribution in Progress Presentation and Question Answer Sessions (4 Marks)

- Individual contribution to the presentation
- Effectiveness in answering questions and handling feedback

3. Involvement in the Project Work and Team Work (3 Marks)

- Active participation and individual contribution
- Teamwork and collaboration

4. Execution and Implementation (10 Marks)

- Adherence to the project timeline and milestones
- Application of theoretical knowledge and problem-solving
- Final Result

5. Final Presentation (5 Marks)

- Quality and clarity of the overall presentation
- Individual contribution to the presentation
- Effectiveness in answering questions

6. Project Quality, Innovation, and Creativity (3 Marks)

- Overall quality and technical excellence of the project
- Innovation and originality in the project
- Creativity in solutions and approaches

SEMESTER S3**INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND
DATA SCIENCE**

Course Code	25EST305	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)	None	Course Type	Theory

Course Objectives:

1. Demonstrate a solid understanding of advanced linear algebra concepts, machine learning algorithms and statistical analysis techniques relevant to engineering applications, principles and algorithms.
2. Apply theoretical concepts to solve practical engineering problems, analyze data to extract meaningful insights, and implement appropriate mathematical and computational techniques for AI and data science applications.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to AI and Machine Learning: Basics of Machine Learning - types of Machine Learning systems-challenges in ML- Supervised learning model example- regression models- Classification model example- Logistic regression-unsupervised model example- K-means clustering. Artificial Neural Network- Perceptron- Universal Approximation Theorem (statement only)- Multi-Layer Perceptron- Deep Neural Network- demonstration of regression and classification problems using MLP.(Text-2)	11

2	Mathematical Foundations of AI and Data science: Role of linear algebra in Data representation and analysis – Matrix decomposition- Singular Value Decomposition (SVD)- Spectral decomposition- Dimensionality reduction technique-Principal Component Analysis (PCA). (Text-1)	11
3	Applied Probability and Statistics for AI and Data Science: Basics of probability-random variables and statistical measures - rules in probability- Bayes theorem and its applications- statistical estimation-Maximum Likelihood Estimator (MLE) - statistical summaries- Correlation analysis- linear correlation (direct problems only)- regression analysis- linear regression (using least square method) (Text book 4)	11
4	Basics of Data Science: Benefits of data science-use of statistics and Machine Learning in Data Science- data science process - applications of Machine Learning in Data Science- modelling process- demonstration of ML applications in data science- Big Data and Data Science. (For visualization the software tools like Tableau, PowerBI, R or Python can be used. For Machine Learning implementation, Python, MATLAB or R can be used.)(Text book-5)	11

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	6. Each question carries 9 marks. 7. Two questions will be given from each module, out of which 1 question should be answered. 8. Each question can have a maximum of 3 sub divisions. (4x9 = 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 concept of machine learning algorithms including neural networks and supervised/unsupervised learning techniques for engineering applications.	K3
CO2	Apply advanced mathematical concepts such as matrix operations, singular values, and principal component analysis to analyze and solve engineering problems.	K3
CO3	Analyze and interpret data using statistical methods including descriptive statistics, correlation, and regression analysis to derive meaningful insights and make informed decisions.	K3
CO4	Integrate statistical approaches and machine learning techniques to ensure practically feasible solutions in engineering contexts.	K3

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

CO-PO Mapping Table:

	PO 1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1
CO1	3	3	3	3							
CO2	3	3	3	3							
CO3	3	3	3	3							
CO4	3	3	3	3							

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Linear Algebra	Gilbert Strang	Wellesley-Cambridge Press	6 th edition, 2023
2	Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow	Aurélien Géron	O'Reilly Media, Inc.	2 nd edition, 2022
3	Mathematics for machine learning	Deisenroth, Marc Peter, A. Aldo Faisal, and Cheng Soon Ong	Cambridge University Press	1 st edition, 2020
4	Fundamentals of mathematical Statistics	Gupta, S. C., and V. K. Kapoor	Sultan Chand & Sons	9 th edition, 2020
5	Introducing data science: big data, machine learning, and more, using Python tools	Cielen, Davy, and Arno Meysman	Simon and Schuster	1 st edition, 2016

Reference Books				
1	Data science: concepts and practice	Kotu, Vijay, and Bala Deshpande	Morgan Kaufmann	2 nd edition, 2018
2	Probability and Statistics for Data Science	Carlos Fernandez-Granda	Center for Data Science in NYU	1 st edition, 2017
3	Foundations of Data Science	Avrim Blum, John Hopcroft, and Ravi Kannan	Cambridge University Press	1 st edition, 2020

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4	Statistics For Data Science	James D. Miller	Packt Publishing	1 st edition, 2019
5	Probability and Statistics - The Science of Uncertainty	Michael J. Evans and Jeffrey S. Rosenthal	University of Toronto	1 st edition, 2009
6	An Introduction to the Science of Statistics: From Theory to Implementation	Joseph C. Watkins	chrome-extension://efaidnbmnnnibpcajpcgclefindmkaj/ https://www.math.arizona.edu/~watkins/	Preliminary Edition

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/106/106/106106198/
2	https://archive.nptel.ac.in/courses/106/106/106106198/ https://ocw.mit.edu/courses/18-06-linear-algebra-spring-2010/resources/lecture-29-singular-value-decomposition/
3	https://ocw.mit.edu/courses/18-650-statistics-for-applications-fall-2016/resources/lecture-19-video/
4	https://archive.nptel.ac.in/courses/106/106/106106198/

SEMESTER S3/S4
ECONOMICS FOR ENGINEERS

Course Code	25HUT346	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	ESE Marks	50
Credits	2	Exam Hours	2.30
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Understanding of finance and costing for engineering operation, budgetary planning and control
2. Provide fundamental concept of micro and macroeconomics related to engineering industry
3. Deliver the basic concepts of Value Engineering.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic Economics Concepts - Basic economic problems – Production Possibility Curve – Utility – Law of diminishing marginal utility – Law of Demand - Law of supply – Elasticity - measurement of elasticity and its applications – Equilibrium- Changes in demand and supply and its effects Production function - Law of variable proportion – Economies of Scale – Internal and External Economies – Cobb-Douglas Production Function	6

2	Cost concepts – Social cost, private cost – Explicit and implicit cost – Sunk cost - Opportunity cost - short run cost curves - Revenue concepts Firms and their objectives – Types of firms – Markets - Perfect Competition – Monopoly - Monopolistic Competition - Oligopoly (features and equilibrium of a firm)	6
3	Monetary System – Money – Functions - Central Banking –Inflation - Causes and Effects – Measures to Control Inflation - Monetary and Fiscal policies – Deflation Taxation – Direct and Indirect taxes (merits and demerits) - GST National income – Concepts - Circular Flow – Methods of Estimation and Difficulties - Stock Market – Functions- Problems faced by the Indian stock market-Demat Account and Trading Account – Stock market Indicators- SENSEX and NIFTY	6
4	Value Analysis and value Engineering - Cost Value, Exchange Value, Use Value, Esteem Value - Aims, Advantages and Application areas of Value Engineering - Value Engineering Procedure - Break-even Analysis - Cost-Benefit Analysis - Capital Budgeting - Process planning	6

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Case study/Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
10	15	12.5	12.5	50

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 3 marks (6x3 = 18 marks)	2 questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 2 sub divisions. - Each question carries 8 marks. (4x8 = 32 marks)	50

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the fundamentals of various economic issues using laws and learn the concepts of demand, supply, elasticity and production function.	K2
CO2	Develop decision making capability by applying concepts relating to costs and revenue, and acquire knowledge regarding the functioning of firms in different market situations.	K3
CO3	Outline the macroeconomic principles of monetary and fiscal systems, national income and stock market.	K2
CO4	Make use of the possibilities of value analysis and engineering, and solve simple business problems using break even analysis, cost benefit analysis and capital budgeting techniques.	K3

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

CO-PO Mapping Table:

	PO 1	PO2	PO 3	PO4	PO 5	PO6	PO7	PO 8	PO9	PO1 0	PO1 1
CO1	-	-	-	-	-	1	-	-	-	1	-
CO2	-	-	-	-	-	1	-	-	-	1	-
CO3	-	-	-	-	1	-	-	-	-	2	-
CO4	-	-	-	-	1	1	-	-	-	2	-

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Managerial Economics	Geetika, Piyali Ghosh and Chodhury	Tata McGraw Hill,	2015
2	Engineering Economy	H. G. Thuesen, W. J. Fabrycky	PHI	1966
3	Engineering Economics	R. Paneerselvam	PHI	2012

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering Economy	Leland Blank P.E, Anthony Tarquin P. E.	Mc Graw Hill	7 TH Edition
2	Indian Financial System	Khan M. Y.	Tata McGraw Hill	2011
3	Engineering Economics and analysis	Donald G. Newman, Jerome P. Lavelle	Engg. Press, Texas	2002
4	Contemporary Engineering Economics	Chan S. Park	Prentice Hall of India Ltd	2001

SEMESTER S3/S4

ENGINEERING ETHICS AND SUSTAINABLE DEVELOPMENT

Course Code	25HUT347	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Equip with the knowledge and skills to make ethical decisions and implement gender-sensitive practices in their professional lives.
2. Develop a holistic and comprehensive interdisciplinary approach to understanding engineering ethics principles from a perspective of environment protection and sustainable development.
3. Develop the ability to find strategies for implementing sustainable engineering solutions.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Fundamentals of ethics - Personal vs. professional ethics, Civic Virtue, Respect for others, Profession and Professionalism, Ingenuity, diligence and responsibility, Integrity in design, development, and research domains, Plagiarism, a balanced outlook on law - challenges - case studies, Technology and digital revolution-Data, information, and knowledge, Cybertrust and cybersecurity, Data collection & management, High technologies: connecting people and places-accessibility and social impacts, Managing conflict, Collective bargaining, Confidentiality, Role of confidentiality in moral integrity, Codes of Ethics. Basic concepts in Gender Studies - sex, gender, sexuality, gender spectrum: beyond the binary, gender identity, gender expression, gender stereotypes, Gender disparity and discrimination in education, employment and everyday life, History of women in Science & Technology, Gendered technologies & innovations, Ethical values and practices in connection with gender - equity, diversity & gender justice, Gender policy and women/transgender empowerment initiatives.	6
2	Introduction to Environmental Ethics: Definition, importance and historical development of environmental ethics, key philosophical theories (anthropocentrism, biocentrism, ecocentrism). Sustainable Engineering Principles: Definition and scope, triple bottom line (economic, social and environmental sustainability), life cycle analysis and sustainability metrics. Ecosystems and Biodiversity: Basics of ecosystems and their functions, Importance of biodiversity and its conservation, Human impact on ecosystems and biodiversity loss, An overview of various ecosystems in Kerala/India, and its significance. Landscape and Urban Ecology: Principles of landscape ecology, Urbanization and its environmental impact, Sustainable urban planning and green infrastructure.	6

3	Hydrology and Water Management: Basics of hydrology and water cycle, Water scarcity and pollution issues, Sustainable water management practices, Environmental flow, disruptions and disasters. Zero Waste Concepts and Practices: Definition of zero waste and its principles, Strategies for waste reduction, reuse, reduce and recycling, Case studies of successful zero waste initiatives. Circular Economy and Degrowth: Introduction to the circular economy model, Differences between linear and circular economies, degrowth principles, Strategies for implementing circular economy practices and degrowth principles in engineering. Mobility and Sustainable Transportation: Impacts of transportation on the environment and climate, Basic tenets of a Sustainable Transportation design, Sustainable urban mobility solutions, Integrated mobility systems, E-Mobility, Existing and upcoming models of sustainable mobility solutions.	6
4	Renewable Energy and Sustainable Technologies: Overview of renewable energy sources (solar, wind, hydro, biomass), Sustainable technologies in energy production and consumption, Challenges and opportunities in renewable energy adoption. Climate Change and Engineering Solutions: Basics of climate change science, Impact of climate change on natural and human systems, Kerala/India and the Climate crisis, Engineering solutions to mitigate, adapt and build resilience to climate change. Environmental Policies and Regulations: Overview of key environmental policies and regulations (national and international), Role of engineers in policy implementation and compliance, Ethical considerations in environmental policy-making. Case Studies and Future Directions: Analysis of real-world case studies, Emerging trends and future directions in environmental ethics and sustainability, Discussion on the role of engineers in promoting a sustainable future. Policies and Regulations: Overview of key environmental policies and regulations (national and international), Role of engineers in policy implementation and compliance, Ethical considerations in environmental policy-making. Case Studies and Future Directions: Analysis of real-world case studies, Emerging trends and future directions in environmental ethics and sustainability, Discussion on the role of engineers in promoting a sustainable future.	6

Course Assessment Method**(CIE: 50 marks , ESE: 50)****Continuous Internal Evaluation Marks (CIE):**

Continuous internal evaluation will be based on individual and group activities undertaken throughout the course and the portfolio created documenting their work and learning. The portfolio will include reflections, project reports, case studies, and all other relevant materials.

- The students should be grouped into groups of size 4 to 6 at the beginning of the semester. These groups can be the same ones they have formed in the previous semester.
- Activities are to be distributed between 2 class hours and 3 Self-study hours.
- The portfolio and reflective 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 various courses.

Sl. No.	Item	Particulars	Group/ Individual (G/I)	Marks
1	Reflective Journal	Weekly entries reflecting on what was learned, personal insights, and how it can be applied to local contexts.	I	5
2	Micro project (Detailed documentation of the project, including methodologies, findings, and reflections)	1 a) Perform an Engineering Ethics Case Study analysis and prepare a report 1 b) Conduct a literature survey on 'Code of Ethics for Engineers' and prepare a sample code of ethics	G	8
		2. Listen to a TED talk on a Gender-related topic, do a literature survey on that topic and make a report citing the relevant papers with a specific analysis of the Kerala context	G	5
		3. Undertake a project study based on the concepts of sustainable development* - Module II, Module III & Module IV	G	12
3	Activities	2. One activity* each from Module II, Module III & Module IV	G	15

4	Final Presentation	A comprehensive presentation summarising the key takeaways from the course, personal reflections, and proposed future actions based on the learnings.	G	5
Total Marks			50	

*Can be taken from the given sample activities/projects

Evaluation Criteria:

- **Depth of Analysis:** Quality and depth of reflections and analysis in project reports and case studies.
- **Application of Concepts:** Ability to apply course concepts to real-world problems and local contexts.
- **Creativity:** Innovative approaches and creative solutions proposed in projects and reflections.
- **Presentation Skills:** Clarity, coherence, and professionalism in the final presentation.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop the ability to apply the principles of engineering ethics in their professional life.	K3
CO2	Develop the ability to exercise gender-sensitive practices in their professional lives	K4
CO3	Develop the ability to explore contemporary environmental issues and sustainable practices.	K5
CO4	Develop the ability to analyse the role of engineers in promoting sustainability and climate resilience.	K4
CO5	Develop interest and skills in addressing pertinent environmental and climate-related challenges through a sustainable engineering approach.	K3

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

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO9	PO1 0	PO1 1
CO1						3	3	3	2		2
CO2		1				3	3	3	2		2
CO3						3	2	3	2		2
CO4		1				3	2	3	2		2
CO5						3	2	3	2		2

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Ethics in Engineering Practice and Research	Caroline Whitbeck	Cambridge University Press & Assessment	2nd edition & August 2011
2	Virtue Ethics and Professional Roles	Justin Oakley	Cambridge University Press & Assessment	November 2006
3	Sustainability Science	Bert J. M. de Vries	Cambridge University Press & Assessment	2nd edition & December 2023
4	Sustainable Engineering Principles and Practice	Bhavik R. Bakshi,	Cambridge University Press & Assessment	2019
5	Engineering Ethics	M Govindarajan, S Natarajan and V S Senthil Kumar	PHI Learning Private Ltd, New Delhi	2012
6	Professional ethics and human values	RS Naagarazan	New age international (P) limited New Delhi	2006.
7	Ethics in Engineering	Mike W Martin and Roland Schinzinger,	Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi	4" edition, 2014

Suggested Activities/Projects:

Module-II

- Write a reflection on a local environmental issue (e.g., plastic waste in Kerala backwaters or oceans) from different ethical perspectives (anthropocentric, biocentric, ecocentric).
- Write a life cycle analysis report of a common product used in Kerala (e.g., a coconut, bamboo or rubber-based product) and present findings on its sustainability.
- Create a sustainability report for a local business, assessing its environmental, social, and economic impacts
- Presentation on biodiversity in a nearby area (e.g., a local park, a wetland, mangroves, college campus etc) and propose conservation strategies to protect it.
- Develop a conservation plan for an endangered species found in Kerala.
- Analyze the green spaces in a local urban area and propose a plan to enhance urban ecology using native plants and sustainable design.
- Create a model of a sustainable urban landscape for a chosen locality in Kerala.

Module-III

- Study a local water body (e.g., a river or lake) for signs of pollution or natural flow disruption and suggest sustainable management and restoration practices.
- Analyse the effectiveness of water management in the college campus and propose improvements - calculate the water footprint, how to reduce the footprint, how to increase supply through rainwater harvesting, and how to decrease the supply-demand ratio
- Implement a zero waste initiative on the college campus for one week and document the challenges and outcomes.
- Develop a waste audit report for the campus. Suggest a plan for a zero-waste approach.
- Create a circular economy model for a common product used in Kerala (e.g., coconut oil, cloth etc).
- Design a product or service based on circular economy and degrowth principles and present a business plan.
- Develop a plan to improve pedestrian and cycling infrastructure in a chosen locality in Kerala

Module-IV

- Evaluate the potential for installing solar panels on the college campus including cost-benefit analysis and feasibility study.

- Analyse the energy consumption patterns of the college campus and propose sustainable alternatives to reduce consumption - What gadgets are being used? How can we reduce demand using energy-saving gadgets?
- Analyse a local infrastructure project for its climate resilience and suggest improvements.
- Analyse a specific environmental regulation in India (e.g., Coastal Regulation Zone) and its impact on local communities and ecosystems.
- Research and present a case study of a successful sustainable engineering project in Kerala/India (e.g., sustainable building design, water management project, infrastructure project).
- Research and present a case study of an unsustainable engineering project in Kerala/India highlighting design and implementation faults and possible corrections/alternatives (e.g., a housing complex with water logging, a water management project causing frequent floods, infrastructure project that affects surrounding landscapes or ecosystems).

SEMESTER S3**ELECTRICAL TECHNOLOGY LAB**

Course Code	25MRL307	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Lab

Course Objectives:

1. This course aims the students to learn about the introduction, working and testing methods of main basics machines of electrical
2. To learn about the introduction of Power Electronics.

Expt. No.	Experiments
1	Brake test on DC series motor
2	Brake test on DC shunt motor.
3	Open circuit characteristics of dc shunt generator
4	Load test on dc shunt generator
5	Load test on single phase transformer
6	Three phase power measurement using two wattmeter method
7	Load test on three phase squirrel cage induction motor
8	OC and SC test on single phase transformer
9	Load test on three phase slip ring induction motor
10	Static characteristics of SCR.
11	Static characteristics of MOSFET.
12	Obtain output waveform of single phase bridge rectifier using SCR.

Minimum of 10 experiments from the above list are to be done.

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedur e/ Preparator y work/Desig n/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viv a voce	Record	Total
10	15	10	10	5	50

- 1. Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.*
- 2. Endorsement by External Examiner: The external examiner shall endorse the record*

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledg e Level (KL)
CO1	Test and validate different types of dc motors.	K3
CO2	Test and validate different types of dc generators.	K3
CO3	Validate and to do different test in transformer.	K3
CO4	To measure power in a three phase system	K3
CO5	Test and validate different types of three phase induction motors	K3

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

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

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

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Theory & performance of	J B Gupta	S K Kataria & Sons	January 2013
2	Power Electronics	P S Bimbhra	Khanna	August 2018

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	V K Mehta & Rohit Mehta	Principles of Electrical Machines	S Chand	2006
2	M H Rashid	Power Electronics Circuits	Khanna	2018

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://nptel.ac.in/courses/108105017
2	https://archive.nptel.ac.in/courses/108/102/108102146/

3	https://www.youtube.com/watch?v=JPhCxbxPHbo
4	https://www.youtube.com/watch?v=4JsR4xfIPa4

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 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 (7 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 (6 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 (5 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 End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 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.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

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

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

SEMESTER S3**INSTRUMENTATION LAB**

Course Code	25MRL308	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Lab

Course Objectives:

1. To make students familiar with the techniques for measuring process parameters and techniques in metrology and evaluate the errors/uncertainties involved in the real time measurements as in the industry

Expt. No.	Experiments
1	Study and calibration of LVDT transducer for displacement measurement.
2	Calibration of pressure gauge using dead weight pressure gauge tester.
3	Calibration of thermocouple/ RTD for temperature measurement.
4	Calibration of strain gauge pressure cell
5	Measurement of vibration using Piezoelectric Accelerometers
6	Measurement of rotation speed using tachometer, tacho generator / stroboscopic Tachometer
7	Acoustic measurement using Sound level meter
8	Study and use of linear measuring devices-vernier caliper, outside and inside micrometer, vernier depth gauge, vernier height gauge
9	Study and use of angular measuring devices, sine bar, clinometer angle gauge, bevel protractor- profile projector
10	Measurement of temperature using Radiation pyrometer and infrared pyrometer
11	Measurement of torque and force Measurement of cutting force during turning, drilling and milling using tool force dynamometer
12	Calibration of Load cell
13	Measurement of Air Humidity using sling psychrometer

14	Measurement of air velocity using anemometer
15	Measurements of parameters of gears and screw threads using profile projector
16	Measurement of surface finish using stylus type surface roughness measuring device

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparation work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

1. **Submission of Record:** Students shall be allowed for the end semester examination only upon submitting the duly certified record.
2. **Endorsement by External Examiner:** The external examiner shall endorse the record

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop knowledge on the fundamental concepts and principles of metrology	K2
CO2	Understand the calibration and use of different measuring instruments & Evaluate the errors/uncertainties involved in any measurement	K5

CO3	Understand the operating principle and analyse the output characteristics of different electronics instruments	K2
CO4	Understand and analyse construction and operational aspects of different electromechanical measuring instruments along with their application domains	K2
CO5	Explain the need of various modern measuring instruments and precision measurement techniques	K2

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

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

	PO 1	PO2	PO 3	PO4	PO5	PO6	PO7	PO 8	PO9	PO1 0	PO1 1
CO1	3	2						2			
CO2	3	2						2			2
CO3	3	2	2					2			2
CO4	3	2						2			
CO5	3	2	2								2

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering Metrology & Measurements	N.V. Raghavendra	Oxford University Press	1 st , 2013
2	Electrical Measurements in the Laboratory Practice	Bartirromo, Rosario, De Vincenzi, Mario	Springer International Publishing AG	1st ed. 2016
3	Basic Theory and Laboratory Experiments in Measurement and Instrumentation:by	Cataldo, A., Giaquinto, N., De Benedetto, E., Masciullo, A., Cannazza, G., Lorenzo, I., Nicolazzo, J., Meo, M.T., Monte, A.D., Parisi, G., Gaetani, F.	Springer	1st ed. 2020

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 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 (7 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 (6 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 (5 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 End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 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.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

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

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

SEMESTER 4

MECHATRONICS ENGINEERING

SEMESTER S4**MATHEMATICS FOR PHYSICAL SCIENCE – 4**

Course Code	25MRT401	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 calculus.	Course Type	Theory

Course Objectives:

1. To familiarize students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science.
2. To provide the students with the basics of various numerical methods to develop problem solving skills used in various engineering disciplines.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Random variables, Discrete random variables and their probability distributions, Cumulative distribution function, Expectation, Mean and variance, Binomial distribution, Poisson distribution, Poisson distribution as a limit of the binomial distribution, Joint pmf of two discrete random variables, Marginal pmf, Independent random variables, Expected value of a function of two discrete variables. [Text 1: Relevant topics from sections 3.1 to 3.4, 3.6, 5.1, 5.2]	9

2	Continuous random variables and their probability distributions, Cumulative distribution function, Expectation, Mean and variance, Uniform, Normal and Exponential distributions, Joint pdf of two Continuous random variables, Marginal pdf, Independent random variables, Expectation value of a function of two continuous variables. [Text 1: Relevant topics from sections 3.1, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2]	9
3	Confidence Intervals, Confidence Level, Confidence Intervals and One-side confidence intervals for a Population Mean for large and small samples (normal distribution and t -distribution), Hypotheses and Test Procedures, Type I and Type II error, z Tests for Hypotheses about a Population Mean (for large sample), t Test for Hypotheses about a Population Mean (for small sample), Tests concerning a population proportion for large and small samples. [Text 1: Relevant topics from 7.1, 7.2, 7.3, 8.1, 8.2, 8.3, 8.4]	9
4	Newton-Raphson Method, Gauss Elimination Method, Gauss - Jordan Method, Numerical solution of ordinary differential equations-Euler's method, Modified Euler's method, Runge - Kutta method of 2 nd Order, Numerical solution of Laplace equation –Jacobi's Method, Curve Fitting by Method of Least Squares - Straight lines, Parabola. (Text 2: Relevant topics from sections 2.5, 4.2, 7.5, 8.4, 8.5, 9.4)	9

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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 the concept, properties and important models of discrete random variables and to apply in suitable random phenomena.	K3
CO2	Understand the concept, properties and important models of continuous random variables and to apply in suitable random phenomena.	K3
CO3	Estimate population parameters, assess their certainty with confidence intervals, and test hypotheses about population means and proportions using z-tests and the one-sample t-test.	K3
CO4	Apply numerical methods to find solutions of linear system of equations, ordinary differential equations and Laplace equations.	K3

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

CO-PO Mapping Table:

	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO7	PO 8	PO9	PO1 0	PO1 1
CO1	3	3	2	2	-	-	-	-	-	-	2
CO2	3	3	2	2	-	-	-	-	-	-	2
CO3	3	3	2	2	-	-	-	-	-	-	2
CO4	3	3	2	2	-	-	-	-	-	-	2

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Probability and Statistics for Engineering and the Sciences	Devore J. L	Cengage Learning	9 th edition, 2016
2	Introductory Methods of Numerical Analysis	S S Sastry	PHI Learning Pvt Limited	5 th edition, 2012

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Probability, Random Variables and Stochastic Processes,	Papoulis, A. & Pillai, S.U.,	McGraw Hill.	4 th edition, 2002
2	Introduction to Probability and Statistics for Engineers and Scientists	Ross, S. M.	Academic Press	6 th edition, 2020
3	Numerical methods for Engineers	Steven C. Chapra, Raymond P. Canale	McGraw Hill Education	8 th edition, 2021

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/117/105/117105085/
2	https://archive.nptel.ac.in/courses/117/105/117105085/
3	https://archive.nptel.ac.in/courses/117/105/117105085/
4	https://archive.nptel.ac.in/courses/111/107/111107105/

SEMESTER S4

DIGITAL ELECTRONICS

Course Code	25MRT402	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)	None	Course Type	Theory

Course Objectives:

1. To acquire basic and application knowledge of digital electronics circuits
2. To prepare students to perform analysis and design of digital circuits

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Number system and codes: Basics of Digital Electronics; Binary, octal, hexadecimal number system - Representations, base conversions and arithmetic; Signed representation of binary numbers-fixed and floating point ; 1's and 2's complement of binary numbers and their arithmetic. BCD number system- conversion of BCD to binary and Binary to BCD; Gray codes; Excess 3 codes; Basics of Verilog-basic language elements: identifiers, data objects, scalar data types, operators	9

2	Boolean Algebra and Logic gates Laws of Boolean algebra-postulates-Simplification of Boolean expressions; De-Morgan's law- minimization of Boolean expressions; Sum of product (SOP); Product of Sum (POS), Canonical form; Karnaugh Map Simplification (upto 4 variables); Quine MucCluskey method Basic and universal gates- Universality of NAND and NOR, ; design of simple logic circuits using logic gates TTL and CMOS logic families- comparison, Internal Diagram of TTL NAND gate and CMOS NOR gate	10
3	Combinational circuits: Difference between combinational and sequential circuits; Half adder/subtractor, Full adder/subtractor; Multiplexer (using logic gates)- 4:1,8:1; De-Multiplexer (using logic gates)-- 1:4,1:8,1:16; implementation of functions using Multiplexer IC74151; Encoder (4:2,8:3); Decoder (2:4,3:8), BCD Adder; Modelling and simulation of combinational circuits with Verilog codes at gate level (Adder, Subtractor, MUX,De-MUX)	12
4	Sequential circuits designs: Introduction to latch, Flip Flops, FSM; concept of Edge triggering and level triggering in FF; SR FF, JK FF, MS-JK FF, D FF, T FF-Truth table, Excitation table and characteristics equation; Counter designs-Asynchronous counter; Synchronous Counter; MOD counters ; Ring Counter , Johnson Counter, Shift registers using FFs- SISO,SIPO,PIPO,PISO; Programmable Logic Devices- PAL, PLA,FPGA (Basic concepts only) Modelling and simulation of JK and D flip flops in Verilog	13

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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	To understand the basic concepts and representations of various number systems and design of codes	K2
CO2	To develop the ability to design and analyse digital logic circuits using Boolean expressions	K3
CO3	To create efficient combinational logic designs to meet specific functional requirements thereby developing problem solving skills among students	K3
CO4	To enhance problem solving skills for tackling complex design of sequential circuits	K3
CO5	To study the fundamentals of Verilog and design of various digital Circuits	K2

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO9	PO1 0	PO1 1
CO1	3	1	1	2	1	-	-	-	-	-	3
CO2	3	2	2	2	-	-	-	-	-	-	3
CO3	3	3	3	2	2	-	-	-	-	-	3
CO4	3	3	3	2	2	-	-	-	-	-	3
CO5	3	1	3	2	3	-	-	-	-	-	3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Digital Fundamentals	Thomas L Floyd	Pearson Education	11 th Edition, 2011
2	Verilog HDL: A guide to Digital Design and Synthesis	Samir Palnikar	Pearson India	2 nd Edition, 2003
3	Digital Circuits and systems	D. V Hall	Tata McGraw Hill	1989
4	Fundamentals of Logic Design	C H Roth and L LKimney	Cengage Learning	7 th Edition, 2013

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fundamentals of Digital Electronics	A Anand Kumar	Maakzoo	4th Edition, 2023

2	Digital Integrated Electronics	Taub& Schilling	McGraw Hill	1997
3	Digital Logic and Computer Design	M Morris Mano	Pearson Education	2002

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/108/105/108105132/
2	https://archive.nptel.ac.in/courses/108/105/108105132/
3	https://archive.nptel.ac.in/courses/108/105/108105132/
4	https://archive.nptel.ac.in/courses/108/105/108105132/

SEMESTER S4**COMPUTER ARCHITECTURE AND MICROCONTROLLER**

Course Code	25MRT403	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)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To acquire basic and application knowledge of basic computer architecture
2. Understand the basic concepts and architectures of microcontrollers

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Algorithms for binary multiplication and division. Fixed and floating-point number representation. Functional units of a computer, Von Neumann and Harvard computer architectures, CISC and RISC architectures. Processor Architecture – General internal architecture, Address bus, Data bus, control bus. Register set – status register, accumulator, program counter, stack pointer, general purpose registers. Processor operation – instruction cycle, instruction fetch, instruction decode, instruction execute, timing response, instruction sequencing and execution (basic concepts, data path.	9
2	Microcontrollers and Embedded Processors. Architecture – Block diagram of 8051, Pin configuration, Registers, Internal Memory, Timers, Port Structures, Interrupts. Assembly Language Programming - Addressing Modes, Instruction set (Detailed study of 8051 instruction set is required). Simple programming examples in assembly language. Interfacing with 8051 using Assembly language programming: LED, Seven segment LED display.	11

3	Programming in C - Declaring variables, Simple examples – delay generation, port programming, code conversion. Interfacing of – Stepper Motor, DAC and ADC -- with 8051 and its programming. 8051 Timers/Counters - Modes and Applications. Serial Data Transfer – SFRs of serial port, working, Programming the 8051 to transfer data serially.	11
4	Introduction to ARM - ARM family, ARM 7 register architecture. ARM programmer's model. System software - Assembler, Interpreter, Compiler, Linker, Loader, Debugger. Types of memory - RAM, ROM. Memory Characteristics and Hierarchy. Cache memory – The basics of Caches, Mapping techniques, Improving Cache performance. Virtual memory – Overlay, Memory management, Address translation. Input/Output Organization – Introduction, Synchronous vs. asynchronous I/O, Programmed I/O, Interrupt driven I/O, Direct Memory Access.	13

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

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
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2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- 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. (4x9 = 36 marks)	60
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Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the functional units, I/O and memory management w.r.t a typical computer architecture.	K2
CO2	Distinguish between microprocessor and microcontroller.	K2
CO3	Develop simple programs using assembly language programming.	K3
CO4	Interface 8051 microcontroller with peripheral devices using ALP/Embedded C	K3
CO5	Familiarize system software and Advanced RISC Machine Architecture.	K3

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO9	PO1 0	PO1 1
CO1	3	2	2	1	2	1	1	1	2	1	2
CO2	3	3	1	1	2	1	1	1	1	1	1
CO3	3	2	2	2	3	1	1	1	2	1	2
CO4	3	3	3	3	3	1	1	2	2	2	2
CO5	3	2	2	2	3	1	1	1	2	1	2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	The 8051 microcontroller and Embedded System	Muhammed Ali Mazidi & Janice Gilli Mazidi, R.D. Kinley	Pearson Education	2nd edition, 2007
2	Computer Architecture and Organization: From 8085 to Core2Duo and beyond	Subrata Ghoshal	Pearson	1 st edition, 2011
3	ARM System - on-chip Architecture	Steve Furber	Pearson Education	2014

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer System Architecture	Mano M M	Prentice Hall of India	3rd Edition, 2017
2	Computer organization and design: The Hardware/Software Interface	David A. Patterson, John L. Hennessy	Elsevier	6th edition. 2021
3	Computer Organisation	V. Carl Hamacher, Zvonko G. Vranesic, Safwat G.Zaky	McGraw-Hill Education	5 th edition, 2017
4	8085 Microprocessor Architecture, Applications and Programming	Ramesh S Goankar	Penram International	5/e

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/106/105/106105163/

2	https://archive.nptel.ac.in/courses/106/105/106105163/
3	https://archive.nptel.ac.in/courses/106/105/106105163/
4	https://archive.nptel.ac.in/courses/106/105/106105163/

SEMESTER S4**MANUFACTURING PROCESS**

Course Code	25MRZ404	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	3:0:0:1	ESE Marks	40
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To gain theoretical and practical knowledge in primary manufacturing processes
2. Provide a detailed discussion on the welding process. Introduce different welding processes and advanced processes to be able to appreciate the practical applications of welding.
3. To understand conventional machining and nonconventional manufacturing techniques

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Primary Processes: Casting- Characteristics of sand, patterns, cores, chaplets, riser, chills, Defects in castings. Forming- Forging - Extrusion- wire drawing process – Rolling. Selection of primary forming process. Defects in forging and rolling.	9
2	Joining processes –Welding: Classification, Gas welding: Oxyacetylene welding- types of flame.– Arc Welding: shielded metal arc welding, TIG, MIG, submerged arc welding, ultrasonic welding, thermit welding, friction welding, resistance spot welding, resistance seam welding. Brazing, Soldering, types of solders and fluxes- Adhesive bonding. Selection of joining process for various applications.	9

3	Machining – orthogonal and oblique cutting, rake and clearance angle, Types of chip, Tool life – Taylor’s tool life equation, Machinability. Lathe – types of operations, tool holders, inserts, work holding devices. Milling – types of operations, types of milling machines, milling cutters, simple indexing. Drilling. Introduction to Shaping, Planing and Slotting machines. Grinding – types of operations. NC and CNC machines, micromachining.	9
4	Non-conventional processes – EDM, ECM, USM, EBM, LBM, WJM, AWJM, PCM, process capabilities, applications. Additive manufacturing, Rapid prototyping, stereo-lithography, LIGA process.	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Total
5	30	12.5	12.5	60

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 2 marks (8x2 =16marks)	- Each question carries 6 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 2 sub divisions. (4x6 = 24 marks)	40

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the basics of the primary manufacturing processes, various joining processes and choose the appropriate mechanical and adhesive joining process for the parts.	K2
CO2	Understand the conventional machining operations	K2
CO3	Understand the various nonconventional machining techniques	K2
CO4	Understand Additive manufacturing and LIGA process	K2
CO5	Apply the concepts learnt in the course to develop a project and prepare a brief report.	K3

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO 1	PO 2	PO 3	PO4	PO 5	PO6	PO7	PO 8	PO9	PO1 0	PO1 1
CO1	3	2									3
CO2	3	2									3
CO3	3	3									3
CO4	3	2									3
CO5	3	3	3		3			3	3	2	3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Manufacturing Engineering and Technology	Serope Kalpakjian, Steven R. Schmid	Pearson	2013
2	Fundamentals of Modern Manufacturing	Mikell P. Groover,	Wiley	2010.
3	Manufacturing Processes for Engineering Materials	Kalpakjian and Schmid	Pearson	2018

4	Manufacturing Engineering	D.K. Singh	Ane Books India,	2008
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Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Manufacturing Technology: Foundry, Farming and Welding - Volume1	P. N. Rao	McGraw Hill	5e, 2018
2	Materials and Processes in Manufacturing	Paul Degarma E and Ronald A. Kosher	Prentice Hall College	8e, 1997

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://onlinecourses.nptel.ac.in/noc21_me81
2	https://archive.nptel.ac.in/courses/112/103/112103263
3	https://onlinecourses.nptel.ac.in/noc21_me29
4	https://onlinecourses.nptel.ac.in/noc24_me72

PBL Course Elements

L: Lecture (3 Hrs.)	R: Project (1 Hr.), 2 Faculty Members		
	Tutorial	Practical	Presentation
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation

Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation / Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity

Sl. No	Evaluation for	Allotted Marks
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		30

Project Assessment and Evaluation criteria (30 Marks)

1. Project Planning and Proposal (5 Marks)

- Clarity and feasibility of the project plan
- Research and background understanding
- Defined objectives and methodology

2. Contribution in Progress Presentation and Question Answer Sessions (4 Marks)

- Individual contribution to the presentation

- Effectiveness in answering questions and handling feedback

3. Involvement in the Project Work and Team Work (3 Marks)

- Active participation and individual contribution
- Teamwork and collaboration

4. Execution and Implementation (10 Marks)

- Adherence to the project timeline and milestones
- Application of theoretical knowledge and problem-solving
- Final Result

5. Final Presentation (5 Marks)

- Quality and clarity of the overall presentation
- Individual contribution to the presentation
- Effectiveness in answering questions

6. Project Quality, Innovation, and Creativity (3 Marks)

- Overall quality and technical excellence of the project
- Innovation and originality in the project
- Creativity in solutions and approaches

SEMESTER S4**INDUSTRIAL ENGINEERING**

Course Code	25MRT411	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)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To enable students to understand, design, analyse about processes in various industries
2. To develop decision making, problem solving, project managing skill among students

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to industrial engineering- concepts and functions of industrial engineering- Manufacturing Vs purchase-problems-economic aspects- C-V-P analysis- simple problems Ergonomics man machine system- Anthropometry – value engineering	7
2	Work place design and ergonomics Work study: procedure-concept of work content- techniques to reduce work content Study method: steps-recording techniques-operation process chart- flow process chart- two hand process chart-multiple activity chart Diagrams: flow diagram- string diagram Principle of motion economy- SIMO chart Work measurement: techniques-time study- steps in time study- calculation of standard time (problems)	10

3	Plant: location, layout, material handling concepts Plant layout: types- tools and techniques-travel chart- REL chart- computer algorithms for layout design: CRAFT-ALDEP (methods only) system layout planning-line balancing- RPW (Problems) Principles of material handling: unit load concept- automated material handling system-AGVs	9
4	Production cost concepts- production planning & control-types of production systems Demand forecasting:forecasting methods- Gantt's chart Need for new product-product life cycle Quality control:statistical quality control-causes and variations in quality-control charts for X and R. Reliability: causes of failure- bath tub curve-system reliability Project management:critical path method- PERT-determination of economic life- replacement policy- methods of replacement analysis (Simple problems)	10

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

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
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2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- 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. (4x9 = 36 marks)	60
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Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	To understand the basic concepts of industrial engineering and various process involved in it	K2
CO2	To study about the feasibility of good working environment, designing of work place, working measurements etc	K2
CO3	To enable students to get a deep knowledge about manufacturing plants, their designs and various algorithms used for preparing design layouts	K2
CO4	To provide knowledge about how production, quality control and project management is done	K2
CO5	To understand the basic concepts of industrial engineering and various process involved in it	K2

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO9	PO1 0	PO1 1
CO1	3	1	-	-	-	2	1	-	-	-	2
CO2	3	3	3	2	-	2	1	1	-	1	2
CO3	3	3	3	2	2	1	-	1	-	2	2
CO4	3	3	2	2	-	3	3	2	-	3	3
CO5	3	1	-	-	-	2	1	-	-	-	2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Industrial Engineering & product management	Martand Telsang	S chand	Third revised edition,2018
2	Industrial Engineering	B Kumar	Khanna publisher	10 th Edition, 2015
3	Industrial engineering & production management	M Mahajan	Dhanpat Rai	2015
4	Manufacturing planning & control for supply chain management	Thomas E Vollmann, William L Berry, D Clay Whybark, F Robert Jacobs	McGraw Hill Education	5 th Edition, 2017

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Industrial Engineering and Management	O P Khanna	Dhanpat Rai	2015
2	Statistical Quality control	Grant and Ieven worth	McGraw Hill	2000
3	Modern production Management	E S Buffa	John Wiley	1983
4	Facility layout and location: An Analytical approach	Richard L Francis, F McGinnis Jr, John A White		2 nd Edition , 1991

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://youtu.be/yhywrCChJBQ?si=ZQVmu80Tv2002lGn
2	https://youtu.be/yhywrCChJBQ?si=ZQVmu80Tv2002lGn , https://youtu.be/zWQovrjB7Uc?si=dqf7k4WOyUvCJpEQ
3	https://youtu.be/yhywrCChJBQ?si=ZQVmu80Tv2002lGn , https://youtu.be/jdFrBtHeJbs?si=xYkcaljh6Ur6syr7
4	https://youtu.be/yhywrCChJBQ?si=ZQVmu80Tv2002lGn , https://youtu.be/jdFrBtHeJbs?si=xYkcaljh6Ur6syr7

SEMESTER S4

BIOMEDICAL INSTRUMENTATION

Course Code	25MRT412	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)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. The course aims to give a brief introduction to human physiology.
2. The course presents various instrumentation systems used for measurement and analysis of physiological parameters.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Biomedical Instrumentation Overview of biomedical instrumentation – Basic principles and concepts –Source of bioelectric potentials - Resting and action potential – Propagation of action potentials - Bioelectric potentials example (ECG, EEG, EMG) - Electrode skin interface - Types of electrodes - Limb electrodes – Floating electrodes - Pre-gelled disposable electrodes - Micro, needle and surface electrodes.	9
2	Physiological measurements Heart and cardio vascular system - Electro conduction system of the heart-Electrocardiograph(ECG) – Electrodes and leads – Einthoven triangle - ECG read out devices - ECG machine – Block diagram - Measurement of blood flow and cardiac output - Measurement of heart sounds – Phonocardiography - Electroencephalogram (EEG) measurement - Electromyogram (EMG).	9

3	Biomedical Imaging Techniques X-rays - Principles of generation - Uses of X-rays - Diagnostic still picture – Fluoroscopy – Angiography – Endoscopy - Diathermy - Basic principle of computed tomography	
	(CT) - Magnetic resonance imaging (MRI) system and nuclear medicine imaging system (PET, SPECT) – Radiation therapy - Ultrasound imaging system - Introduction and basic principle	
4	Electrical safety and Therapeutic Devices Physiological effects of electric current – Shock hazards from electrical equipment, Leakage current - Electrical safety analyser – Testing of biomedical equipment – Method of accident prevention. Cardiac pacemakers – Internal and external pacemakers – Defibrillators –Artificial heart valves - Heart lung machine - Biotelemetry - Introduction to telemedicine - Cyber medicine.	9

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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 the fundamental principles and concepts of biomedical instrumentation, biopotential signals produced by the human body and electrodes used for biopotential signal acquisition.	K2
CO2	Understand the various physiological measurement techniques for cardiovascular, nervous and muscle systems.	K2
CO3	Acquire knowledge of the fundamental principles underlying medical imaging techniques	K2
CO4	Summarize the importance of electrical safety within medical Environment	K2
CO5	Discuss the application of electronics in therapeutic applications and the field of biotelemetry	K2

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO 1	PO 2	PO 3	PO4	PO5	PO 6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2								
CO2	3	2	2								
CO3	3	2	2								
CO4	3	2	2			2					
CO5	3	2	2			2					

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Medical Instrumentation: Application and Design	John G. Webster	John Wiley and Sons	4th ed., 2010
2	Handbook of Biomedical Instrumentation	R. S. Khandpur	McGraw Hill Education (India) Private Limited	3rd ed., 2014

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Principles of Biomedical Instrumentation	Andrew G. Webb	Cambridge University Press	1 st ed., 2018
2	Biomedical Instrumentation and Measurements	L. Cromwell, F. J. Weibell and E. A. Pfeiffer	Prentice Hall	2 nd ed., 1980
3	Fundamentals of Biomedical Engineering	G.S. Sawhney	New Age International Publishers	1 st ed., 2007
4	Medical Imaging Signals and Systems	J. L. Prince and J. M. Links	Pearson Prentice Hall,	1 st ed., 2006

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://onlinecourses.swayam2.ac.in/nou24_bt07/preview

2	https://onlinecourses.swayam2.ac.in/nou24_bt07/preview
3	https://archive.nptel.ac.in/courses/102/105/102105090/ https://onlinecourses.swayam2.ac.in/nou24_bt07/preview
4	https://onlinecourses.swayam2.ac.in/nou24_bt07/preview

SEMESTER S4**AUTOMOBILE ENGINEERING**

Course Code	25MRT413	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)	Basics of Mechanical Engineering	Course Type	Theory

Course Objectives:

1. To know the anatomy of automobile in general
2. To understand the working of different automotive systems and subsystems
3. To update the latest developments in automobiles

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Components of an automobile. General classification. Conventional Chassis construction- Types of frames- Frameless constructions. Friction clutch: Principle, dry friction clutches- Pull type diaphragm clutch, multiple diaphragm clutch, multi-plate hydraulically operated automatic transmission clutch, semi centrifugal clutch, fully automatic centrifugal clutch, and integral single plate diaphragm clutch. Electromagnetic clutch operation. wet clutch	8

2	Manual transmission- Need of gear box, power to weight ratio, speed operating range-, constant mesh, and synchromesh gear boxes. Automatic transmission- Epicyclic gear box - torque convertor – Over drives. Automated manual transmission. Suspension: - suspension geometry, terminology- Macpherson strut friction and spring offset - suspension roll centers: -roll centers, roll axis, roll centre height, short swing arm suspension, transverse double wishbone, Macpherson strut suspension, body roll stability analysis: - body roll couple, body roll stiffness, body over turning couple	9
3	Brakes: mechanical and hydraulic brakes (review only) – Anti-Lock Braking system (ABS):- hydro-mechanical ABS - hydro-electric ABS - air-electric ABS. Pneumatic operated disc brakes – electronic-pneumatic brakes. Regenerative braking system. Steering: -basic principle of a steering system– Ackermann –over steer and under steer – slip angle, camber, king pin inclination, caster, toe-in and toe- out . Steering gear box:-worm and roller type steering gear box – need of power assisted steering.	9
4	Fuel injection systems: multiport fuel injection (MPFI) and common rail direct injection (CRDI) systems. Electric Vehicle Technology (EVT): EV Architecture, types of batteries, battery parameters, super capacitors. Fuel cells and its efficiency. EV Chassis – requirements, suspension for EVs. Recent Electric vehicles- Electric mobility aids. Future of electric vehicles –Tesla S, Maglev trains, Electric rail road systems.	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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	Explain different automotive systems and subsystems.	K2
CO2	Illustrate the principles of transmission, suspension systems of an Automobile	K2
CO3	Illustrate the steering and braking systems of an automobile.	K2
CO4	Build a basic knowledge about the technology in electric vehicles.	K2

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Vehicle and engine technology	Heinz Heisler	Butterworth-Heinemann	2nd edition, 1998
2	Auto design	R.B. Gupta.	Satya Prakashan Publishers	2016.
3	Electric vehicle technology Explained	James Larminie and John Lowry	Wiley publications	2nd edition, 2015.
4	Automobile Engineering Vol.1 & Vol.2	Kirpal Singh	Standard Publishers	13th edition, 2020

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fundamentals of modern vehicle technology	V.A.W. Hillier	Butterworth-Heinemann	2nd edition, 1998.

2	Electric and Hybrid Vehicles	Tom Denton.	Routledge Publishers	2nd edition, 2020.
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Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://youtu.be/hs7bABMtOMI
2	https://youtu.be/hs7bABMtOMI
3	https://youtu.be/hs7bABMtOMI
4	https://youtu.be/9JFSJmD3m1E

SEMESTER S4**NETWORK THEORY**

Course Code	25MRT414	CIE Marks	40	Course
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)	25EST204	Course Type	Theory	

Objectives:

1. Gain a solid foundation in the principles of electrical networks, including the analysis and design of electrical circuits
2. Develop the ability to analyse complex AC and DC circuits

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Mesh and node analysis of network containing independent and dependent sources. Supermesh and Supernode analysis. Steady-state AC analysis using Mesh and Node analysis.	9
2	Thevenin's theorem, Norton's theorem, Superposition theorem, Reciprocity theorem, Maximum power transfer theorem. (applied to both dc and ac circuits having dependent source). Review of Laplace Transforms and Inverse Laplace Transforms, Initial value theorem & Final value theorem, Transformation of basic signals and circuits into s-domain.	9

3	Transient analysis of RL, RC, and RLC networks with impulse, step and sinusoidal inputs (with and without initial conditions). Network functions for the single port and two port network. Properties of driving point and transfer functions. Significance of Poles and Zeros of network functions, Time domain response from pole zero plot. Impulse Function & Response. Network functions in the sinusoidal steady state, Magnitude and Phase response.	9
4	Impedance, Admittance, Transmission and Hybrid parameters of two port network. Interrelationship among parameter sets. Series and parallel connections of two port networks. Reciprocal and Symmetrical two port network. Characteristic impedance, Image impedance and propagation constant (derivation not required).	9

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

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

\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 (8x3 =24marks)	- 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. (4x9 = 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 Mesh / Node analysis or Network Theorems to obtain steady state response of the linear time invariant networks	K3
CO2	Apply Laplace Transforms to determine the transient behaviour of RLC networks.	K3
CO3	Apply Network functions and Network Parameters to analyse the single port and two port networks	K3
CO4	Conduct steady-state AC analysis using mesh and node analysis methods to determine voltages, currents, and power in AC circuits	K3
CO5	Understand and analyze network functions for single port and two port Networks	K3

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO9	PO1 0	PO1 1
CO1	3	3	2	2	2	-	-	1	2	-	2
CO2	3	3	2	2	2	-	-	1	1	-	2
CO3	3	3	2	2	2	-	-	1	2	-	2
CO4	3	3	2	2	2	-	-	1	2	-	2
CO5	3	3	2	2	2	-	-	1	2	-	2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Network Analysis	Valkenburg V	Pearson	3/e, 2019
2	Circuits and Networks- Analysis and Synthesis	Sudhakar A, Shyammohan S. P	McGraw Hill	5/e, 2015

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Electric Circuits – Schaum’s Outline Series	Edminister	McGraw-Hill	2009
2	Engineering Circuit Analysis	W. Hayt, J. Kemmerly, J. Phillips, S. Durbin	McGraw Hill	
3	Electric Circuits and Networks	K. S. Suresh Kumar	Pearson	2008
4	Network Analysis with Applications	William D. Stanley	Pearson	4/e 2006

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/108/105/108105159/
2	https://archive.nptel.ac.in/courses/108/105/108105159/
3	https://archive.nptel.ac.in/courses/108/105/108105159/
4	https://archive.nptel.ac.in/courses/108/105/108105159/

SEMESTER S4

OBJECT ORIENTED PROGRAMMING

Course Code	25MRT415	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	25EST105 Algorithmic Thinking with Python	Course Type	Theory

Course Objectives:

1. The purpose of this course is to enable learners to solve problems by breaking it down to object level while designing software and to implement it using Java.
2. This course covers the fundamental principles of object-oriented programming in Java, including classes, objects, inheritance, polymorphism, encapsulation and abstraction, and effectively applies them.
3. This course helps the learners to develop Java applications that utilize object-oriented programming principles to achieve modularity, reusability, and scalability in software design and implementation

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic Object-Oriented concepts, Introduction to Java - Java programming and Runtime Environment, Development Platforms- Java Virtual Machine (JVM), Java compiler, Bytecode, Java Buzzwords, Java program structure, Comments. Primitive Data types - Integers, Floating Point Types, Characters, Boolean. Literals, Operators - Arithmetic Operators, Bitwise Operators, Relational Operators, Boolean Logical Operators, Assignment Operator, Conditional (Ternary) Operator. Control Statements - Selection Statements, Iteration Statements and Jump Statements.	11
2	Object Oriented Programming in Java - Class Fundamentals, Declaring Objects, Introduction to Methods, Constructors, this Keyword, Method Overloading, Using Objects as Parameters, Returning Objects. Static Members, Final Variables, Inner Classes. Inheritance - Super Class, Sub Class, The Keyword super, protected Members, Calling Order of Constructors, Method Overriding, the Object class, Abstract Classes and Methods, using final with Inheritance. Packages and Interfaces	11
3	Exception Handling - Checked Exceptions, Unchecked Exceptions, try Block and catch Clause, Multiple catch Clauses, Nested try Statements, throw. Java Library - String Handling – String Constructors, String Length, Special String Operations. Multithreaded Programming - The Java Thread Model, The Main Thread, Creating Thread, Creating Multiple Threads, Synchronization, Suspending, Resuming and Stopping Threads.	11

4	Event handling - Event Handling Mechanisms, Delegation Event Model, Event Classes, Sources of Events, Event Listener Interfaces. Java Database Connectivity (JDBC) - JDBC overview, Creating and Executing Queries – create table, delete, insert, select.	11
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Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination n-1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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 apply fundamental Java programming concepts, including the runtime environment, primitive data types, operators, and control statements, to develop efficient and well-structured Java applications.	K3
CO2	Apply key object-oriented programming principles in Java, leveraging packages and interfaces effectively to design and implement Java applications.	K3
CO3	Understand the handling of Java exceptions, effectively manipulate strings, and implement multithreaded programming techniques.	K3
CO4	Understand the different JDBC queries to handle a data base.	K2

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO 1	PO 2	PO 3	PO4	PO 5	PO6	PO7	PO8	PO9	PO1 0	PO1 1
CO1	3	3	3								2
CO2	3	3	3								2
CO3	3	3	3		2						2
CO4	3	3	3		2						2
CO5	3	3	3		2						2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Java: The Complete reference	Herbert Schildt	Tata McGraw Hill	8/e, 2011.
2	Programming JAVA a Primer	Balagurusamy E	Tata McGraw Hill	5/e, 2014

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Java Programming	Y. Daniel Liang	Pearson Education	7/e, 2013
2	Java How to Program, Early Objects	Paul Deitel, Harvey Deitel	Pearson Education	11/e, 2018
3	Core Java: An Integrated Approach	Nageswararao R	Dreamtech Press	2008
4	Java in A Nutshell	Flanagan D	O'Reilly	5/e, 2005
5	Core Java: Volume I & II– Fundamentals	Cay S. Horstmann and Gary Cornell	Pearson Education	2008

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/106/105/106105191
2	https://archive.nptel.ac.in/courses/106/105/106105191
3	https://archive.nptel.ac.in/courses/106/105/106105191
4	https://archive.nptel.ac.in/courses/106/105/106105191

SEMESTER S3/S4**ECONOMICS FOR ENGINEERS**

Course Code	25HUT346	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Understanding of finance and costing for engineering operation, budgetary planning and control
2. Provide fundamental concept of micro and macroeconomics related to engineering industry
3. Deliver the basic concepts of Value Engineering.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic Economics Concepts - Basic economic problems – Production Possibility Curve – Utility – Law of diminishing marginal utility – Law of Demand - Law of supply – Elasticity - measurement of elasticity and its applications – Equilibrium- Changes in demand and supply and its effects Production function - Law of variable proportion – Economies of Scale – Internal and External Economies – Cobb-Douglas Production Function	6

2	Cost concepts – Social cost, private cost – Explicit and implicit cost – Sunk cost - Opportunity cost - short run cost curves - Revenue concepts Firms and their objectives – Types of firms – Markets - Perfect Competition – Monopoly - Monopolistic Competition - Oligopoly (features and equilibrium of a firm)	6
3	Monetary System – Money – Functions - Central Banking –Inflation - Causes and Effects – Measures to Control Inflation - Monetary and Fiscal policies – Deflation Taxation – Direct and Indirect taxes (merits and demerits) - GST National income – Concepts - Circular Flow – Methods of Estimation and Difficulties - Stock Market – Functions- Problems faced by the Indian stock market-Demat Account and Trading Account – Stock market Indicators- SENSEX and NIFTY	6
4	Value Analysis and value Engineering - Cost Value, Exchange Value, Use Value, Esteem Value - Aims, Advantages and Application areas of Value Engineering - Value Engineering Procedure - Break-even Analysis - Cost-Benefit Analysis - Capital Budgeting - Process planning	6

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Case Study/Micro project	Internal Examination n-1 (Written)	Internal Examination - 2 (Written)	Total
10	15	12.5	12.5	50

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 3 marks (6x3 =18marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. (4x8 = 32 marks)	50

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the fundamentals of various economic issues using laws and learn the concepts of demand, supply, elasticity and production function.	K2
CO2	Develop decision making capability by applying concepts relating to costs and revenue, and acquire knowledge regarding the functioning of firms in different market situations.	K3
CO3	Outline the macroeconomic principles of monetary and fiscal systems, national income and stock market.	K2
CO4	Make use of the possibilities of value analysis and engineering, and solve simple business problems using break even analysis, cost benefit analysis and capital budgeting techniques.	K3

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

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO90	PO10	PO11
CO1	-	-	-	-	-	1	-	-	-	1	-
CO2	-	-	-	-	-	1	-	-	-	1	-
CO3	-	-	-	-	1	-	-	-	-	2	-
CO4	-	-	-	-	1	1	-	-	-	2	-

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Managerial Economics	Geetika, Piyali Ghosh and Chodhury	Tata McGraw Hill,	2015
2	Engineering Economy	H. G. Thuesen, W. J. Fabrycky	PHI	1966
3	Engineering Economics	R. Paneerselvam	PHI	2012

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering Economy	Leland Blank P.E, Anthony Tarquin P. E.	Mc Graw Hill	7 TH Edition
2	Indian Financial System	Khan M. Y.	Tata McGraw Hill	2011
3	Engineering Economics and analysis	Donald G. Newman, Jerome P. Lavelle	Engg. Press, Texas	2002
4	Contemporary Engineering Economics	Chan S. Park	Prentice Hall of India Ltd	2001

SEMESTER S3/S4**ENGINEERING ETHICS AND SUSTAINABLE DEVELOPMENT**

Course Code	25HUT347	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Equip with the knowledge and skills to make ethical decisions and implement gender-sensitive practices in their professional lives.
2. Develop a holistic and comprehensive interdisciplinary approach to understanding engineering ethics principles from a perspective of environment protection and sustainable development.
3. Develop the ability to find strategies for implementing sustainable engineering solutions.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Fundamentals of ethics - Personal vs. professional ethics, Civic Virtue, Respect for others, Profession and Professionalism, Ingenuity, diligence and responsibility, Integrity in design, development, and research domains, Plagiarism, a balanced outlook on law - challenges - case studies, Technology and digital revolution-Data, information, and knowledge, Cybertrust and cybersecurity, Data collection & management, High technologies: connecting people and places-accessibility and social impacts, Managing conflict, Collective bargaining, Confidentiality, Role of confidentiality in moral integrity, Codes of Ethics. Basic concepts in Gender Studies - sex, gender, sexuality, gender spectrum: beyond the binary, gender identity, gender expression, gender stereotypes, Gender disparity and discrimination in education, employment and everyday life, History of women in Science & Technology, Gendered technologies & innovations, Ethical values and practices in connection with gender - equity, diversity & gender justice, Gender policy and women/transgender empowerment initiatives.	6
2	Introduction to Environmental Ethics: Definition, importance and historical development of environmental ethics, key philosophical theories (anthropocentrism, biocentrism, ecocentrism). Sustainable Engineering Principles: Definition and scope, triple bottom line (economic, social and environmental sustainability), life cycle analysis and sustainability metrics. Ecosystems and Biodiversity: Basics of ecosystems and their functions, Importance of biodiversity and its conservation, Human impact on ecosystems and biodiversity loss, An overview of various ecosystems in Kerala/India, and its significance. Landscape and Urban Ecology: Principles of landscape ecology,	6

	Urbanization and its environmental impact, Sustainable urban planning and green infrastructure.	
3	Hydrology and Water Management: Basics of hydrology and water cycle, Water scarcity and pollution issues, Sustainable water management practices, Environmental flow, disruptions and disasters. Zero Waste Concepts and Practices: Definition of zero waste and its principles, Strategies for waste reduction, reuse, reduce and recycling, Case studies of successful zero waste initiatives. Circular Economy and Degrowth: Introduction to the circular economy model, Differences between linear and circular economies, degrowth principles, Strategies for implementing circular economy practices and degrowth principles in engineering. Mobility and Sustainable Transportation: Impacts of transportation on the environment and climate, Basic tenets of a Sustainable Transportation design, Sustainable urban mobility solutions, Integrated mobility systems, E-Mobility, Existing and upcoming models of sustainable mobility solutions.	6
4	Renewable Energy and Sustainable Technologies: Overview of renewable energy sources (solar, wind, hydro, biomass), Sustainable technologies in energy production and consumption, Challenges and opportunities in renewable energy adoption. Climate Change and Engineering Solutions: Basics of climate change science, Impact of climate change on natural and human systems, Kerala/India and the Climate crisis, Engineering solutions to mitigate, adapt and build resilience to climate change. Environmental Policies and Regulations: Overview of key environmental policies and regulations (national and international), Role of engineers in policy implementation and compliance, Ethical considerations in environmental policy-making. Case Studies and Future Directions: Analysis of real- world case studies, Emerging trends and future directions in environmental ethics and sustainability, Discussion on the role of engineers in promoting a sustainable future.	6

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

Continuous Internal Evaluation Marks (CIE):

Continuous internal evaluation will be based on individual and group activities undertaken throughout the course and the portfolio created documenting their work and learning. The portfolio will include reflections, project reports, case studies, and all other relevant materials.

- The students should be grouped into groups of size 4 to 6 at the beginning of the semester. These groups can be the same ones they have formed in the previous semester.
- Activities are to be distributed between 2 class hours and 3 Self-study hours.
- The portfolio and reflective 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 various courses.

Sl. No	Item	Particulars	Group/ Individual (G/I)	Marks
1	Reflective Journal	Weekly entries reflecting on what was learned, personal insights, and how it can be applied to local contexts.	I	5
2	Micro project (Detailed documentation of the project, including methodologies, findings, and reflections)	1 a) Perform an Engineering Ethics Case Study analysis and prepare a report 1 b) Conduct a literature survey on 'Code of Ethics for Engineers' and prepare a sample code of ethics	G	8
		2. Listen to a TED talk on a Gender-related topic, do a literature survey on that topic and make a report citing the relevant papers with a specific analysis of the Kerala context	G	5
		3. Undertake a project study based on the concepts of sustainable development* - Module II, Module III & Module IV	G	12
3	Activities	2. One activity* each from Module II, Module III & Module IV	G	15
4	Final Presentation	A comprehensive presentation summarising the key takeaways from the course, personal reflections, and proposed future actions based on the learnings.	G	5
Total Marks				50

*Can be taken from the given sample activities/projects

Evaluation Criteria:

- **Depth of Analysis:** Quality and depth of reflections and analysis in project reports and case studies.
- **Application of Concepts:** Ability to apply course concepts to real-world problems and local contexts.
- **Creativity:** Innovative approaches and creative solutions proposed in projects and reflections.
- **Presentation Skills:** Clarity, coherence, and professionalism in the final presentation.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop the ability to apply the principles of engineering ethics in their professional life.	K3
CO2	Develop the ability to exercise gender-sensitive practices in their professional lives	K4
CO3	Develop the ability to explore contemporary environmental issues and sustainable practices.	K5
CO4	Develop the ability to analyse the role of engineers in promoting sustainability and climate resilience.	K4
CO5	Develop interest and skills in addressing pertinent environmental and climate-related challenges through a sustainable engineering approach.	K3

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

CO-PO Mapping Table:

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

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Ethics in Engineering Practice and Research	Caroline Whitbeck	Cambridge University Press & Assessment	2nd edition & August 2011
2	Virtue Ethics and Professional Roles	Justin Oakley	Cambridge University Press & Assessment	November 2006
3	Sustainability Science	Bert J. M. de Vries	Cambridge University Press & Assessment	2nd edition & December 2023
4	Sustainable Engineering Principles and Practice	Bhavik R. Bakshi,	Cambridge University Press & Assessment	2019
5	Engineering Ethics	M Govindarajan, S Natarajan and V S Senthil Kumar	PHI Learning Private Ltd, New Delhi	2012
6	Professional ethics and human values	RS Naagarazan	New age international (P) limited New Delhi	2006.
7	Ethics in Engineering	Mike W Martin and Roland Schinzinger,	Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi	4th edition, 2014

Suggested Activities/Projects:

Module-II

- Write a reflection on a local environmental issue (e.g., plastic waste in Kerala backwaters or oceans) from different ethical perspectives (anthropocentric, biocentric, ecocentric).
- Write a life cycle analysis report of a common product used in Kerala (e.g., a coconut, bamboo or rubber-based product) and present findings on its sustainability.
- Create a sustainability report for a local business, assessing its environmental, social, and economic impacts
- Presentation on biodiversity in a nearby area (e.g., a local park, a wetland, mangroves, college campus etc) and propose conservation strategies to protect it.
- Develop a conservation plan for an endangered species found in Kerala.
- Analyze the green spaces in a local urban area and propose a plan to enhance urban ecology using native plants and sustainable design.
- Create a model of a sustainable urban landscape for a chosen locality in Kerala.

Module-III

- Study a local water body (e.g., a river or lake) for signs of pollution or natural flow disruption and suggest sustainable management and restoration practices.
- Analyse the effectiveness of water management in the college campus and propose improvements - calculate the water footprint, how to reduce the footprint, how to increase supply through rainwater harvesting, and how to decrease the supply-demand ratio
- Implement a zero waste initiative on the college campus for one week and document the challenges and outcomes.
- Develop a waste audit report for the campus. Suggest a plan for a zero-waste approach.
- Create a circular economy model for a common product used in Kerala (e.g., coconut oil, cloth etc).
- Design a product or service based on circular economy and degrowth principles and present a business plan.
- Develop a plan to improve pedestrian and cycling infrastructure in a chosen locality in Kerala

Module-IV

- Evaluate the potential for installing solar panels on the college campus including cost-benefit analysis and

feasibility study.

- Analyse the energy consumption patterns of the college campus and propose sustainable alternatives to reduce consumption - What gadgets are being used? How can we reduce demand using energy-saving gadgets?
- Analyse a local infrastructure project for its climate resilience and suggest improvements.
- Analyse a specific environmental regulation in India (e.g., Coastal Regulation Zone) and its impact on local communities and ecosystems.
- Research and present a case study of a successful sustainable engineering project in Kerala/India (e.g., sustainable building design, water management project, infrastructure project).
- Research and present a case study of an unsustainable engineering project in Kerala/India highlighting design and implementation faults and possible corrections/alternatives (e.g., a housing complex with water logging, a water management project causing frequent floods, infrastructure project that affects surrounding landscapes or ecosystems).

SEMESTER S4**ANALOG AND DIGITAL ELECTRONICS LAB**

Course Code	25MRL407	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	25MRZ304, 25ESL107	Course Type	Lab

Course Objectives:

1. To impart working knowledge, design and practical skills among students.

Expt. No.	Experiments
1	Study and verify the truth table of basic gates, half and full adder & subtractor
2	Design and implementation of binary to gray , gray to binary code converter, BCD to excess 3 code using logic gates
3	Design and implementation of MUX and De-Mux using a) logic gates (4x1 MUX, 1X 4 De-Mux) IC 74151 – Implementation of basic SOP functions (16x1 , 8x1)
4	Study and verify the truth table of flip flops (Implement using logic gates)
5	Design and Implementation of 3 bit Synchronous and Asynchronous counter using JK Flip Flop
6	Design and Implementation of a) 3 bit Synchronous and Asynchronous up counter using JK Flip Flop b) MOD counters (eg: MOD 10, MOD 12 Ripple counter)
7	Implementation of basic programs using verilog-Adder, Subtractor, Mux, De-MUX

8	CE characteristics of BJT (Input and output Chara)
9	Characteristics of JFET(Input and output Chara)
10	Design and implement Inverting op-amp, non inverting op-amp and voltage follower using op amp. Plot the frequency response curve.
11	Design and implement Integrator, Differentiator, Schmitt trigger (UTP=+3v & LTP= -3v) using IC 741. Verify the output waveform on CRO.
12	Design and implement RC phase shift oscillator/wein bridge oscillator, Triangular/ Saw tooth wave generator, Astable/ Monostable multivibrator using IC 741
13	Astable/ Monostable multivibrator using IC 555 timer
14	Design of PLL using IC 565.

Any 3 experiments (8 to 14) can be simulated using LT SPICE/ PROTEUS

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	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	15	10	10	5	50

- **Submission of Record:** Students shall be allowed for the end semester examination only upon submitting the duly certified record.
- **Endorsement by External Examiner:** The external examiner shall endorse the record

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	To acquire skills in designing, analysing, testing and implementing various digital and analog circuits	K3, K4, K5, K6
CO2	Analyse and interpret circuits using software and simulation tools	K3, K4, K5, K6
CO3	To enhance the ability to function effectively as an individual and in a team to accomplish the given task	K4

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

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	2	1	1	3	2	2	2
CO2	2	2	2	3	3	1	1	3	2	2	2
CO3	1	2	2	2	2	1	3	3	2	2	2

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fundamentals of Logic Design	Charles H Roth Jr	CENGAGE Learning Custom Publishing	7 th /2013

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2	Fundamentals of Digital Logic With Verilog Design	Stephen Brown, Zvonko Vranesic	McGraw Hill	3 rd /2013
3	Digital Fundamentals	Floyd and Jain	Pearson Education	11 th /2017
4	Laboratory Manual for Operational Amplifiers and Linear ICs	David A. Bell	OUP Canada	2 nd edition 2006

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Electronics Lab Manual- volume 1, 2	K A Navas	PHI Learning Private Ltd	2015

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 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 (7 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 (6 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 (5 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 End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 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.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

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

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

SEMESTER S4**MECHANICAL ENGINEERING LAB**

Course Code	25MRL408	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Lab

Expt. No.	Experiments
1, 2,3, 4	Exercises on Centre Lathe: - Facing, plain turning, step turning, taper turning and form turning, groove cutting, knurling and chamfering, multi-start thread, square thread and internal thread, Inspection of the work using measuring instruments
5, 6	Exercises on Milling Machine: - Face milling, end milling – spur and helical gear cutting, milling of key ways, T slot cutting, Inspection of the work using measuring instruments
7	Exercises on drilling machine: - drilling, boring, reaming, tapping and counter sinking etc.
8	Exercises on shaping machine / slotting machine - flat surfaces, grooves and key ways.
9	Exercises on Grinding machine: - Exercise on surface grinding, cylindrical grinding and tool grinding, Inspection of the work using measuring instruments
10	Exercises on Welding: - Exercises on arc and gas welding - butt welding and lap welding of M.S. sheets.
11	Preparation of program and Exercise on CNC lathe including simulation: -turning, step turning, taper turning, thread cutting, etc.
12	Preparation of program and Exercise on CNC milling machine including simulation: - surface milling, pocket milling, etc
13	Use of CAM software for generation of CNC code from CAD data.
14	Exercises on Rapid Prototyping: - 3D printing - simple box, helix shape, U bracket

A minimum of 10 experiments are to be carried out

Course Assessment Method

(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	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	15	10	10	5	50

- **Submission of Record:** Students shall be allowed for the end semester examination only upon submitting the duly certified record.
- **Endorsement by External Examiner:** The external examiner shall endorse the record

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Get hands on various manual production machines and processes	K3
CO2	Identify the various operations and the required machines and attachments for various applications	K3
CO3	Preparing the CNC machines and programming.	K3
CO4	Use CAD/CAM for generating CNC code for production machines to realise parts	K3
CO5	Understand the properties of 3D printed parts and use the rapid prototyping effectively to make prototypes.	K3

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

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

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

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Production Technology,	HMT	Tata McGraw Hill.	1e, 1986
2	Machine Tool Design, Vol. I, II, III and IV,	Acherkan N. S.	MIR Publications.	1969

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Workshop Technology Part I	W. A. J. Chapman,	ELBS & Edward Arnold Publishers.	1e, 1972

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://onlinecourses.nptel.ac.in/noc21_me04

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 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 (7 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 (6 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 (5 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 End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 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.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

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

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

SEMESTER 5

MECHATRONICS ENGINEERING

SEMESTER S5**LINEAR CONTROL SYSTEMS**

Course Code	25MRT501	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)	25MAT102, 25MAT202, 25MRT301	Course Type	Theory

Course Objectives:

1. To introduce the elements of control system and its modelling
2. To introduce methods for analyzing the time response, the frequency response and the stability of systems.
3. This course enables students to systematically study the principles of system modelling

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Control systems: Basic components of a Control System, Open-Loop Control Systems and Closed-Loop Control Systems, Examples of control system, Transfer functions, Block diagram reduction, Signal flow graph and Mason's gain formula. Differential equations for mass, spring and dashpot elements, Mathematical modelling of control systems - Electrical Systems, Translational and Rotational Mechanical systems, Analogous systems-force voltage & force-current analogy - torque-voltage & torque-current analogy.	11

2	Time domain analysis: Continuous systems -standard test signals - step, ramp, parabolic, impulse - transient and steady state response –first order systems – second order systems, step responses of first order systems and second order systems - under damped and over damped systems - time domain specifications - steady state error – static position, velocity &	11
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	acceleration error constants.	
3	Stability of control systems and Frequency Domain Analysis: Concept of stability - stability & location of the poles in S-plane - Routh-Hurwitz stability criterion-Root Locus Method, Construction of root locus- Effect of poles and zeros and their location on the root locus. Frequency Response representation- Polar Plot- Relative stability: gain margin and phase margin, Stability analysis with Bode plot.	11
4	Compensation techniques and Case studies in Mechatronics: Need for Cascade compensation, Cascade Compensation- PI, PD and PID controllers – tuning of PID Controller- Lead, Lag and Lead- Lag compensation- Role of control system in mechatronics-case studies Automatic temperature control, automatic traffic light control-Automatic street light control	11

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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	To introduce the elements of control system and its modelling	K2
CO2	To introduce methods for analyzing the time response.	K3
CO3	To introduce methods for analyzing the frequency response and the stability of systems.	K3
CO4	Apply the knowledge of control systems in real time control applications	K2

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Control Systems Engineering	I. J. Nagrath and M. Gopal	New Age International Pvt Ltd, 6/e	Seventh Edition 2021
2	Control Systems	A. Nagoorkani	RBA Publications	Fifth Edition 2020

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Modern Control Engineering	Katsuhiko Ogata	Pearson Education India, 5/e	Fifth Edition 2015

2	Automatic Control Systems	Kuo	Prentice Hall	First Editio n 2012
3	Control Systems Engineering	Norman S. Nise	Wiley India Pvt. Ltd	First Editio n 2018

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://onlinecourses.nptel.ac.in/noc20_ee90/preview
2	https://archive.nptel.ac.in/courses/107/106/107106081/
3	https://archive.nptel.ac.in/content/storage2/courses/112104040/lecture23/23_8.htm
4	https://archive.nptel.ac.in/courses/107/106/107106081/

SEMESTER S5**THERMODYNAMICS**

Course Code	25MRT502	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)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To understand basic concepts and laws of thermodynamics
2. Determine change in properties of pure substances during phase change processes

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Role of Thermodynamics and its applications–Basic Concepts Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic System and Control Volume, Surrounding, Boundaries, Types of Systems, Universe, Thermodynamic properties, Process, Cycle, Thermodynamic Equilibrium, Quasi – static Process State, Point and Path function. Zeroth Law of Thermodynamics, Measurement of Temperature, reference Points, Temperature Scales.	11
2	Energy - Work - Pdv work and other types of work transfer, free expansion work, heat and heat capacity. Joule's Experiment- First law of Thermodynamics - First law applied to Non flow Process- Enthalpy-specific heats- PMM1, First law applied to Flow Process, Mass and Energy balance in simple steady flow process, Limitations of First Law.	11

3	Second Law of Thermodynamics, Thermal Reservoir, Heat Engine, Heat pump – Kelvin- Planck and Clausius Statements, Equivalence of two statements, Reversibility, Irreversible Process, Causes of Irreversibility, PMM2, Carnot's theorem and its corollaries, Absolute Thermodynamic Temperature scale. Clausius Inequality, Entropy- Entropy changes in various thermodynamic processes, principle of increase of entropy, Entropy generation, Entropy and Disorder, isentropic process, Third law of thermodynamics.	11
4	Pure Substances, Phase Transformations, Triple point, properties during change of phase, T-v, p-v and p-T diagram of pure substance, Saturation pressure and Temperature, T-s, h-s diagrams or Mollier Charts, Dryness Fraction, Property calculations using steam tables. The ideal Gas Equation, Characteristic an Universal Gas constants, Deviations from ideal Gas Model: Equation of state of real substances, Vander Waals Equation of State, Compressibility factor, General Thermodynamic Relations–Helmholtz and Gibb's functions - Maxwell's Relations, Tds equations, Throttling process, Joule Thomson Coefficient.	11

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

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 = 24marks)	• 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. (4x9 = 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 basic concepts and laws of thermodynamics	K2
CO2	Conduct first law analysis of open and closed systems	K3
CO3	Determine entropy and availability changes associated with different processes	K3
CO4	Understand the application and limitations of different equations of state	K2
CO5	Determine change in properties of pure substances during phase change processes	K3

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation\

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering Thermodynamics	P. K. Nag	McGraw Hill	2013
2	Fundamentals of Engineering Thermodynamics	E. Rathakrishnan	PHI	2005
3	Thermodynamics an Engineering Approach	Y. A. Cengel and M. A. Boles	McGraw Hill	2011

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fundamentals of Engineering Thermodynamics	Moran J., Shapiro N. M.	Wiley	2006
2	Fundamentals of Thermodynamics	R. E. Sonntag and C. Borgnakke	Wiley	2009
3	Thermodynamics	Holman J. P.	McGraw Hill	2004
4	Engineering Thermodynamics	M. Achuthan	PHI	2004

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/112/106/112106310/ https://www.youtube.com/watch?v=9GMBpZZtjXM&list=PLD8E646BAB3366BC8
2	https://archive.nptel.ac.in/courses/112/106/112106310/ https://www.youtube.com/watch?v=sUDfpFD0xX4&list=PLD8E646BAB3366BC8&index=4
3	https://archive.nptel.ac.in/courses/112/106/112106310/ https://www.youtube.com/watch?v=lvy8h-yWhRQ&list=PLD8E646BAB3366BC8&index=6
4	https://archive.nptel.ac.in/courses/112/106/112106310/ https://www.youtube.com/watch?v=QdnssaDSyZs&list=PLD8E646BAB3366BC8&index=14

SEMESTER S5**INDUSTRIAL HYDRAULICS & PNEUMATICS**

Course Code	25MRT503	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To understand various components of pneumatic and fluid power systems and their advantages
2. Applying the fundamental concepts of fluid power and pneumatic to obtain solution to engineering problems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basics of fluid power system, Components, Advantages and applications of Fluid power systems Fluid properties: specific weight, density and specific gravity, Pascal's Law and its application Continuity equation, Conservation Of Energy, Frictional losses in hydraulic pipelines - laminar and turbulent flow, Fluid power symbols.	11
2	Hydraulic pumps: Gear, Vane and Piston pumps, Pump performance, Characteristics and Selection - Sizing of pumps Hydraulic Motors- Limited Rotation Hydraulic Motors, Gear Motors, Vane Motors, Piston Motors, Hydraulic Motor Theoretical Torque, Power, And Flow Rate, Hydraulic Motor Performance	11

3	Hydraulic Valves- Direction control valves: Three way valve, Four way valves, Check valve and shuttle valve Actuation mechanisms in DCV Pressure control valves: Pressure relief, Pressure Reducing, Counter balance, Sequencing and Unloading Valves Flow control valves and its types Proportional Valves Servo valves: Mechanical type and Electrohydraulic servo valves.	11
4	Pneumatics: Air compressors, air treatment: Air filters, Dryer, Lubricator, pressure regulation, Compressor types, Pneumatics and Hydraulics, Properties Of Air, The Perfect Gas Laws, Fluid Conditioners, Air Control Valves, Pneumatic Actuators, Fluid Logic Control Systems - Introduction To Boolean Algebra, Laws Of Boolean Algebra, Illustrative Examples Using Boolean Algebra	11

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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 various components of fluid power systems, their advantages and select them for various applications.	K2
CO2	Design and simulate fluid power systems for automation of machine tools and other equipment's.	K3
CO3	Choose appropriate control valves for fluid power applications	K3
CO4	Select pneumatic components and fluid power actuators for low cost automation	K2
CO5	Apply the fundamental concepts of fluid power and to obtain solution to engineering problems.	K3

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Hydraulics and Pneumatics	A. Parr	Elsevier	1999
2	Fluid Power with Applications	Anthony Esposito	Pearson New International Edition- Pearson	2013
3	Pneumatic System-Principles and Maintenance	S.R.Majumdar	McGraw Hill	2017.
4	Hydraulic and Pneumatics control	R.Srinivasan	McGraw Hill	2008

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Hydraulic control systems	H. E. Merritt	John Wiley& Sons, NewYork	1967
2	Basic fluid power	D. A. Peace	Prentice Hall	1987
3	Power Hydraulic	M. J. Pinches	Longman	1988

SEMESTER S5**SIGNAL PROCESSING & COMMUNICATION**

Course Code	25MRZ504	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	4	ESE Marks	40
Credits	3:0:0:1	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	-	Course Type	Theory

Course Objectives:

1. This course aims to impart the basic concepts of continuous and discrete signals and systems.
2. This course aims to develop understanding about frequency domain approaches used for analysis of continuous and discrete time signals and systems.
3. This course introduces various schemes of analog and digital modulation used in communication systems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Signals & Systems: Elementary Signals, Classification of signals, Basic operations on signals. Concept of System, Classification, Properties of Systems-Linearity, Time invariance, Causality, Stability. Linear Time Invariant (LTI) Systems – Convolution sum, Impulse response, Difference Equation representation of LTI Systems	9

2	Frequency Domain Approaches: Discrete Time Fourier Transform (DTFT), Discrete Fourier Transform (DFT)-Properties. Review of Laplace Transform, Region of Convergence (ROC), Properties of ROC, Transfer function, Stability and causality conditions. Analysis of LTI systems using Laplace transforms. Sampling of continuous time signals (definition and concept only), Sampling	9
	theorem for lowpass signals, aliasing. Basic Elements of a Digital Signal Processing (DSP) system, Typical DSP applications.	
3	Analog Communication: Block diagram of a communication system, Need for modulation. Principle of Amplitude Modulation (AM) – Frequency spectrum – power relations – generation of AM – DSB, DSB/SC, SSB. Angle Modulation - Frequency and Phase modulation - Theory and generation of Frequency Modulation (FM). Super heterodyne receivers (AM and FM).	9
4	Digital Communication: Sampling Process-Pulse modulation Techniques- PAM, PWM and PPM, Principles of digital communication & advantages – PCM encoder and decoder, Applications of data communication. Digital modulation schemes – ASK, FSK, PSK.	9

Suggestion on Project Topics

Course Assessment Method

(CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Ex-1	Internal Ex-2	Total
5	30	12.5	12.5	60

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 2 marks (8x2 =16 marks)	2 questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 2 sub divisions. - Each question carries 6 marks. (4x6 = 24 marks)	40

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply properties of signals and systems to classify them.	K3
CO2	Apply frequency domain approaches on continuous and discrete time signals and systems.	K3
CO3	Summarize analog modulation techniques and the need for modulation	K2
CO4	Explain analog and digital pulse modulation schemes.	K2

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

CO-PO Mapping Table:

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

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Signals & Systems	Simon Haykin	Wiley	2/e, 2007
2	Signals and Systems	Alan V. Oppenheim and Alan Willsky	Pearson Education India	2/e, 2015
3	Electronic Communication Systems	Kennedy G.	McGraw-Hill Education	5/e, 2011
4	Communication Systems	Simon Haykin	Wiley	4/e, 2006

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Signals and Systems	Anand Kumar	Prentice Hall India	3/e, 2013
2	Digital Signal Processing	Proakis J. G. and Manolakis D. G	Pearson Education India	4/e, 2007
3	Electronic Communications	Roody and Coolen	Pearson Education India	4/e, 2008
4	Digital Communications	John G Proakis	McGraw-Hill Education	5/e, 2018

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
Module - I	https://nptel.ac.in/courses/108104100
Module - II	https://nptel.ac.in/courses/108104100
Module - III	https://nptel.ac.in/courses/117102059
Module - IV	https://nptel.ac.in/courses/117102059

PBL Course Elements

L: Lecture (3 Hrs.)	R: Project (1 Hr.), 2 Faculty Members		
	Tutorial	Practical	Presentation
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation/ Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity

Sl. No	Evaluation for	Allotted Marks
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		30

1. Project Planning and Proposal (5 Marks)

- Clarity and feasibility of the project plan
- Research and background understanding
- Defined objectives and methodology

2. Contribution in Progress Presentation and Question Answer Sessions (4 Marks)

- Individual contribution to the presentation
- Effectiveness in answering questions and handling feedback

3. Involvement in the Project Work and Team Work (3 Marks)

- Active participation and individual contribution
- Teamwork and collaboration

4. Execution and Implementation (10 Marks)

- Adherence to the project timeline and milestones
- Application of theoretical knowledge and problem-solving
- Final Result

5. Final Presentation (5 Marks)

- Quality and clarity of the overall presentation
- Individual contribution to the presentation
- Effectiveness in answering questions

6. Project Quality, Innovation, and Creativity (3 Marks)

- Overall quality and technical excellence of the project
- Innovation and originality in the project
- Creativity in solutions and approaches

SEMESTER S5**POWER ELECTRONICS**

Course Code	25MRT521	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)	25MRT302	Course Type	Theory

Course Objectives:

1. Identify and describe the characteristics and operations of various power semiconductor devices.
2. Comprehend the operation and design of basic power converter circuits.
3. Implement control strategies in power electronic converters.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Power semiconductor devices: Power diodes, power transistors, thyristor family, SCRs, Triac, GTOs, power MOSFETs, IGBTs, MCTs-static and dynamic characteristics, protection circuits, series and parallel connections, turn-on characteristics, turn off characteristics.	9
2	DC-DC Converters Step down and Step up choppers – Single-quadrant and Two-quadrant chopper – control schemes Switching regulators – Buck, Boost & Buck-boost –Operation with continuous conduction mode – Waveforms	9

3	DC-AC Converters (Inverters) Basic principles of inverters and types (square wave, sine wave, PWM inverters). Performance parameters and harmonic analysis. Applications in UPS, motor drives, and grid-tied renewable energy systems AC-DC Converters (Rectifiers) Operation of half-wave and full-wave rectifiers. Bridge rectifiers and performance parameters (ripple, efficiency).	9
4	Control Techniques in Power Electronics Pulse Width Modulation (PWM): Introduction to PWM techniques, Types of PWM (single-pulse, multiple-pulse, sinusoidal PWM). Applications in voltage regulation and motor control. Industrial Applications and Practical Considerations Power Electronics in Renewable Energy, Role of power electronics in solar PV and wind energy systems. Role of power electronics in motor control. Variable frequency drives (VFD).	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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	Explain the fundamental concepts and significance of power electronics in modern technology.	K2
CO2	Design and analyse DC-DC converters.	K4
CO3	Design and analyse DC-AC and AC to DC converters.	K4
CO4	Apply pulse-width modulation and feedback control techniques in power electronic systems and understand the applications of power electronics in renewable energy systems and motor drives.	K3

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3										3
CO2	3										3
CO3	3										3
CO4	3										3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Power Electronics: Converters, Applications, and Design	Ned Mohan, Tore M. Undeland, and William P. Robbins.	WILEY INDIA	3RD EDITION 2002
2	Power Electronics Handbook	Muhammad H. Rashid.	BH ELSEVIER	5TH EDITION 2023

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Power Electronics: Circuits, Devices and Applications	Muhammad H. Rashid	BH ELSEVIER	5TH EDITION 2023

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/108/102/108102145/
2	https://archive.nptel.ac.in/noc/courses/noc20/SEM2/noc20-ee97/
3	https://archive.nptel.ac.in/noc/courses/noc20/SEM2/noc20-ee97/
4	https://archive.nptel.ac.in/noc/courses/noc20/SEM2/noc20-ee97/

SEMESTER S5**DESIGN OF MANUFACTURE**

Course Code	25MRT522	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)	25MRZ404	Course Type	Theory

Course Objectives:

1. Equip students with a comprehensive understanding of engineering design principles, including material selection, manufacturability, process capability, and form design.
2. Enable students to apply sustainable and environmentally responsible design practices, focusing on recyclability, energy efficiency, and minimizing environmental impact.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Engineering design: Concept – Kinds of design – Design process steps – Factors influencing design – Concurrent Engineering – Material selection process – Evaluation methods for material selection. General design principles for manufacturability: strength and mechanical factors, mechanisms selection, evaluation method	9

2	Factors Influencing form Design: Working principle, Material, Manufacture, Design- Possible solutions, Materials choice, Influence of materials on form design. Process capability: Feature tolerances, Geometric tolerances, Assembly limits, Datum features, and Tolerance stacks. Process capability analysis – Centrality analysis – Compound assembly – Selective and Interchangeable assembly – Grouped Datum systems.	9
3	Design for machining: Design features to facilitate machining using drills, milling cutters, keyways, Doweling procedures, Reduction of machined area, simplification by separation, simplification by amalgamation, Design for machinability, Design for economy, Design for accessibility, Design for assembly, Design for disassembly.	9
4	Design for the Environment: Introduction, Basic DFE methods, Design guide lines, Example application, Lifecycle assessment, Basic method, Environmentally responsible product assessment, Weighted sum assessment method, Lifecycle assessment method, Techniques to reduce environmental impact, Design to minimize material usage, Design for recyclability, Design for remanufacture, Design for energy efficiency.	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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 knowledge of General design principles for manufacturability	K3
CO2	Identify Factors Influencing form Design, improve process capability and use Selective and Interchangeable assembly to simplify designs.	K2
CO3	Identify uneconomical design of casting and welding, Modify the design, and design better castings, welded joints and brazing and soldering joints.	K3
CO4	Simplify Design features to facilitate simplicity in different machining processes and apply design principles for machinability, assembly and disassembly.	K2
CO5	Apply the knowledge of Design for energy efficiency and less environmental impact	K3

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering Design: A Materials and processing Approach	Dieter, G.E.	McGraw Hill Co. Ltd	2000
2	Assembly, Automation and product design	Boothroyd, G.	CRC press	2005
3	Product Design	Kevien Otto and Kristin Wood	Pearson Publication	2004
4	Product design and development	Ulrich, K.T. and Eppinger, S.D.	Tata McGraw Hill	
5	Design for Manufacturability Handbook	James G. Bralla	McGraw-Hill companies, New York, USA	Second Edition, 1998
6	Design for the Environment	Fixel, J.	McGraw Hill	1996

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Product Design for Manufacture	Boothroyd, G, Hertz and Nike	Marcel Dekker	1994
2	Engineering Design and Design for Manufacture and Structural Approach	Dickson, John. R, and Corroda Poly	Field Stone Publisher, USA	1995
3	Design for the Environment	Graedel T. Allen By. B	Reason Pub.	1996
4	Engineering Design	Eggert, R.J.	Pearson Education, Inc. New Jersey	2005
5	Engineering Design for Manufacture	KalandarSaheb, S.D and Prabhakar, O.	ISPE	1999.

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://youtu.be/1YvyQ0sXrrU
2	https://youtu.be/1YvyQ0sXrrU
3	https://youtu.be/1YvyQ0sXrrU
4	https://youtu.be/1YvyQ0sXrrU

SEMESTER S5**OPERATIONAL RESEARCH**

Course Code	25MRT523	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)	None	Course Type	Theory

Course Objectives:

1. To provide students with a problematic understanding of linear programming and transportation.
2. To familiarize students with different algorithms in network theory and game theory.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Linear programming problems Convex functions - Linear programming problem- Graphical method -Basic feasible solutions- Optimal solutions-additional topics of LPP-The Simplex Method-The simplex method in tabular form- Tie breaking in simplex method.	9
2	Transportation and assignment problems Transportation problem - Formulation - Existence of solutions of Transportation problems - Solutions of Transportation problem - Finding an initial basic solution- Vogel's approximation method-assignment problem- A special algorithm for the assignment problem.	9

3	Network optimization models The terminology of networks-The shortest path problem- Dijkstras Algorithm-The minimum spanning tree problem- The maximum flow problem- Ford Fulkerson algorithm- The minimum cost flow problem – The network simplex method.	9
4	Theory of games Introduction to game theory-Matrix(rectangular) games- Problem of game theory-Minimax theorem- Saddle point- Strategies and pay off- Theorems of matrix games- Graphical solutions- Notion of dominance- Rectangular game as an Linear programming problem.	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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 different methods for solving a linear programming problem	K2
CO2	Illustrate the graphical methods for solving LPP	K3
CO3	Apply various methods in transportation problem	K3
CO4	Understand and utilize different algorithms for network theory	K2
CO5	Apply various techniques for solving rectangular games	K3

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to operations research concepts and cases	Frederick S. Hillier Gerald J. Lieberman	Mc Graw Hill	8 th and 2011
2	Optimization methods in operations research and systems analysis	K.V. Mital C. Mohan	New age international (P) Ltd	3 rd and 1996

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Operations Research (SIE)	Frederick S. Hillier Gerald J. Lieberman Bodhibroto Nag <u>Preetam Basu</u>	Mc Graw Hill	11th Edition and 2021
2	Operations Research	R Panneerselvam	PHI	5 th and 2004
3	Linear programming	G Hadley	Adison	1975

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://onlinecourses.nptel.ac.in/noc22_ma48/preview
2	https://onlinecourses.nptel.ac.in/noc22_ma48/preview
3	https://onlinecourses.nptel.ac.in/noc22_ma48/preview
4	https://onlinecourses.nptel.ac.in/noc22_ma48/preview

SEMESTER S5**NUMERICAL COMPUTATION USING PYTHON**

Course Code	25MRT524	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)	None	Course Type	Theory

Course Objectives:

1. To provide students with a solid foundation in numerical methods for solving engineering problems using Python.
2. To enable students to implement numerical techniques for nonlinear equations, interpolation, integration, differentiation, and ordinary differential equations.
3. To develop students' skills in applying numerical methods to analyse and interpret engineering data and solve real-world problems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Root Finding Methods (6 Hours) (Derivation or proof not required) Bisection method; Newton-Raphson method; Secant method; False Position Method; Fixed-point iteration; Convergence and error analysis of root-finding methods. Solving nonlinear equations using the above methods in Python (2 Hours)	8

2	Interpolation (9 Hours) (Derivation or proof not required) Finite difference interpolation: Newton's finite and backward difference interpolation methods. Polynomial Interpolation: Lagrange interpolation and Newton's divided difference interpolation. Spline Interpolation: Cubic splines and B-splines. Error analysis in interpolation. Implementing interpolation methods in Python (2 Hours)	11
3	Numerical Integration and Differentiation (6 Hours) Numerical Differentiation: Finite difference methods; Error analysis in numerical differentiation. Numerical Integration: Trapezoidal rule, Simpson's rule, Gaussian quadrature, Adaptive quadrature methods. Writing Python programs to perform numerical differentiation and integration (2 Hours)	8
4	Solution of Ordinary Differential Equations (7 Hours) Initial Value Problems: Euler's method; Runge-Kutta methods; Multistep methods (Adams-Bashforth and Adams-Moulton methods). Boundary Value Problems: Shooting method; Finite difference method. Solving ODEs using Python (2 Hours)	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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	Implement root-finding algorithms in Python to solve nonlinear equations and analyse the convergence behaviour of these methods.	K3
CO2	Apply interpolation techniques in Python for data fitting and solving engineering problems and perform error analysis.	K3
CO3	Develop Python programs to implement numerical differentiation and integration techniques.	K3
CO4	Implement numerical methods in Python to solve ordinary differential equations.	K3

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3				3						3
CO2	3				3						3
CO3	3				3						3
CO4	3				3						3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Numerical Methods in Engineering with Python 3	Jaan Kiusalaas	Cambridge University Press	3 & 2013
2	Numerical Methods for Engineers	Steven C. Chapra and Raymond P. Canale	McGraw-Hill Education	7 & 2014

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Numerical Analysis	Richard L. Burden and J. Douglas Faires	Cengage Learning	10 & 2015
2	Applied Numerical Methods with MATLAB for Engineers and Scientists	Steven C. Chapra	McGraw-Hill Education	4 & 2017
3	Introductory Methods of Numerical Analysis	S.S.Sastry	Prentice Hall India Learning Private Limited	5 & 2012
4	Numerical Method and Programming	Bikas Chandra Bhui & Dipak Chatterjee	Vikas	2 & 2016

5	Numerical Methods Using Matlab	Mathews and Fink	Pearson Education India	4 & 2015
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Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	NPTEL - MATLAB Programming for Numerical Computation, IIT Madras NPTEL - Numerical methods, IIT Roorkee NPTEL - Applied Numerical Methods, IIT Kanpur
2	NPTEL - MATLAB Programming for Numerical Computation, IIT Madras NPTEL - Numerical methods, IIT Roorkee NPTEL - Applied Numerical Methods, IIT Kanpur
3	NPTEL - MATLAB Programming for Numerical Computation, IIT Madras NPTEL - Numerical methods, IIT Roorkee NPTEL - Applied Numerical Methods, IIT Kanpur
4	NPTEL - MATLAB Programming for Numerical Computation, IIT Madras NPTEL - Numerical methods, IIT Roorkee NPTEL - Applied Numerical Methods, IIT Kanpur

SEMESTER S5**METALLURGY AND MATERIAL ENGINEERING**

Course Code	25MRT526	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)	Engineering Physics and Engineering Chemistry	Course Type	Theory

Course Objectives:

1. Provide students with a deep understanding of crystal imperfections, diffusion, phase diagrams, and heat treatment processes, and their impact on material properties and mechanical behaviour.
2. Enable students to explore and apply advanced materials and strengthening mechanisms, including fatigue, creep, composites, superalloys, ceramics, and various alloy steels, to improve material performance in engineering applications.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Classification of crystal imperfections - forest of dislocation, role of surface defects on crack initiation- Burgers vector –Frank Read source - Correlation of dislocation density with strength and nano concept - high and low angle grain boundaries– driving force for grain growth and applications - Polishing and etching - X – ray diffraction, simple problems –SEM and TEM – Diffusion in solids, fick’s laws, mechanisms, applications of diffusion in mechanical engineering, simple problems.	9

2	Phase diagrams: - need of alloying - classification of alloys - Hume Rothery's rule – equilibrium diagram of common types of binary systems: five types - Coring - lever rule and Gibb's phase rule- Reactions- Detailed discussion on Iron-Carbon equilibrium diagram with microstructure and properties -Heat treatment: - TTT, CCT diagram, applications -	9
	Tempering- Hardenability, Jominy end quench test, applications- Surface hardening methods.	
3	Strengthening mechanisms - cold and hot working - alloy steels: how alloying elements affecting properties of steel - nickel steels - chromium steels - high speed steels -cast irons - principal non ferrous alloys.	9
4	Fatigue: - creep -DBTT - super plasticity - need, properties and applications of composites, super alloy, intermetallics, maraging steel, Titanium - Ceramics:- structures, applications.	9

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 = 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. (4x9 = 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 the basic chemical bonds, crystal structures (BCC, FCC, and HCP), and their relationship with the properties	K2
CO2	Analyze the microstructure of metallic materials using phase diagrams and modify the microstructure and properties using different heat treatments.	K3
CO3	Quantify mechanical integrity and failure in materials.	K2
CO4	Apply the basic principles of ferrous and non-ferrous metallurgy for selecting materials for specific applications.	K3
CO5	Define and differentiate engineering materials on the basis of structure and properties for engineering applications.	K2

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Material Science and Engineering	Callister William. D.	John Wiley	2014
2	Engineering Metallurgy part - I	Higgins R. A.	ELBS	1998

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Physical Metallurgy	E Avner H Sidney	Tata McGraw Hill	2009
2	Material Science for Engineers	Anderson J.C. et.al.	Chapman and Hall	1990
3	Physical metallurgy for Engineers	Clark and Varney	Van Nostrand	1964
4	Mechanical Metallurgy, Tata	Dieter George E	McGraw Hill	1976
5	Material Science and Engineering	Raghavan V	Prentice Hall	2004
6	Physical metallurgy principles	Reed Hill E. Robert	Cengage Learning	4th edition, 2009
7	Mechanical behavior of materials	Myers Marc and Krishna Kumar Chawla	Cambridge University press	2008
8	Elements of Material Science	Van Vlack	Addison Wesley	1989

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://nptel.ac.in/courses/113/106/11310603s

2	https://nptel.ac.in/courses/113/106/11310603s
3	https://nptel.ac.in/courses/113/106/11310603s
4	https://nptel.ac.in/courses/113/106/11310603s

SEMESTER S5

IOT AND APPLICATIONS

Course Code	25MRT525	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs.30 Min.
Prerequisites (if any)	None	Course Type	

Course Objectives:

1. Equip students with a comprehensive understanding of IoT technology, including its architecture, enabling technologies, communication models, and protocols, to effectively design and deploy IoT systems.
2. Enable students to address IoT security, privacy, and vulnerability issues, and apply practical IoT solutions using platforms like Raspberry Pi for real-world applications such as smart cities.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to IoT technology: Definitions and Characteristics of IoT, IoT Architectural View, Physical Design of IOT, Logical Design of IoT- IoT Functional blocks, IoT communication models, IoT Enabling Technologies, IoT Levels & Deployment Templates.	9

2	IoT and M2M- M2M, Difference between IoT and M2M, SDN and NFV for IoT, Smart Objects: The “Things” in IoT: Sensors, Actuators, and Smart Objects, Sensor Networks- Wireless Sensor Networks (WSNs), Communication Protocols for Wireless Sensor Networks- Connecting Smart Objects- Communication Criteria.	9
3	Unified Data Standards –Protocols –IEEE 802.15.4 -The Physical Layer, The Media-Access Control Layer, Uses of 802.15.4, The Future of 802.15.4: 802.15.4e and 802.15.4g–Modbus– ZigBee-Zigbee Architecture- LoRaWAN -Standardization and Alliances, Physical Layer, MAC Layer, Topology, LTE-M, NB-IoT-Network layer –The next generation: IP-based protocols	9
4	Raspberry-Pi-Raspberry-Pi Interfaces (serial, SPI, I2C). Raspberry Pi interfacing and programming examples using python (LED, switch, sensor, serial, SPI, I2C devices). IoT privacy, security and vulnerabilities solutions, vulnerabilities, security requirements, threat analysis, security tomography, layered attacker model, Identity management, access control, secure message communication. Smart City IoT Architecture-Street Layer, City Layer, Data Center Layer, Services Layer.	9

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

<i>Attendance</i>	<i>Internal Ex</i>	<i>Evaluate</i>	<i>Analyse</i>	<i>Total</i>
5	15	10	10	40

Criteria for Evaluation (Evaluate and Analyse): 20 marks

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 (8x3 =24marks)	2 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. - Each question carries 9 marks. (4x9 = 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 the IoT fundamentals and architecture modelling	K2
CO2	Understand the smart things in IoT and functional blocks	K2
CO3	To understand the communication networks and protocols used in IoT.	K2
CO4	To understand the cloud resources, data analysis and applications.	K2
CO5	To apply the IoT processes in embedded applications.	K4

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Internet of Things (A Hands - on-Approach)	Vijay Madiseti and ArshdeepBahga	VPT	Ist Edition,2014
2	IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry,	Cisco Press	Ist Edition,2017
3	Internet of Things: Architecture and Design Principles	Rajkamal	McGraw Hill (India)	2nd edition, 2022
4	Raspberry Pi Cookbook, Software and Hardware Problems and solutions	Simon Monk, O'Reilly (SPD)	ISBN	2016

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	“The Internet of Things – Key applications and Protocols”,	Olivier Hersent, David Boswarthick, Omar Elloumi	Wiley,	2012
2	Internet of things: A survey on enabling technologies, protocols, and applications.	Al-Fuqaha <i>et.al</i>	IEEE Communications Surveys & Tutorials	(2015), pp. 2347-2376.
3	The Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems	Ovidu Vermesan and Peter Friess	River Publishers	1st edition, on,

				2013
4	Internet of Things - From Research and Innovation to Market Deployment-	Ovidu Vermesan	River Publishers	1st edition, 2014

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://onlinecourses.nptel.ac.in/noc22_cs53/preview
2	https://nptel.ac.in/courses/106105081
3	https://nptel.ac.in/courses/108108098
4	https://onlinecourses.nptel.ac.in/noc21_cs14/preview

SEMESTER S5**CAD LAB**

Course Code	25MRL507	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Lab

Course Objectives:

1. To introduce students to the basics and standard of engineering design related to machine components.
2. To make students familiarize with different solid modelling software's
3. To convey the principle and requirements of modelling of machine elements
4. To introduce the preparation of part modelling and assembly modelling of machineries
5. To introduce standard CAD package to perform animations of machine parts

Expt. No.	Experiments
1	Introduction to computer aided design
2	Creation of 2D drawings (At least 8)
3	Creation of 3D objects from 2D drawings (At least 4)
4	Creation of part drawings (At least 4)
5	Making of assembly drawings (at least 4) (Universal joints, Flanged coupling, Cotter joint, Old ham's joint, Plumber block, Screw jack, knuckle joint, Clutch etc.)
6	Creation of 3D animation models (at least 1 drawing) (Industrial robot, Robotic arm, Robotic gripper, Piston cylinder & Connecting rod, etc.

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	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	15	10	10	5	50

- *Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.*
- *Endorsement by External Examiner: The external examiner shall endorse the record*

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Gain working knowledge in Computer Aided Design and modelling procedures	K2
CO2	Gain knowledge in creating solid machinery parts	K3
CO3	Gain knowledge in assembling machine elements	K3
CO4	Gain knowledge in creating solid machinery parts with animation	K3

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

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	3	-	-	3	-	-	3
CO2	3	-	3	-	3	-	-	3	3	-	3
CO3	3	-	3	-	3	-	-	3	3	-	3
CO4	3	-	3	-	3	-	-	3	3	-	3

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	CAD/ CAM Theory and Practice	Ibrahim Zeid	McGraw Hill	2007
2	CAD/ CAM – Computer Aided Design and Manufacturing	Mikell P. Groover and Emory W. Zimmer	Pearson Education	1987

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Autodesk Fusion 360	Sandeep Dogra, Cadartifex	A power guide for beginners and intermediate users by John Willis	2018
2	Beginner's guide to solid works 2022 – Level I: Parts, Assemblies, Drawings, Photo view 360 and simulation Xpress		1st edition by Alejandro Reyes	2022
3	Machine Drawing	P. I. Varghese, K. C. John	VIP publications	2001
4	A Textbook of machine drawing	K. C. John	PHI publications	2009

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 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 (7 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 (6 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 (5 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 End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 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.

- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

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

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

SEMESTER S5**MICROCONTROLLER LAB**

Course Code	25MRL508	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	25MRT403	Course Type	Lab

Course Objectives:

1. Familiarize the students with Assembly Language Programming of modern microcontrollers.
2. Impart the skills for interfacing the microcontroller with the help of Embedded C/Assembly Language Programming.

Expt. No.	Experiments
1	Data transfer/exchange between specified memory locations.
2	Largest/smallest from a series.
3	Sorting (Ascending/Descending) of data.
4	Addition / subtraction / multiplication / division of 8/16 bit data.
5	Sum of a series of 8 bit data.
6	Multiplication by shift and add method.
7	Code conversion – Hex to Decimal/ASCII to Decimal and vice versa.
8	Time delay generation and relay interface.
9	Display (LED/Seven segments/LCD) and keyboard interface.
10	DAC interface with wave form generation.
11	Stepper motor and DC motor interface.
12	Realization of Boolean expression through port.

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	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	15	10	10	5	50

- *Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.*
- *Endorsement by External Examiner: The external examiner shall endorse the record*

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Demonstrate the ability to transfer, manipulate, and exchange data between specified memory locations, and perform arithmetic operations on 8-bit and 16-bit data using a microcontroller.	K3
CO2	Develop and implement algorithms for sorting data in ascending and descending order, finding the largest and smallest elements in a series, and calculating the sum of a series of 8-bit data efficiently on a microcontroller.	K6
CO3	Design and implement interfaces for various peripherals, such as LED, seven-segment displays, LCDs, keyboards, DACs for waveform generation, and motors (stepper and DC motors), and generate appropriate time delays and relay control signals.	K6
CO4	Execute code conversion between different number systems (Hex to Decimal, ASCII to Decimal, and vice versa) and understand the significance of various data representations in microcontroller programming.	KK3
CO5	Realize and implement Boolean expressions through microcontroller ports, demonstrating the ability to design and control logical operations in embedded systems.	K3

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

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

	PO 1	PO 2	PO 3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2			2						
CO2	3	3	2		2						
CO3	3	2	3	2	3			2			
CO4	3				2						2
CO5	3	2	2		2			2			

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	The 8051 microcontroller and Embedded System	Muhammed Ali Mazidi & Janice Gilli Mazidi, R.D. Kinley	Pearson Education	2nd edition, 2007
2	Computer Architecture and Organization: From 8085 to Core2Duo and beyond	Subrata Ghoshal	Pearson	1st edition, 2011
3	ARM System - on-chip Architecture	Steve Furber	Pearson Education	2014

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer System Architecture	Mano M M	Prentice Hall of India	3rd Edition, 2017
2	Computer organization and design: The Hardware/Software interface	David A. Patterson, John L. Hennessy	Elsevier	6th edition. 2021
3	Computer Organisation	V. Carl Hamacher, Zvonko G. Vranesic, Safwat G.Zaky	McGraw-Hill Education	5th edition, 2017
4	8085 Microprocessor Architecture, Applications and Programming	Ramesh S Goankar	Penram International	5/e

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
Module - I	https://archive.nptel.ac.in/courses/106/108/106108100/
Module - II	https://archive.nptel.ac.in/courses/106/108/106108100/
Module - III	https://archive.nptel.ac.in/courses/106/108/106108100/
Module - IV	https://archive.nptel.ac.in/courses/106/108/106108100/

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 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 (7 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 (6 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 (5 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 End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 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.

- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

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

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

SEMESTER 6

MECHATRONICS ENGINEERING

SEMESTER S6**ROBOTICS & MACHINE VISION**

Course Code	25MRT601	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)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To impart knowledge about the robotics as well as the concept of machine vision.
2. This includes basics of robots, sensors, kinematics as well as details of machine vision, an advanced sensor for robotics and automation

SYLLABUS

Module No.	Syllabus Description	Content Hours
1	Robotics –Introduction –Basic Structure-Classification of Robot and Robotic System-Law of Robotics-Robot Motion-Wrist Configuration-Motion – Roll –Pitch-Yaw-Drives-Hydraulic Motors-DC Motor...Stepper Motor-Power Transmission Systems	11

2	Sensors in Robotics: Position Sensor-Potentiometer-Encoders-LVDT-Velocity Sensor-Acceleration Sensor-Force-Pressure and Torque Sensor-Touch and Tactile Sensor-Proximity –Range and Sniff Sensor-Robot End Effectors-Types of End Effectors- Mechanical Gripper –Types of Gripper Mechanism	11
3	Position Orientation-Frames-Mapping-Changing Description from Frames to Frames. Transformation arithmetic's -Translation-rotation- transformation- transforms equations- transformation of the vectors- Introduction to manipulations Forward Kinematics and inverse Kinematics- D-H representation-Method of Robotic Programming (Qualitative Treatment Only).	11
4	Machine Vision: Machine Vision as a sensor - low and higher level vision- 1D and 3D vision-image acquisition and digitization- cameras- CCD- CID- CPD illumination and types- image processing and analysis- feature extraction- Applications of vision in industrial automation – Control systems using vision for decision making and feedback-Visual Servoing	11

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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 the basics of robotics & its various classifications and configurations	K2
CO2	Understand the robot actuators and controls	K2
CO3	Get knowledge on robot sensors & actuators for robotic application	K2
CO4	Understand the kinematics of robots and adaptive control	K3
CO5	Identify machine vision as an advanced sensor for automation.	K3

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1									
CO2	3	2		2							

CO3	3	2	2	2							2
CO4	3	3									
CO5	3	1		1							2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Industrial Robotics- Technology, Programming and Applications	M.P Groover	McGraw-Hill USA	1986
2	Introduction to Robotics	John Craig	Macmillan	1985
3	Machine Vision – Automated Visual Inspection and Robot Vision	Vernon D	Prentice Hall, International Ltd	1991
4	Machine Vision	Ramesh Jain, Rangachar Kasturi, Brain G. Schunk	McGraw Hill International	-

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Robotics Technology and Flexible Automation	Deb S. R, Deb S	Tata McGraw Hill Education Pvt. Ltd	2010

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://onlinecourses.nptel.ac.in/noc24_me117/preview
2	https://onlinecourses.nptel.ac.in/noc24_me117/preview
3	https://onlinecourses.nptel.ac.in/noc24_me88/preview
4	https://onlinecourses.nptel.ac.in/noc24_me88/preview

SEMESTER S6

AUTOTRONICS

Course Code	25MRT602	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To understand the fundamentals and control of automobiles using electronic equipment.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Automotive fundamentals: The engine, components, drive train, starting & charging systems operation, ignition system, suspension systems, brakes, steering system. Sensors and actuators for power train and chassis systems: Introduction, working principle, throttle position, Manifold absolute pressure (MAP), lambda sensor, detonation, emission.	11

2	SI Engine Management: Feedback carburettor system, throttle body injection and multi point fuel injection system, injection system controls, advantage of electronic ignition systems, three way catalytic converter, group and sequential injection techniques. Working of the fuel system components. Advantages of electronic ignition systems CI Engine Management: Parameters affecting combustion, noise and emissions in CI engines. Pilot, main, advanced, post injection and retarded post injection layout of the Common Rail Fuel Injection system, working of components like fuel injector, fuel pump, rail pressure limiter, flow limiter, EGR valve control in electronically controlled systems.	11
3	Safety and comfort : Antilock Braking System (ABS), Electronic Stability Control (ESC), Roll Stability Control (RSC), traction control system, adaptive cruise control, electric power steering, electronic clutch, electronic suspension system, airbags. Electric vehicles and hybrid vehicles: Introduction, electric vehicle development, system layout, basic system components, fuel cell, electric vehicle, hybrid vehicle: series hybrid vehicle, parallel hybrid vehicle, CNG-electric hybrid vehicle.	11
4	Vehicle Intelligence: Introduction, basic structure, vision based autonomous road vehicles, architecture for dynamic vision system, features, applications, application of mobile robot vision to a vehicle information system, object detection, collision warning and avoidance system, low tire pressure warning system.	11

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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	Acquire knowledge on various electronic controls, sensors and actuators used in automobiles	K2
CO2	Obtain an overview of components, sub-systems, and basics of engine management employed in today's automotive industry.	K2
CO3	Apply fundamental knowledge for design of safety systems like airbags, ABS, etc. in automobiles.	K3
CO4	Comprehend the basic system components and their functions of electric and hybrid vehicles. Acquire a fundamental knowledge on intelligence vehicle systems.	K3

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2									
CO2	3	2									

CO3	3	2	2					1			
CO4	3	2	2					1			2
CO5											

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Automobile electrical and electronic systems	Tom Denton	BH Publications	3rd Ed., 2004
2	Automobile Electrical & Electronic Equipments	Young, Griffiths	Butterworths	
3	Automotive Electronics Design Fundamental	Najamuz Zaman	Springer,	1st Ed., 2015
4	Fundamentals of Motor Vehicle Technology on Chassis and Body Electronics	Hillier's	Nelson	5th Ed.

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Automotive Technology	Jack Erjavec, Robert Scharff	Delmar publications Inc	1992
2	Electric and Hybrid-electric vehicles	Ronald K. Jurgen	SAE	2002
3	Vision-based Vehicle Guidance	Ichiro Masaki	Springer Verlag, Newyork	1992
4	Class room manual for automotive service and system	Jay Webster	Delmer	1995

SEMESTER S6

NETWORK & DATA SECURITY

Course Code	25MRT631	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)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To understand the fundamental principles and architectures of computer networks, including physical structures, network models, and the interconnection of networks, along with an in-depth exploration of the OSI model and TCP/IP protocol suite.
2. To gain comprehensive knowledge of network security mechanisms, including symmetric and public-key cryptography, authentication protocols, and firewall technologies, while mastering advanced topics in reliable data transfer, congestion control, and routing algorithms in the Internet.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Networks: Network criteria, physical structures, network models, categories of networks, Interconnection of Networks: Internetwork. Network models: Layered tasks, OSI model, Layers in OSI model, TCP/IP protocol suite. Application Layer: Principles of Network Applications: Network Application Architectures, Processes Communicating, Transport Services Available to Applications, Transport Services Provided by the Internet, Application-Layer Protocols. Guided and unguided transmission media - Co-axial cable, UTP, STP, Fiber optic cable	9
2	Transport Layer : Introduction and Transport-Layer Services: Relationship Between Transport and Network Layers, Overview of the Transport Layer in the Internet. Multiplexing and Demultiplexing: Connectionless Transport: UDP, UDP Segment Structure, UDP Checksum Principles of Reliable Data Transfer: Building a Reliable Data Transfer Protocol, Pipelined Reliable Data Transfer Protocols, Go-Back-N, Selective repeat, Connection-Oriented Transport TCP: The TCP Connection, TCP Segment Structure, Reliable Data Transfer, Flow Control, TCP Connection Management, Principles of Congestion Control: The Causes and the Costs of Congestion, Approaches to Congestion Control, Network-assisted congestion-control example, ATM ABR Congestion control, TCP Congestion Control: Fairness.	9

3	The Network layer: Router: Input Processing, Switching, Output Processing, Routing: Routing and Forwarding, Static routing and Dynamic routing, Routing control plane, IPv6, A Brief foray into IP Security, Routing Algorithms: The Link-State (LS) Routing Algorithm, The Distance-Vector (DV) Routing Algorithm, Hierarchical Routing, Routing in the Internet, Intra-AS Routing in the Internet: RIP, Intra-AS Routing in the Internet: OSPF, Inter/AS Routing: BGP, Broadcast Routing Algorithms and Multicast.	9
4	Network Security: Overview of Network Security: Elements of Network Security, Classification of Network Attacks, Security Methods, Symmetric-Key Cryptography: Data Encryption Standard (DES), Advanced Encryption Standard (AES), Public-Key Cryptography: RSA Algorithm, Diffie-Hellman Key-Exchange Protocol, Authentication: Hash Function, Secure Hash Algorithm (SHA), Digital Signatures, Firewalls and Packet Filtering, Proxy Server.	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 = 24marks)	- 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. (4x9 = 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	Demonstration of application layer protocols	K2
CO2	Discuss transport layer services and understand UDP and TCP Protocols	K2
CO3	Explain routers, IP and Routing Algorithms in network layer	K2
CO4	Explain network security, and attacks and its security methods	K2

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer Networking, A Top-Down Approach	James F Kurose and Keith W Ross	Pearson	Eighth Edition, 2021
2	Computer and Communication Networks	Nader F Mir	Pearson	2nd Edition, 2014
3	CRYPTOGRAPHY AND NETWORK SECURITY	Behrouz A Forouzan	McGraw Hill, Indian Edition	2007
4	Data Networks	D. Bertsekas, RG Gallager,	Prentice Hal	2nd edition, 1991

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Data and Communications and Networking	Behrouz A Forouzan	McGraw Hill, Indian Edition	Fifth Edition
2	Computer Networks	Larry L Peterson and Bruce S Davie	ELSEVIER 3	Fifth Edition
3	Computer Networks	Andrew S Tanenbaum	Pearson 4	Fifth Edition
4	Computer Networks	Mayank Dave	Cengage Learning	Second edition

SEMESTER S6**RENEWABLE ENERGY**

Course Code	25MRT632	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)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. Inculcate in students an awareness of new and renewable energy sources.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction, Classification of Energy Resources- Conventional Energy Resources - Availability and their limitations- Non-Conventional Energy Resources – Classification, Advantages, Limitations; Comparison. SOLAR THERMAL SYSTEMS- Principle of Conversion of Solar Radiation into Heat – Solar thermal collectors. – Flat plate collectors. SOLAR ELECTRIC SYSTEMS- Solar Thermal Electric Power Generation – Solar Photovoltaic – Solar Cell fundamentals - characteristics, classification, construction. Solar PV Systems – stand-alone and grid connected- Applications.	9

2	ENERGY FROM OCEAN- Ocean Thermal Energy Conversion (OTEC)- Principle of OTEC system- Open Cycle (Claude cycle), Closed Cycle TIDAL ENERGY – Principle of Tidal Power- Components of Tidal Power Plant (TPP)- Classification-single basin- double basin types –Limitations - Environmental impacts. WIND ENERGY- Introduction- Basic principles of Wind Energy Conversion Systems (WECS). Types of rotors. wind power equation -Betz limit. Advantages and Disadvantages of WECS -site selection criteria.	9
3	BIOMASS ENERGY- Introduction- Biomass Fuels-Biomass conversion technologies -Urban waste to Energy Conversion- Biomass Gasification- Biomass to Ethanol Production- Biogas production from waste biomass-factors affecting biogas generation-types of biogas plants – KVIC and Janata model-Biomass program in India.	9
4	SMALL HYDRO POWER- Classification as micro, mini and small hydro projects - Basic concepts and types of turbines- selection considerations. EMERGING TECHNOLOGIES: Fuel Cell-principle of operation – classification- conversion efficiency and losses - applications. Hydrogen energy -hydrogen production -electrolysis thermo chemical methods - hydrogen storage and utilization.	9

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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	Choose the appropriate energy source depending on the available resources and the concepts of solar thermal and solar electric systems.	K2
CO2	Illustrate the operating principles of wind, and ocean energy conversion systems.	K2
CO3	Outline the features of biomass and small hydro energy resources	K2
CO4	Describe the concepts of fuel cell and hydrogen energy technologies	K2

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Non-Conventional Energy Sources	G. D. Rai	Khanna Publishers	2010
2	Energy Technology	Rao S. and B. B. Parulekar	Khanna Publishers	1999
3	Non-Conventional Energy Resources	Sawhney G. S	PHI Learning	2012

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Renewable and Novel Energy Sources	Sab S. L	MI. Publications	1995
2	Renewable Energy Sources and Their Environmental Impact	Abbasi S. A. and N. Abbasi	Prentice Hall of India	2001
3	Renewable Energy - Power for Sustainable Future	Boyle G	Oxford University Press	1996

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
For all module	https://nptel.ac.in/courses/103103206

SEMESTER S6**ADVANCED AUTOMATION**

Course Code	25MRT633	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)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. Make students familiar with automation and control technologies in modern manufacturing.
2. Determine the modern application of automation systems in manufacturing industry.
3. Provide knowledge on the elements of modern manufacturing systems.
4. Examine the mechanisms of CMM and FMS.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Production system facilities-Manufacturing support systems - Automation in production systems-manual labor in production systems - automation principles and strategies USA principle-ten strategies of Automation and Production Systems - Automation Migration strategy-manufacturing industries and products-manufacturing operations-processing and assembly operations-product / production relationships. Classification of manufacturing systems	9

2	Elements of an automated system-advanced automation functions - safety monitoring-maintenance and repair diagnostics - capabilities of computer control and levels of industrial process control-computer process monitoring-direct digital control-numerical control and robotics- PLC. Components of a manufacturing system - production machines - material handling system.	9
3	Automation levels - part or product variety - Type I type II and type III manufacturing systems. Part families - parts classification and coding-features and examples of part classification and coding systems - production flow analysis-cellular manufacturing - application of group technology. Inspection metrology-coordinate measuring machines - CMM construction - CMM operation and planning - CMM applications and benefits.	9
4	Machine vision - image acquisition and digitizing - machine vision applications. Flexible manufacturing systems - types of FMS - FMS components - workstations - material handling and storage systems - computer control systems - human resources - FMS applications and benefits - FMS planning and implementation issues - FMS planning and design issues - FMS operational issues. Comparison of lean and agile manufacturing.	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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 the principles of automation systems and to determine the relationship between product and production.	K2
CO2	Analyse the different elements of automation system and to find the importance of control systems in automation.	K3
CO3	Classify the manufacturing systems, what are the components of manufacturing systems and understand about CMM.	K2
CO4	Explain about Machine vision in manufacturing system and FMS.	K2

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1		1							
CO2	3	2	1	2							2
CO3	3	3									

CO4	3	2	3	2							2
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Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Automation, Production Systems and Computer – Integrated Manufacturing	Mikell P Groover,	Pearson Education	2001

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	CAD/CAM and CIM	Radhakrishnan, P Subramanian	Wiley Eastern	2003
2	Advanced Automation Techniques in Adaptive material processing	XiaoQi Chen, Rajagopalan Devanathan, Aik Meng Fong	World Scientific, first edition	2002
3	Principles of automation and Advanced Manufacturing System	Dr. KC Jain, Sanjay Jain	Khanna Publishers	2004

SEMESTER S6**WIRELESS & SENSORS NETWORKS**

Course Code	25MRT634	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)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To make students understand the basics of Wireless sensor Networks.
2. To familiarize with learning of the Architecture of WSN.
3. To understand the concepts of Networking and Networking in WSN.
4. To study the design consideration of topology control and solution to the various problems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	OVERVIEW OF WIRELESS SENSOR NETWORKS Single-Node Architecture Hardware Components Network Characteristics unique constraints and challenges, Enabling Technologies for Wireless Sensor Networks Types of wireless sensor networks.	9
2	ARCHITECTURES Network Architecture Sensor Networks Scenarios Design Principle, Physical Layer and Transceiver Design Considerations, Optimization Goals and Figures of Merit, Gateway Concepts, Operating Systems and Execution Environments introduction to Tiny OS and nesC Internet to WSN Communication.	9

3	NETWORKING SENSORS MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts SMAC, BMAC Protocol, IEEE 802.15.4 standard and ZigBee, the Mediation Device Protocol, Wakeup Radio Concepts,	10
4	Address and Name Management, Assignment of MAC Addresses, Routing Protocols Energy Efficient Routing, Geographic Routing. INFRASTRUCTURE ESTABLISHMENT Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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 challenges and technologies for wireless networks	K4
CO2	Understand architecture and sensors	K4
CO3	Describe the communication, energy efficiency, computing, storage and transmission	K6
CO4	Establishing infrastructure and simulations	K4

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Protocols And Architectures for Wireless Sensor Networks	Holger Karl & Andreas Willig	John Wiley	1 st and 2005
2	Wireless Sensor Networks An Information Processing Approach	Feng Zhao & Leonidas J.Guibas,	Elsevier	1 st and 2007

3	Fundamentals of Wireless Sensor Networks Theory and Practice	Waltenegus Dargie , Christian Poellabaue	John Wiley & Sons Publications	1 st and 2011
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Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Wireless Sensor Networks Technology, Protocols, and Applications	Kazem Sohraby, Daniel Minoli, & Taieb Znati	John Wiley	1 st and 2007
2	Wireless Sensor Network Designs	Anna Hac	John Wiley	1 st and 2003

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://youtu.be/GUSrkWJ_Z2g?feature=shared
2	https://nptel.ac.in/courses/106/105/106105160/
3	https://onlinecourses.swayam2.ac.in/arp19_ap52/preview
4	https://cse.iitkgp.ac.in/~smisra/course/wasn.html

SEMESTER S6

EMBEDDED SYSTEMS

Course Code	25MRT636	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)	25MRT403	Course Type	Theory

Course Objectives:

1. The purpose of this course is to mould students into high calibre embedded real time application designers by enhancing their knowledge and skills in various system design aspects of embedded real time system.
2. This course helps to make students familiar with the architecture, hardware and software elements, programming models, tools for embedded system design and implementation of embedded system.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Embedded Systems: Application domain of embedded systems, features and characteristics, System model, Microprocessor Vs Microcontroller, current trends and challenges, hard and soft real time systems, Embedded product development, Life Cycle Management (water fall model), Tool Chain System, Assemblers, Compilers, linkers, Loaders, Debuggers Profilers & Test Coverage Tools-cross compilation.	9

2	Embedded System Design: Introduction to Embedded Systems and Computer Systems Terminology. Modular approach to Embedded System Design using Six-Box model: Input devices, output devices, embedded computer, communication block, host and storage elements and power supply. Microcontroller Based Embedded System Design. Salient Features of Modern Microcontrollers. Elements of Microcontroller Ecosystem and their significance	9
3	ATMEGA 8 Microcontroller: Architecture of ATMEGA 8, Pin Description, Memory organization: Program memory, Data Memory, I/O Ports, Timers, Counters, Analog comparator, Serial Peripheral Interface, USART, External Hardware Interrupts, ADC.	9
4	ATMEGA 8 Embedded C Programming: I/O ports, Register configuration, Programming – Timers: Modes – Programming – Counters – ADC: Configuration registers – Programming – External Hardware Interrupts: Types – Programming.	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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
		1

2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- 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. (4x9 = 36 marks)	60
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Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand Embedded Systems enabling them to analyze application domains, navigate the development lifecycle using the waterfall model, and proficiently utilize tool chain components for efficient embedded system development.	K2
CO2	Understand the basic concept of microcontroller based embedded system design	K2
CO3	Interpret architecture and interfacing concepts of ATMEGA 8 microcontroller.	K2
CO4	Develop embedded programming using ATMEGA 8 microcontrollers.	K3

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Embedded System Design – A Unified Hardware/ Software Introduction	Frank Vahid And Tony Givargis	John Wiley & Sons	2002
2	Embedded Systems – An Integrated Approach	Lyla B Das	Pearson Publication	6 th edition, 2014
3	The Avr Microcontroller and Embedded Systems Using Assembly and C - using Arduino Uno and Atmel Studio	Sarmad Naimi, Muhammad Ali Mazidi, Sepehr Naimi	MicroDigitalEd	2017

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Designing Embedded Hardware.	John Catsoulis	Shroff Publishers and Distributors	2 nd edition
2	Embedded System- Architecture, programming, Design.	Rajkamal	Tata McGraw Hill	2011
3	Embedded Systems	Rao B. Kanta	PHI Learning Pvt. Ltd.	2011
4	An embedded software primer	David E.Simon	Pearson Education Asia	2001
5	Data sheet – ATMEGA 8		ATMEGA	

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/106/105/106105193
2	https://onlinecourses.nptel.ac.in/noc20_ee98/preview https://archive.nptel.ac.in/courses/108/102/108102169

3	https://nptel.ac.in/courses/108105102
4	https://nptel.ac.in/courses/108105102

SEMESTER S6**MECHANICS OF MACHINERY**

Course Code	25MRT637	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)	25EST107	Course Type	Theory

Course Objectives:

1. Have fundamental knowledge of Kinematics and Dynamics of Machines.
2. To study basics of power transmission.
3. To Study the essentiality of balancing.
4. To acquaint with working principles of CAM Mechanism.
5. To gain knowledge on gyroscope and types of vibration on machines.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to kinematics and mechanisms - various mechanisms, kinematic diagrams, degree of freedom- Grashof's criterion, inversions, coupler curves mechanical advantage, transmission angle. Straight line mechanisms exact, approximate. Displacement, velocity analysis– relative motion - relative velocity. Instantaneous centre -Kennedy's theorem.	9

2	Belt Drivers: Flat Belt Drives, Ratio of Belt Tensions, Centrifugal Tension, power Transmitted. Gears and Gear Trains: Gear terminology, law of gearing, Path of contact Arc of contact, Contact ratio of spur gears. Simple gear trains, Compound gear trains for large speed. Reduction, Epicyclic gear trains. Related Problems. Study of various power transmission methods used in robotic and automation applications	9
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3	Static and Dynamic Balancing -Balancing of single rotating mass by a single mass rotating in the same plane -Balancing of several masses rotating in the same plane-Problems on above (Analytical and Graphical methods). Cams: classification of cam and followers - displacement diagrams Cams: velocity and acceleration analysis of SHM, uniform velocity, uniform acceleration, cycloidal motion, Graphical cam profile synthesis, pressure angle.	9
4	Gyroscope: Vectorial Representation of Angular Motion, Gyroscopic Couple. Effect of Gyroscopic Couple on Ship, Plane Disc, Aircraft. Vibration: Terms used in Vibrations-Types of Vibrations-Free Vibrations- Forced Vibrations-Damped Vibrations-Types of Free Vibrations- Longitudinal, Transverse and Torsional- Critical or Whirling speed of a shaft.	9

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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
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2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- 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. (4x9 = 36 marks)	60
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Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the fundamentals of kinematics, various planar mechanisms and interpret the basic principles of mechanisms and machines	K2
CO2	Select appropriate power transmission mechanisms	K2
CO3	Appreciate the essentiality of balancing in Rotating Parts	K2
CO4	To acquaint with working principles of CAM Mechanism.	K2
CO5	To study the different types of vibration and to understand gyroscopic effects.	K2

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Theory of Machines and Mechanisms	Ballaney P. L	Khanna Publishers	25 th Edition 2018
2	Theory of Machines	S. S. Rattan	Tata Mc Graw Hill	4 th edition 2017
3	Theory of machines	Khurmi R S, Gupta J.K	S.Chand and company	2015

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Kinematics and Dynamics of Machinery	.C E. Wilson, P. Sadler,	Pearson Education	2005
2	Machines and Mechanisms Applied Kinematic Analysis	D.H. Myszka	Pearson Education	2013
3	Mechanism Design: Analysis and synthesis Vol I & II	G. Erdman, G. N. Sandor	Prentice Hall of India,.	1984
4	Kinematics and Dynamics of Machinery,	Norton	Tata McGraw Hill	2009

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/112/105/112105268/
2	https://archive.nptel.ac.in/courses/112/105/112105268/

3	https://www.youtube.com/watch?v=oQrcPiQuCHI
4	https://www.youtube.com/watch?v=OyqHoJ2Wd8Q&list=PLAC668A0566953FB5&index=2

SEMESTER S6

SOFT COMPUTING

Course Code	25MRT635	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To introduce students to the fundamental concepts and techniques of Soft Computing, including Neural Networks, Fuzzy Logic, and Genetic Algorithms.
2. To enable students to apply Soft Computing methods to real-world problems through project-based learning.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Overview of Soft Computing Definition and importance of Soft Computing - Comparison with Hard Computing - Applications in various domains. Introduction to Neural Networks Biological inspiration and McCulloch-Pitts model - Activation functions: Types and uses - Neural Network Architectures: Single layer feedforward networks - Multilayer feedforward networks - Recurrent networks. Learning Process in Neural Networks Supervised vs. Unsupervised learning - Learning rules: Perceptron, Widrow-Hoff, Delta rule, Hebbian and Competitive learning - Applications: Pattern association, recognition, and function approximation.	9
2	Single Layer Networks Perceptron and ADALINE - Adaptive filtering and optimisation techniques - Perceptron convergence theorem. Multilayer Networks Architecture and learning algorithms - Backpropagation: Detailed working, issues, and solutions - XOR problem and decision rules - Introduction to MADALINE. Radial Basis Neural Networks Concept and applications - Network training and regularisation theory - Comparison with Multilayer Perceptron.	9
3	Basics of Fuzzy Logic Introduction to Fuzzy Sets - Properties, operations, and relations - Membership functions and fuzzy rules. Fuzzy Rule-Based Systems Canonical rule forms - Composite rules and their decomposition - Aggregation of fuzzy rules and decision-making. Introduction to Genetic Algorithms Evolutionary concepts and GA features - Coding, selection, crossover, and mutation - Basic GA structure and operators.	9

4	Hybrid Systems Concept of Neuro-Fuzzy Systems - Integration of neural networks and fuzzy logic - Introduction to Neuro-Genetic Systems. Advanced Topics and Cross-Validation Cross-validation methods and model selection - Early stopping methods and their importance - Introduction to Boltzmann Machines and Mean Field Theory (brief overview)	9
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Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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	Explain the working principles and architectures of various neural networks and learning rules to train different neural network models.	K2
CO2	Apply and implement single-layer and multilayer perceptron networks to solve complex problems, and Radial Basis Function (RBF) networks for classification tasks.	K3
CO3	Design and implement fuzzy logic systems for real-world problems.	K3
CO4	Design and implement hybrid systems combining neural networks, fuzzy logic, and genetic algorithms, and apply advanced techniques for model validation and optimisation.	K3

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Neural Networks, Fuzzy Logic and Genetic Algorithm (Synthesis and Application)	S.Rajasekaran & G.A.Vijayalakshmi Pai	Prentice Hall of India	2 & 2017

2	Neural Nrtworks (A Comprehensive Foundation)	Simon Haykins	Pearson Education	1 & 1997
3	Fuzzy Logic With Engineering Applications	Ross.T.J	McGraw Hill	3 & 2011
4	Neural Networks for Pattern Recognition	Christopher M. Bishop	Oxford	1 & 1995

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Neural Networks and Fuzzy Systems	Bart Kosko	Prentice Hall of India	1 & 1994
2	Introduction to Artificial Neural Systems	Jacek M.Zurada	Jaico Publishing House	1 & 1994
3	An Introduction to Fuzzy Control.	Driankov.D, Flellendoom.H & Reinfrank.M	Springer-Verlag Berlin and Heidelberg GmbH & Co. K	2 & 1996
4	Genetic Algorithms	David E.Goldberg	Pearson Education	1 & 1989
5	Neural Networks. A comprehensive foundation	Simon Haykins	Macmillan College, Proc, Con, Inc, New York	1 & 1997

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	Swayam - Introduction To Soft Computing - Prof. Debasis Samanta, IIT Kharagpur

SEMESTER S6**PLC & DATA ACQUISITION SYSTEM**

Course Code	25MRZ604	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	3:0:0:1	ESE Marks	40
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)		Course Type	Theory

Course Objectives:

1. To study about PLC and the different programming languages
2. To understand the various PLC instructions
3. To understand the need of computer control in automation
4. To study the data acquisition systems.

SYLLABUS

Module No.	Syllabus Description	Content Hours
1	PLC PROGRAMMING METHODS Architecture, Study of different types of pneumatic and hydraulic valves, PLC Programming languages - Relay Logic-Ladder Logic-Programming of Gates, PLC Timers-ON delay, OFF delay, Retentive Timers, Programming Counters-up/down counter-Combining counter, PLC Arithmetic functions	11

2	PLC DATA HANDLING FUNCTIONS PLC Program control instructions: Master Control Reset - Skip -Jump & Move Instruction, Sequencer instructions, Types of PLC analog modules and systems, PLC analog signal processing - Case study of Tank level control system, bottle filling system and sequential switching of motors	11
3	COMPUTER CONTROL Need of computer in a control system-Functional block diagram of a computer control system-Data Loggers - Supervisory computer control- Direct Digital Control - SCADA -Programming of Robot (Pick and Place)	11
4	DATA ACQUISITION SYSTEMS Sampling Theorem - Sampling and digitizing - Aliasing - Sample and Hold Circuit -signal conditioning of Strain gauge, LVDT, Thermocouple, Pressure Transducer. Interfacing ADC and DAC with microprocessor / Multiplexer- Microprocessor/PC based acquisition systems	11

Suggestion on Project Topics

Course Assessment Method

(CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Ex-1	Internal Ex-2	Total
5	30	12.5	12.5	60

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 2 marks (8x2 =16 marks)	2 questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 2 sub divisions. - Each question carries 6 marks. (4x6 = 24 marks)	40

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Study about programming of PLC and Understand the various PLC Instruction	K2
CO2	Design specification using PLC	K3
CO3	Understand the need of computer control in Automation	K2
CO4	Study data acquisition systems	K1
CO5	Apply the concepts learnt in the course to develop a project and prepare a brief report.	K3

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

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2			2			3		3
CO2	3	3	3	3	3	2		3	3		3
CO3	3	2	2		3	2		3	3		3
CO4	3	2	2			2			3		3
CO5	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	Programmable Logic Controllers	Petrezoulla	McGraw Hill	1989
2	Process Control Instrumentation Technology	Curtis D Johnson	Prentice Hall	8th Edition June 2005
3	Linear Integrated Circuits	D Roy Choudhury & Shail B Jain	New age International Pvt.Ltd	6th Edition , 2021

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Programmable Logic Controllers	Hughes.T	ISA Press	1989
2	Data Converters	G B Clayton	The Mac Millian Press Ltd.	1982
3	Programmable Logic Controllers- Principles and Applications	John W Webb & Ronald A Reis	PHI Learning Pvt.Ltd.,New Delhi	5 th edition 2010

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://youtu.be/MS3qJq2jvu0
2	https://youtu.be/UQ16Cous_tY

3	https://youtu.be/a0lCy5Q7n88
4	https://youtu.be/nX_Xp2hVc0s

PBL Course Elements

L: Lecture (3 Hrs.)	R: Project (1 Hr.), 2 Faculty Members		
	Tutorial	Practical	Presentation
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation/ Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity

Sl. No	Evaluation for	Allotted Marks
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		30

1. Project Planning and Proposal (5 Marks)

- Clarity and feasibility of the project plan
- Research and background understanding
- Defined objectives and methodology

2. Contribution in Progress Presentation and Question Answer Sessions (4 Marks)

- Individual contribution to the presentation
- Effectiveness in answering questions and handling feedback

3. Involvement in the Project Work and Team Work (3 Marks)

- Active participation and individual contribution
- Teamwork and collaboration

4. Execution and Implementation (10 Marks)

- Adherence to the project timeline and milestones
- Application of theoretical knowledge and problem-solving
- Final Result

5. Final Presentation (5 Marks)

- Quality and clarity of the overall presentation
- Individual contribution to the presentation
- Effectiveness in answering questions

6. Project Quality, Innovation, and Creativity (3 Marks)

- Overall quality and technical excellence of the project
- Innovation and originality in the project
- Creativity in solutions and approaches

SEMESTER S6

DESIGN THINKING AND PRODUCT DEVELOPMENT

Course Code	25EST605	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	2:0:0:0	ESE Marks	60
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To guide students through the iterative stages of design thinking, including empathizing with users, defining problems, ideating solutions and developing Proof of Concepts (PoC) and technical feasibility studies.
2. To promote the development of critical thinking skills by engaging students in integrative inquiry, where they ask meaningful questions that connect classroom knowledge with real-world applications.
3. To equip students with the ability to involve in product design considering the sustainability, inclusivity, diversity and equity aspects.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Fundamentals of design thinking and product development: Overview of stages of product development lifecycle; Design thinking -Definition-Design thinking for product innovation; Bringing social impact in ideation-Identifying societal needs-understanding multi-faceted issues-community engagement and empathetic design-technological innovation meeting societal needs; Understanding and Bridging the divide using Human Centered Design (HCD); Designing for inclusivity in product development-embracing user diversity - Long term impact - sustainability encompassing environmental,economic and social dimensions; Technology Readiness Level in the Innovation Life-cycle; Performing a self-check on innovative ideas - Originality of idea- understanding innovation landscape - patentability - understanding the economic landscape - Unique Selling Proposition (USP) - Repeatability and Manufacturability - Sustainability - Leveraging business models for comprehensive analysis	6
2	Empathize: Design thinking phases; Role of empathy in design thinking; Methods of empathize phase - Ask 5 Why/ 5 W+H questions; Empathy maps - Things to be done prior to empathy mapping - Activities during and after the session; Understanding empathy tools - Customer Journey Map - Personas. Define: Methods of Define Phase: Storytelling, Critical items diagrams, Define success.	6
3	Ideation : Stages of ideation; Techniques and tools - Divergent thinking tools - Convergent thinking tools - Idea capturing tools; Cross-industry inspiration; Role of research in ideation - Market research - consumer research - leveraging research for informed ideation; Technological trends - navigating the technological landscape - Integrating emerging technologies; Feasibility studies - technical, economic, market, operational, legal, and ethical feasibility; Ideation session- techniques and tips. Proof of Concept (PoC) : Setting objectives; Risk assessment; Technology scouting; Document and process management; Change management; Knowledge Capture; Validating PoC; Story telling in PoC presentation	6

4	Design: Navigating from PoC to detailed design; Developing Specification Requirement Document (SRD); Design for manufacturability; Design to cost; Pre-compliance; Design Failure Mode and Effects Analysis (DFMEA); Forecasting future design changes. Prototyping: Alpha prototypes; Beta prototypes; Transition from design to prototype; Goals and expectations for Alpha and Beta prototypes; Effective strategies for maintaining timeline in prototyping; Testing and refining Alpha prototypes; Transitioning to Beta prototypes. Pilot build: Definition and purpose of a pilot build; setting objectives; Identification and selection of manufacturing partner for pilot build; Testing procedures in pilot build; Scaling from pilot build to full-scale production / implementation.	6
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Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination n-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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	Empathize to capture the user needs and define the objectives with due consideration of various aspects including inclusivity, diversity and equity	K5
CO2	Ideate using divergent and convergent thinking to arrive at innovative ideas keeping in mind the sustainability, inclusivity, diversity and equity aspects.	K6
CO3	Engage in Human Centric Design of innovative products meeting the specifications	K5
CO4	Develop Proof of Concepts (PoC), prototypes & pilot build of products and test their performance with respect to the Specification Requirement Document.	K4
CO5	Reflect on professional and personal growth through the learnings in the course, identifying areas for further development	K4

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO 1	PO2	PO 3	PO4	PO 5	PO6	PO7	PO8	P O9	PO1 0	PO 11
CO1	3	2	2		2	3	3	2	2		3
CO2	3	2	3		2	3	3	2	2		3
CO3	3	2	3		2	3	2	2	2		3
CO4	3	2	2		3	3	2	2	2		3
CO5	3					3	2	2	2		3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Product Sense: Engineering your ideas into reality	Dr. K R Suresh Nair	NotionPress.com	2024
2	Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation	Tim Brown	HarperCollins Publishers Ltd.	2009
3	Design Thinking for Strategic Innovation	Idris Mootee	John Wiley & Sons Inc.	2013

Sample Assignments:

1. Evaluate and prepare a report on how the aspects including inclusivity, diversity and equity are taken into consideration during the empathize and define phases of the Miniproject course.
2. Evaluate and prepare a report on how the aspects including sustainability, inclusivity, diversity and equity are taken into consideration during the ideate phase of the Miniproject course.
3. Evaluate and prepare a report on how User-Centric Design (UCD) is used in the design and development of PoC of the product being developed in the Miniproject course.
4. Prepare a plan for the prototype building of the product being developed in the Miniproject course.
5. Report on the activities during the empathize phase including the maps & other materials created during the sessions.
6. Report on the activities during the define phase including the maps & other materials created during the sessions.

SEMESTER S6**TRANSDUCERS & MEASUREMENTS**

Course Code	25MRT611	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)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To provide students with a comprehensive understanding of various types of transducers used in engineering applications, including their principles of operation and characteristics
2. To familiarize students with different measurement techniques and instruments commonly used in engineering, enabling them to apply these techniques effectively for accurate measurement and analysis in practical scenarios

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to transducers and sensors Definition of sensors and transducers –Mechanical devices as Primary Detectors-Pressure Sensitive Primary Devices- Temperature Detectors- Hydro pneumatic Devices. Electric Transducers. Advantages of Electrical Transducers. Classification of Electrical Transducers- Primary and Secondary Transducers, Active and Passive Transducers, Analog and Digital Transducers. Electrical Phenomena Used in Transducers.	9

2	Resistive Transducers- Potentiometers, Strain gauges-gauge factor- Resistance Thermometers, Thermistors. Capacitance transducers -piezo electric transducers – Inductive transducers: LVDT characteristics- photoelectric sensors – Hall Effect transducers -measuring circuits- calibration- Optical transducers. Ionization transducers. Digital Transducer. Shaft Encoder.	9
3	Measurements and Measurement Systems Measurements- Significance of Measurements- Methods of Measurement: Direct & Indirect Methods-Instruments-Mechanical, Electrical and Electronic instruments- Classification of Instruments-Analog and Digital Modes of Operation-Functions of Instruments and Measurement Systems- Applications of Measurement Systems- Elements of a Generalized Measurement System- Characteristics of Instruments and Measurement Systems: Measurement system Performance- Static Calibration- Static Characteristics- Errors in Measurements-True Value-Static Error- Static Correction -Scale Range and Scale Span- Error Calibration Curve- Reproducibility and Drift- Accuracy and Precision, Linearity. Hysteresis- type of errors- classification of errors	9
4	DC bridges: introduction, sources and detectors-General equation-Types of bridges: Wheatstone, Kelvin bridge- AC bridges: introduction, sources and detectors- General equation. Maxwell's inductance and Maxwell's inductance -capacitance bridge. Cathode ray oscilloscopes: principles, construction and limitations- Digital storage oscilloscopes: principles- Measurements using CRO s and DSOs- Recording instruments: Strip chart recorder, X-Y Plotter, LCD displays.	9

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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	Summarize the concepts of sensors, transducers and classify various transducers.	K2
CO2	Apply the principles and functions of various types of Transducers in measuring systems.	K3
CO3	Illustrate the working principles of electronic measuring instruments and Identify various types of errors in measuring systems and choose methods for minimization of the errors.	K3
CO4	Explain the concepts of CRO, DSO, various recording devices.	K2
CO5	Understand and utilize various measurement systems, enhancing their capability to apply theoretical knowledge in practical scenarios	K2

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	A Course in Electronic Measurements and Instrumentation	A. K. Sawhney	Dhanpat Rai & Co.	2015 Edition
2	Electronic Instrumentation and Measurements	David A Bell	Oxford University Press	3rd Edition on 2013
3	Electronic Instrument Design	Kim R Fowler	Oxford reprint	2 nd Edition, 2015

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Sensors and Transducers,	D .Patranabis	PHI	2nd edition, 2003

2	Electronic Instrumentation and Measurements	Kalsi HS	Mc Graw hill	4th edition, 2019.
3	Electrical Measurements and Measuring systems	Golding E W and Widdis F C	Wheeler & co	1993

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://www.youtube.com/watch?v=1uPTyJxZzyo
2	https://onlinecourses.nptel.ac.in/noc23_ee105/preview
3	https://nptel.ac.in/courses/112107242
4	https://onlinecourses.nptel.ac.in/noc23_ee112/preview https://www.youtube.com/watch?v=0FVzYLEdSA8

SEMESTER S6**PLC & DATA ACQUISITION SYSTEM**

Course Code	25MRT612	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)		Course Type	Theory

Course Objectives:

1. To study about PLC and the different programming languages
2. To understand the various PLC instructions
3. To understand the need of computer control in automation
4. To study the data acquisition systems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	PLC PROGRAMMING METHODS Architecture, Study of different types of pneumatic and hydraulic valves, PLC Programming languages - Relay Logic-Ladder Logic-Programming of Gates, PLC Timers-ON delay, OFF delay, Retentive Timers, Programming Counters-up/down counter-Combining counter, PLC Arithmetic functions	9

2	PLC DATA HANDLING FUNCTIONS PLC Program control instructions: Master Control Reset - Skip -Jump & Move Instruction, Sequencer instructions, Types of PLC analog modules and systems, PLC analog signal processing - Case study of Tank level control system, bottle filling system and sequential switching of motors	9
3	COMPUTER CONTROL Need of computer in a control system-Functional block diagram of a computer control system-Data Loggers - Supervisory computer control- Direct Digital Control - SCADA -Programming of Robot (Pick and Place)	9
4	DATA ACQUISITION SYSTEMS Sampling Theorem - Sampling and digitizing - Aliasing - Sample and Hold Circuit -signal conditioning of Strain gauge, LVDT, Thermocouple, Pressure Transducer. Interfacing ADC and DAC with microprocessor / Multiplexer-Microprocessor/PC based acquisition systems	9

Suggestion on Project Topics

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Ex-1	Internal Ex-2	Total
5	30	12.5	12.5	60

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 question

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 2 marks (8x2 =16 marks)	2 questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 2 sub divisions. - Each question carries 6 marks. (4x6 = 24 marks)	40

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Study about programming of PLC and Understand the various PLC instruction	K2
CO2	Design specification using PLC	K3
CO3	Understand the need of computer control in Automation	K2
CO4	Study data acquisition systems	K1
CO5	Apply the concepts learnt in the course to develop a project and prepare a brief report.	K3

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

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2			2			3		3
CO2	3	3	3	3	3	2		3	3		3
CO3	3	2	2		3	2		3	3		3
CO4	3	2	2			2			3		3
CO5	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	Programmable Logic Controllers	Petrezeulla	McGraw Hill	1989
2	Process Control Instrumentation Technology	Curtis D Johnson	Prentice Hall	8th Edition June 2005
3	Linear Integrated Circuits	D Roy Choudhury & Shail B Jain	New age International Pvt.Ltd	6th Edition , 2021

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Programmable Logic Controllers	Hughes.T	ISA Press	1989
2	Data Converters	G B Clayton	The Mac Millian Press Ltd.	1982
3	Programmable Logic Controllers- Principles and Applications	John W Webb & Ronald A Reis	PHI Learning Pvt.Ltd.,New Delhi	5 th edition 2010

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://youtu.be/MS3qJq2jvu0
2	https://youtu.be/UQ16Cous_tY
3	https://youtu.be/a0lCy5Q7n88
4	https://youtu.be/nX_Xp2hVc0s

PBL Course Elements

L: Lecture (3 Hrs.)	R: Project (1 Hr.), 2 Faculty Members		
	Tutorial	Practical	Presentation
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation/ Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity

Sl. No	Evaluation for	Allotted Marks
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3

4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		30

1. Project Planning and Proposal (5 Marks)

- Clarity and feasibility of the project plan
- Research and background understanding
- Defined objectives and methodology

2. Contribution in Progress Presentation and Question Answer Sessions (4 Marks)

- Individual contribution to the presentation
- Effectiveness in answering questions and handling feedback

3. Involvement in the Project Work and Team Work (3 Marks)

- Active participation and individual contribution
- Teamwork and collaboration

4. Execution and Implementation (10 Marks)

- Adherence to the project timeline and milestones
- Application of theoretical knowledge and problem-solving
- Final Result

5. Final Presentation (5 Marks)

- Quality and clarity of the overall presentation
- Individual contribution to the presentation
- Effectiveness in answering questions

6. Project Quality, Innovation, and Creativity (3 Marks)

- Overall quality and technical excellence of the project
- Innovation and originality in the project
- Creativity in solutions and approaches

SEMESTER: S6**MECHATRONICS SYSTEMS & PLC LAB**

Course Code	25MRL607	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None / Course Code	Course Type	Lab

Course Objectives:

1. Giving experience to students in the practical aspects of hydraulic and pneumatic kits and operation of robots as well as sensors. System modelling using software like MATLAB and LABVIEW provides simulation studies.
2. PLC Programming gives introduction to automation.

Expt. No.	Experiments
1	Design and assembly of pneumatic and hydraulic valve
2	Study of different type of pneumatic and hydraulic valve
3	Study of reciprocating movement of double acting cylinder using pneumatic direction control valve
4	Programming robot (pick and place)
5	Sensors for automotive
6	Automatic door opening and closing
7	Data acquisition for virtual instrumentation
8	Image acquisition techniques

9	Control of stepper motor
10	Control of servo motor
11	A/D and D/A conversion
12	Image processing examples using python
13	Image processing examples using matlab
14	Implementation of logic gates and flip - flops using plc
15	Implementation of timers and counters using plc
16	Tank level control using plc
17	Simulation sequential switching of motors using plc simulation

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparation work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- **Submission of Record:** Students shall be allowed for the end semester examination only upon submitting the duly certified record.
- **Endorsement by External Examiner:** The external examiner shall endorse the record

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Acquire the basic knowledge in using electro – pneumatic kits and assemble them	K2
CO2	Operate a robot for applications like pick and place	K2
CO3	Experimentally apply the virtual instrumentation technique using LABVIEW	K3
CO4	Develop automation modules using PLC	K3
CO5	Use platforms like MATLAB or python for data processing and acquire basic knowledge in various sensors used in automotive	K3

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

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

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

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Mechatronics System Design	Devadas Shetty,Richard A Kolkm	PWS Publishing company	2009

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering Metrology	R K Jain	Khanna Publishers	1994
2	Hydraulics and pneumatics	Andrew Parr	Butterworth-Heinemann	Third edition, 20 11

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 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 (7 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 (6 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 (5 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 End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 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.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

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

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

SEMESTER: S6**MINI PROJECT**

Course Code	25MRP608	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:0:3	ESE Marks	50
Credits	2	Exam Hours	1 Hrs
Prerequisites (if any)	None / Course Code	Course Type	Project

Preamble: This course is designed for enabling the students to apply the knowledge to address the real-world situations/problems and find solutions. The course is also intended to estimate the ability of the students in transforming theoretical knowledge studied as part of the curriculum so far in to a working model. The students are expected to design and develop a software/hardware project to innovatively solve a real-world problem.

Prerequisites: Subjects studied upto sixth semester.

Course Outcomes: After the completion of the course the student will be able to

CO No.	Course Outcome(CO)	Bloom's Category Level
CO 1	Make use of acquired knowledge within the selected area of Technology for project development.	Level3:Apply
CO 2	Identify, discuss and justify the technical aspects and design Aspects of the project with a systematic approach.	Level3:Apply
CO 3	Interpret, improve and refine technical aspects for engineering projects.	Level3:Apply
CO 4	To exercise their creative and innovative qualities in a group Project environment	Level3: Apply
CO 5	Report effectively the project related activities and findings.	Level2: Understand

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
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CO 1	3	3	3	3	3	3	3	-	-	-	3
CO 2	3	3	3	3	3	-	3	-	3	2	3
CO 3	3	3	3	3	3	2	3	-	2	3	3
CO 4	3	3	2	2	-	-	3	3	3	3	3
CO 5	3	-	-	-	2	-	3	2	3	2	3

Assessment Pattern

The End Semester Evaluation (ESE) will be conducted as an internal evaluation based on the product/project, the report and a viva- voce examination, conducted by a 3-member committee appointed by Head of the Department comprising HoD or a senior faculty member, academic coordinator for that program and project guide/coordinator. The Committee will be evaluating the level of completion and demonstration of functionality/specifications, presentation, oral examination, working knowledge and involvement.

The Continuous Internal Evaluation (CIE) is conducted by evaluating the progress of the Mini Project through minimum of TWO reviews. At the time of the 1st review, students are supposed to propose a new system/design/idea, after a thorough literature study of the existing systems under the chosen area. In the 2nd review students are expected to highlight the implementation details of the proposed solution. The review committee should assess the extent to which the implementation reflects the proposed design. The final CIE mark is the average of 1st and 2nd review marks.

A zeroth review may be conducted before the beginning of the project to give a chance for the students to present their area of interest or problem domain or conduct open brain storming sessions for innovative ideas. Zeroth review will not be a part of the CIE evaluation process.

In the final review students are expected to demonstrate the product with its full specification along with a final report. A well coded, assembled and completely functional product is the expected output during the end of the semester.

Marks Distribution

Total Marks	CIE	ESE	ESE Duration
100	50	50	1 Hour

Continuous Internal Evaluation Pattern:

- (a) Attendance: 05 marks

- (b) Marks awarded by Guide: 10 marks
- (c) Project Report: 05 marks
- (d) Evaluation by the Committee: 30 Marks

End Semester Examination Pattern:

The following guidelines should be followed regarding award of marks.

- (a) Level of Completion: 05 Marks
- (b) Demonstration of Functionality: 20 Marks
- (b) Project Report: 10 Marks
- (d) Viva Voce: 15 marks

Course Plan

In this course, each group consisting of **three/four** members is expected to design and develop a moderately complex software/hardware system with practical applications. This should be a working model. The basic concept of product design may be taken into consideration.

Students should identify a topic of interest in consultation with Faculty-in-charge of Mini Project/Advisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design/fabrication or develop codes/programs to achieve the objectives. Demonstrate the novelty of the project through the results and outputs. The progress of the mini project is evaluated based on a minimum of two reviews.

The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The product must be demonstrated for its full design specifications. Innovative design concepts, reliability considerations, aspects taken care of in the project shall be given due weight.

SEMESTER S7

MECHATRONICS ENGINEERING

SEMESTER S7**FLUID MECHANICS & MACHINERY**

Course Code	25MRT741	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)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. Gain fundamentals knowledge of fluid physical properties, pressure and its measurements, fluid statics, kinematics, dynamics and turbo machines.
2. Understand the concepts of Fluid statics, Fluid dynamics, Fluid kinematics, Dimensional analysis, turbo machines, Hydraulic turbines.
3. Apply the principles of turbo machines, fluid mechanics and machines

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Fundamental concepts: Properties of fluid - density, specific weight, viscosity, surface tension, capillarity, vapour pressure, bulk modulus, compressibility, velocity, rate of shear strain, Newton's law of viscosity, Newtonian and non-Newtonian fluids, real and ideal fluids, incompressible and compressible fluids. Fluid statics: Atmospheric pressure, gauge pressure and absolute pressure. Pascal's Law, measurement of pressure - piezo meter, manometers, pressure gauges, energies in flowing fluid, head - pressure, dynamic, static and total head, forces on planar and curved surfaces immersed in fluids, centre of pressure, buoyancy, equilibrium of floating bodies, metacentre and metacentric height.	9

2	Fluid Kinematics: Types of fluid flow, continuity equation in 2D and 3D (Cartesian Co-ordinates only), velocity and acceleration, velocity potential function and stream function, problems. Fluid Dynamics: Introduction, Euler's equation of motion, Bernoulli's equation from first principles and also from Euler's equation, limitations of Bernoulli's equation, problems.	9
3	Equations of fluid dynamics: (Euler's equation), Navier-Stokes equations Bernoulli's equation and its applications: Venturimeters and Orifice meters, Hydraulic coefficients, Flow through pipes: Laminar and Turbulent flow, Reynold's experiment, loss of head due to friction, Darcy – Weishbach Equation, Chezy's formula, Minor losses in pipes. Turbomachines: Definition of a Turbomachine, parts of a Turbomachine Hydraulic Turbines: Classification; Constructional features.	9
4	Pumps: Classifications-types of casing and impellers, Velocity triangle for pumps, Head of pump, Losses and efficiency, Minimum starting speed, Specific speed, NPSH, Multistage pump, Pumps in parallel and series, selection of pumps. Positive displacement pumps – working principle, types of reciprocating pumps, Indicator diagram- work done, effect of acceleration and frictional resistance, slip and coefficient of discharge., separation in suction and delivery pipes, Air vessel, Gear pump, Lobe pump, Vane pump, Screw pump.	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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 the concept of fluid statics	K2
CO2	Calculate pressure variations in accelerating fluids using Euler's and Bernoulli's equations and become conversant with the concepts of flow measurements and flow through pipes	K2
CO3	Understand applications of Fluid flow measurements, dimensional analysis, turbo machines, hydraulic turbines	K2
CO4	Discuss the characteristics of different type of pumps.	K2

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	1	-	-	1	-	-	-	-	2
CO2	2	-	-	-	-	1	-	-	-	-	2
CO3	2	1	-	-	-	1	-	-	-	-	2
CO4	3	2	2	-	-	1	-	-	-	-	2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Hydraulics & Fluid Mechanics	Modi P. N. and S. M. Seth	Standard Book House	22 nd Edition 2019
2	Fluid Mechanics and Fluid Power Engineering	Kumar D. S	S. K. Kataria & Sons, New Delhi	2013

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fluid Mechanics and Fluid Machines	Dr. Bansal, R.K.	Lakshmi Publications	2019
2	A Textbook of Turbomachines	M S Govinde Gowda	M M Publishers	2018
3	Fluid Mechanics (SI Units)	Yunus A. Cengel John M.Oimbala	Tata McGraw Hill	2 nd Ed. 2006
4	Fluid Mechanics	John F. Douglas, Janul and M. Gasiosek and John A. Swaffield	Pearson Education Asia	5th ed., 2006

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/112/105/112105171/
2	https://www.youtube.com/watch?v=5H0euuo1PGQ https://youtu.be/vXPtNNLEOUc
3	https://www.youtube.com/watch?v=5aDa30ym8RI
4	https://archive.nptel.ac.in/courses/112/103/112103249/

SEMESTER S7**MACHINE LEARNING**

Course Code	25MRT742	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)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. Equip students with the skills to understand, apply, and evaluate various machine learning algorithms and techniques, and to address real-world problems using these tools while considering ethical implications

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Overview of machine learning Machine learning paradigms-supervised, semi-supervised, unsupervised, reinforcement learning. Basics of parameter estimation - maximum likelihood estimation (MLE) and maximum a posteriori estimation(MAP). Introduction to Bayesian formulation.	9
2	Supervised Learning Regression - Linear regression with one variable, Linear regression with multiple variables, solution using gradient descent algorithm and matrix method, basic idea of overfitting in regression. Linear Methods for Classification- Logistic regression, Naive Bayes, Decision tree algorithm ID3.	9

3	Unsupervised Learning Clustering - Similarity measures, Hierarchical Agglomerative Clustering, K-means partitional clustering, Expectation maximization (EM) for soft clustering. Dimensionality reduction – Principal Component Analysis.	9
4	Neural Networks (NN) and Support Vector Machines (SVM) Perceptron, Neural Network - Multilayer feed forward network, Activation functions (Sigmoid, ReLU, Tanh), Backpropagation algorithm. SVM - Introduction, Maximum Margin Classification, Mathematics behind Maximum Margin Classification, Maximum Margin linear separators, soft margin SVM classifier, non-linear SVM, Kernels for learning non-linear functions, polynomial kernel, Radial Basis Function(RBF)	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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	Illustrate Machine Learning concepts and basic parameter estimation methods.	K2
CO2	Demonstrate supervised learning concepts (regression, linear classification).	K2
CO3	Illustrate the concepts of Multilayer neural network and Support Vector Machine	K2
CO4	Describe unsupervised learning concepts and dimensionality reduction techniques.	K2
CO5	Solve real life problems using appropriate machine learning models and evaluate the performance measures	K3

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Machine Learning	Ethem Alpaydin	MIT Press	2nd Edition, 2010
2	Data Mining and Analysis: Fundamental Concepts and Algorithms,	Mohammed J. Zaki and Wagner Meira	Cambridge University Press	First South Asia edition, 2016
3	Python Data Science Handbook	Jake Vander Plas	O'Reilly Media	1st Edition, 2016
4	Machine Learning	Tom Mitchel	McGraw-Hill	1st Edition, 1997

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools	Davy Cielen, Arno D. B. Meysman, and Mohamed Ali	Dreamtech Press	1st Edition, 2016
2	Machine Learning: A Probabilistic Perspective	Kevin P. Murphy	MIT Press	1st Edition, 2012
3	Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools	Davy Cielen, Arno D.B. Meysman, and Mohamed Ali	Dreamtech Press	2016
4	Building Machine Learning Systems with Python	Willi Richert and Luis Pedro Coelho	Packt Publishing	2nd Edition, 2015
5	Elements of Machine Learning	Pat Langley	Morgan Kaufmann	1995

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://onlinecourses.nptel.ac.in/noc23_cs18/preview
2	https://onlinecourses.nptel.ac.in/noc23_cs87/preview
3	https://onlinecourses.nptel.ac.in/noc19_ee56/preview
4	https://onlinecourses.nptel.ac.in/noc20_cs62/preview

SEMESTER S7**ENTREPRENEURSHIP**

Course Code	25MRT743	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)	None	Course Type	Theory

Course Objectives:

1. To equip students with comprehensive knowledge of entrepreneurship, including different types of entrepreneurs, forms of business, and the role of entrepreneurship in economic development, while fostering an understanding of ethical and social responsibilities.
2. To develop practical skills in entrepreneurial ideation, business planning, financial management, and the operation of MSMEs, with a focus on leveraging government schemes and understanding contemporary challenges and opportunities in both Indian and global contexts.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Entrepreneurship-Types of entrepreneurs, Forms of business, Entrepreneurial Traits and competencies, Entrepreneur vs. Manager, Entrepreneur vs. Intrapreneur. Role of Entrepreneurship in Economic Development, Ethics and Social responsibility of Entrepreneurs. Opportunities for Entrepreneurs in India and abroad. Start-up India, Stand up India, National Skill Development Program, PMEGP, Mudra Yojana, and KVIC schemes.	9

2	The Entrepreneurial ideation and decision process. Incubation procedures and processes, Business plan preparation, DPR preparation. Managing Finance and Growth- Sources of capital, Venture capitalists, Angel Investors, Crowd Funding, Institutional financial assistance- Role of Financial Institutions and Commercial Banks for loans and financial controls. Features and evaluation of joint ventures, acquisitions, mergers, franchising, public issues, rights issues, bonus issues and stock splits..	9
3	Micro, Small and Medium Enterprises - Importance, Evolution, Organisational Structure, Decision Making, Starting an MSME unit- phases, training requirements Extension Training Institute, Legal frameworks, Registration procedures, concessions and reliefs by Government. Production in MSME, Optimum Size of plant, Factors affecting production process, Production planning.	9
4	Monitoring and evaluation of enterprise, Reasons for failures, Sickness in Small Scale Industries. Rehabilitation of sick units, Effective management of the enterprise. E-commerce and Entrepreneurship. Rural entrepreneurship, Social entrepreneurship. Challenges in entrepreneurship. Successful Entrepreneurs from the contemporary Indian business world- Success stories of great Indian Tycoons who have contributed to build the nation.	9

**Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)**

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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	Imbibe the spirit, roles, functions and fundamentals of entrepreneurship in a developing economy.	K2
CO2	Develop Proficiency in business plan preparation and detailed project report (DPR) preparation and ensure all round development of them	K3
CO3	Familiarize with the ground realities of starting MSME units and opportunities available in the country	K2
CO4	Analyze the operation and management of MSME units and develop motivation and entrepreneurial competency to start and run an enterprise successfully.	K3
CO5	Evaluate the scope of e-commerce and the challenges in entrepreneurship	K3

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1		2	1	1							2
CO2		3		1							2

CO3		3	3	1						2
CO4			2	1	2	2				2
CO5		2		2						1

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Entrepreneurial Development.	Khanka SS	S. Chand & Company Pvt.Ltd	Revised edition, 2012
2	Entrepreneurship	Robert D.Hisrich, Mathew J Manimala, Michael P. Peters and Dean A. Shepherd:	McGraw Hill Education India (P) Ltd, Chennai,	9e (2014)

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Competing through Innovation	Bellon Whittington	Prentice Hall	2006
2	The Origin and Evolution of New Business	Bhide, Amar V	Oxford University Press	2000
3	Entrepreneurship development small business enterprises	Charanthimath	Pearson Education	2008
4	Entrepreneurship strategies and resources	Dollinger M J	Pearson Education, New Delhi	2006

SEMESTER S7**MICRO ELECTRO MECHANICAL SYSTEMS**

Course Code	25MRT744	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)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To develop knowledge on Micro electro mechanical systems and materials used in the manufacture
2. To understand various micro fabrication procedures, techniques and packaging considerations

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Micro Electronic Mechanical Systems: Materials for MEMS- silicon- structure and orientations, properties. Other materials- shape memory alloy (SMA), polymers, silicon compounds etc, material properties. Commercial MEMS structures and systems: Overview of commonly used mechanical structures in MEMS - Beams, Cantilevers, Plates, Diaphragms – Typical applications. Passive MEMS structures- fluid nozzles- ink jet nozzles. Sensors- piezoresistive pressure sensors- mass flow sensors- acceleration sensors, actuators- micro mechanical valves-micro pumps.	9

2	Process of micromachining: Process of micromachining- pattern transfer using additive technique. Silicon growth- oxidation of silicon-molecular beam epitaxy. Physical vapour deposition (PVD)- sputtering- laser deposition- ion plating- cluster beam technology- Chemical vapour deposition (CVD)- step coverage- plasma enhanced CVD, Electron cyclotron resonance CVD, (ECRCVD)- sol-gel deposition technique.	9
3	Lithography Photolithography- Introduction- masks- spinning- resist and soft backing- exposure and post exposure treatment- development- descumming and post baking- resists- wafer priming, wafer cleaning and contamination- clean room- resist striping. Next generation lithography-extreme ultra violet lithography (EUVL)- x-ray lithography- LIGA- charged particle beam lithography- electron beam lithography- ion beam lithography. Etching: Introduction- dry etching- physical etching- ion etching or sputtering- ion beam etching, plasma etching- deep reactive ion etching (DRIE)- isotropic wet etching- anisotropic wet etching.	9
4	MEMS packaging: Key design and packaging consideration- wafer stack thickness- wafer dicing concerns, thermal management- stress isolation- protective coating and media isolation. Wafer level packaging and die level packaging. Hermetic packaging- calibration and compensation- die attach process- solder alloy- bonding process using solder alloy- organic adhesive wiring and inter connections- Wire bonding- flip chip bonding- micro fluidics interconnections. Packaging material properties- mechanical- moisture penetration- interfacial adhesion, thermal- chemical- electrical.	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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	Define MEMS and elaborate on various materials used for MEMS fabrication and to describe different kinds of commercial applications like micropumps, valves and sensors.	K2
CO2	Describe the various techniques involved in micromachining and discuss techniques for deposition of materials to create structures.	K2
CO3	Discuss lithography and etching techniques.	K2
CO4	Develop a deep understanding of design and packaging considerations during manufacture of MEMS devices	K2

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3										3
CO2	3										3
CO3	3										3
CO4	3										3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	An Introduction to Micro electromechanical Systems Engineering	Nadim Maluf	Artech house Boston London	6/e, 2006
2	Fundamentals of Micro-fabrication	Mark Madou	CRC Press, New York	3/e, 2011
3	Foundations of MEMS	Chang Liu	Pearson	2/e, 2011
4	MEMS and Microsystems Design and Manufacture	Tai Ran Hsu	McGraw Hill	4/e, 2015

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Electromechanics and MEMS	Thomas B. Jones, Nenad G. Nenadic	Cambridge University Press	Illustrated edition, 2013
2	Microsystem design	Stephen D. Senturia,	Springer (India)	2nd edition, 2006
3	Smart Sensors and MEMS	Stoyan Nihtianov, Antonio Luque	Woodhead Publishing Series	2nd edition, 2006

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://nptel.ac.in/courses/117105082
2	https://nptel.ac.in/courses/117105082
3	https://nptel.ac.in/courses/117105082
4	https://nptel.ac.in/courses/117105082

SEMESTER S7

ENERGY MANAGEMENT & AUDITING

Course Code	25MRT746	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)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. This course introduces basic knowledge about energy management and audit
2. Energy management opportunities in electrical and mechanical systems are discussed.
3. Economic analysis of different energy conservation measures is also described.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Energy Management - General Principles and Planning: General principles of energy management and energy management planning Energy Audit: Definition, need, types and methodologies. Instruments for energy audit, Energy audit report - Power quality audit. Energy conservation in buildings: ECBC code (basic aspects), Building Management System (BMS).	9
2	Energy management in Electricity Utilization: Energy management opportunities in Lighting and Motors, Electrolytic Process and Electric heating. Types of industrial loads. Peak demand controls and methodologies	9

3	Energy management in HVAC systems: HVAC system: Coefficient of performance, Capacity, Factors affecting Refrigeration and Air conditioning system performance and savings opportunities. Classification and Advantages of Waste Heat Recovery system, analysis of waste heat recovery for Energy saving opportunities Cogeneration-Types and Schemes, Optimal operation of cogeneration plants- Case study. Computer aided energy management	9
4	Energy Economics: Economic analysis methods-cash flow model, time value of money, evaluation of proposals, payback method, average rate of return method, internal rate of return method, present value method, life cycle costing approach, Case studies.	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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	Explain the significance and procedure for energy management and audit.	K2
CO2	Discuss the energy efficiency and management of electrical loads.	K2
CO3	Explain the energy management opportunities in HVAC systems	K2
CO4	Compute the economic feasibility of the energy conservation measures.	K2

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2					1					2
CO2	2					1					2
CO3	2					1					2
CO4	2					1					2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Energy management principles	Craig B. Smith	Pergamon Press	2007
2	Optimizing energy efficiencies in industry	G.G. Rajan	Tata McGraw Hill	2001
3	Handbook of Energy Audits	Albert Thumann, William J. Younger,	CRC Press	2003
4	Intro to Energy Conservation and manag.	M Jayaraju and Premlet,	Phasor Books	2008

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Industrial energy conservation	Charles M. Gottschalk	John Wiley & Sons	1996
2	Energy management Hand Book	Wayne C. Turner	The Fairmount Press	1997

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://www.youtube.com/watch?v=WwBquDjDGOA&list=PLImNQubhYtnAmyPNwO-nPU-VQIIXH0xqM
2	https://www.youtube.com/watch?v=WwBquDjDGOA&list=PLImNQubhYtnAmyPNwO-nPU-VQIIXH0xqM
3	https://www.youtube.com/watch?v=WwBquDjDGOA&list=PLImNQubhYtnAmyPNwO-nPU-VQIIXH0xqM
4	https://www.youtube.com/watch?v=WwBquDjDGOA&list=PLImNQubhYtnAmyPNwO-nPU-VQIIXH0xqM

SEMESTER 7

SMART MANUFACTURING

Course Code	25MRT745	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. This course introduces Smart Manufacturing, encompassing the integration of advanced manufacturing techniques with digital technologies to create intelligent, interconnected systems.
2. Students will learn about the principles, technologies, and applications of SM, preparing them to implement and innovate within the modern manufacturing landscape.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Smart Manufacturing: Definition and evolution of Smart Manufacturing, Key components and principles, Comparison with traditional manufacturing. Industry 4.0 and Digital Transformation: Overview of Industry 4.0, Digitalization in manufacturing, Cyber-Physical Systems (CPS), Internet of Things (IoT) in Manufacturing: IoT fundamentals and architecture, IoT devices and sensors.	9
2	Data-Driven Manufacturing: Internet of Things (IoT) in Manufacturing (contd.) Applications of IoT in manufacturing, Data Analytics and Big Data in Manufacturing: Introduction to data analytics, Big Data in manufacturing, Predictive analytics and maintenance, Artificial Intelligence and Machine Learning: AI and ML basics, Applications of AI in manufacturing, Case studies of AI-driven manufacturing.	9

3	Advanced Manufacturing Technologies: Robotics and Automation: Robotics in manufacturing, Autonomous systems and collaborative robots, Automation technologies, Additive Manufacturing and 3D Printing: Principles of additive manufacturing, 3D printing technologies, Applications in manufacturing.	9
4	Smart Manufacturing Systems and Integration: Integration of digital and physical systems, Smart factories and digital twins. Case studies of integrated systems, Cybersecurity in Smart Manufacturing: Cybersecurity challenges in manufacturing, Protection strategies and best practices, Case studies of cybersecurity breaches, Sustainability and Future Trends in Smart Manufacturing: Sustainable manufacturing practices, Future trends.	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Internal Ex	Evaluate	Analyse	Total
5	15	10	10	40

Criteria for Evaluation (Evaluate and Analyse): 20 marks

A 'Micro-Project' or Detailed presentation of 'Case Study' with a maximum of 3 students related to the application of smart manufacturing in modern industry should be done.

By using following rubrics table, evaluators can systematically assess students' performance on the "Evaluate and Analyse" component based on their understanding, application, critical thinking, and quality of analysis in the context of Smart Manufacturing.

Rubrics Table: (Evaluate and Analyse: 20 Marks)

Criteria	Excellent (5 Marks)	Good (4 Marks)	Satisfactory (3 Marks)	Needs Improvement (2 Marks)	Unsatisfactory (1 Mark)	Mark
1.Understanding of Concepts	Demonstrates a thorough and comprehensive understanding of the concepts related to Smart Manufacturing	Shows a Good Understanding of the core concepts, with minor gaps in knowledge.	Has a basic understanding of the concepts, but with noticeable gaps.	Demonstrates limited understanding of the concepts.	Shows little to no understanding of the concepts.	
	including IoT, AI, data analytics, and Industry 4.0.					
2.Application of Knowledge	Applies theoretical knowledge effectively to real-world scenarios and case studies, providing Insightful analysis and solutions.	Applies knowledge to real-world scenarios with some insightful analysis.	Applies knowledge to real-world scenarios, but the analysis is basic and lacks depth.	Struggles to apply knowledge effectively to real-world scenarios.	Fails to apply knowledge to real-world scenarios.	

3.Critical Thinking and Problem-Solving	Demonstrates strong critical thinking and problem-solving skills, identifying and addressing complex issues in Smart Manufacturing.	Shows good critical thinking and problem-solving skills, but with minor gaps in addressing complex issues.	Demonstrates basic critical thinking and problem-solving skills, but with noticeable gaps.	Shows limited critical thinking and problem-solving skills.	Demonstrates little to no critical thinking or problem-solving skills.	
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Criteria	Excellent (5 Marks)	Good (4 Marks)	Satisfactory (3 Marks)	Needs Improvement (2 Marks)	Unsatisfactory (1 Mark)	Mark
4.Quality of Analysis	Provides a comprehensive and in-depth analysis, backed by relevant data and references, demonstrating a strong grasp of the subject matter.	Offers a solid analysis with good use of data and references, though with minor gaps in depth or relevance.	Delivers a basic analysis with some use of data and references, but lacking depth and comprehensiveness.	Provides limited analysis with minimal use of data and references.	Offers little to no analysis, with few or no relevant data or references.	

Total: 20 Marks

Score Range	Performance Level
18-20 Marks	Excellent
14-17 Marks	Good

10-13 Marks	Satisfactory
6-9 Marks	Needs Improvement
0-5 Marks	Unsatisfactory

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 (8x3 =24marks)	2 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. - Each question carries 9 marks. (4x9 = 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 the fundamentals of Smart Manufacturing and Industry 4.0.	K2
CO2	Explore the key technologies driving Smart Manufacturing, such as IoT, AI, and data analytics.	K2
CO3	Learn about the integration of digital and physical systems in manufacturing.	K2
CO4	Analyze the impact of Smart Manufacturing on productivity, quality, and sustainability.	K4
CO5	Develop skills to design, implement, and manage Smart Manufacturing systems.	K5

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO 1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9	PO1 0	PO1 1
CO1	3	2	1	1	-	-	-	-	-	-	-
CO2	3	2	-	-	2	-	-	-	-	-	3
CO3	3	-	2	-	2	-	-	-	1	-	-
CO4	3	-	-	-		-	2	-	-	-	3
CO5	-	-	2	3	2	-	-	-	-	1	-

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Smart Manufacturing: Concepts and Methods	Shahrukh A. Irani	CRC Press	1st Edition, 2020
2	Industry 4.0: The Industrial Internet of Things	Alasdair Gilchrist	Apress	1st Edition, 2016
3	Big Data in Practice	Bernard Marr	Wiley	1st Edition, 2016
4	Artificial Intelligence: A Guide for Thinking Humans	Melanie Mitchell	Farrar, Straus and Giroux	1st Edition, 2019
5	Robotics and Automation Handbook	Thomas R. Kurfess	CRC Press	1st Edition, 2004

Additional References:

1. Research papers and articles from journals such as "Journal of Manufacturing Systems" and "International Journal of Advanced Manufacturing Technology."
2. Industry reports and whitepapers from organizations like McKinsey & Company, Deloitte, and PwC.

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Smart Manufacturing: An Overview	Rajat Kumar Roy	Tata McGraw-Hill Education	1st Edition , 2020
2	Industry 4.0: A Roadmap for Smart Manufacturing	Alok Kumar Jain	Wiley India	1st Edition , 2019
3	Big Data and Analytics in Manufacturing	Sudipta Roy, P.C. Mandal	Springer India	1st Edition , 2021
4	Artificial Intelligence in Industrial Applications"	Ajit Kumar	PHI Learning Pvt. Ltd.	1st Edition , 2019
5	Robotics and Automation: Principles and Applications	R.K. Mittal, I.J. Nagrath	Tata McGraw-Hill Education	2nd Edition , 2018
6	3D Printing and Additive Manufacturing: Principles and Applications	C.P. Kumar	IK International Publishing House	1st Edition , 2020
7	Cybersecurity in Smart Manufacturing"	Anil Kumar Singh	Wiley India	1st Edition , 2021
8	Sustainable Manufacturing and Operations	Ashok Kumar Sarkar	CRC Press India	1st Edition , 2019

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	INTRODUCTION TO INDUSTRY 4.0 AND INDUSTRIAL INTERNET OF THINGS Industry 4.0 https://archive.nptel.ac.in/courses/106/105/106105195/ IoT https://youtu.be/olZ3Iyib_wg CPS https://youtu.be/8wBQMbOntNc
2	AI https://youtu.be/zsE9EH0oJSk https://youtu.be/cTZVK7CK1gs
3	AM https://archive.nptel.ac.in/courses/112/103/112103306/
4	CS: https://youtu.be/KqSqyKwVuA8

SEMESTER S7**COMPUTER NETWORKS**

Course Code	25MRT751	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)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. Provide students with the knowledge to explain the roles and functions of various network protocols and to understand the OSI (Open Systems Interconnection) and TCP/IP models, along with their respective layers.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction – Uses of computer networks, Network hardware, Network software. Reference models – The OSI reference model, The TCP/IP reference model, Comparison of OSI and TCP/IP reference models. Physical Layer – Modes of communication, Physical topologies, Signal encoding, Repeaters and hub, Transmission media overview. Performance indicators – Bandwidth, Throughput, Latency, Queuing time, Bandwidth–Delay product.	9

2	Data link layer - Data link layer design issues, Error detection and correction, Sliding window protocols, High-Level Data Link Control(HDLC)protocol. Medium Access Control (MAC) sublayer –Channel allocation problem, Multiple access protocols, Ethernet, Wireless LANs - 802.11, Bridges & switches - Bridges from 802.x to 802.y, Repeaters, Hubs, Bridges, Switches, Routers and Gateways.	9
3	Network layer design issues. Routing algorithms - The Optimality Principle, Shortest path routing, Flooding, Distance Vector Routing, Link State Routing, Multicast routing, Routing for mobile hosts. Congestion control algorithms. Quality of Service (QoS) - requirements, Techniques for achieving good QoS.	9
4	Transport service – Services provided to the upper layers, Transport service primitives. User Datagram Protocol (UDP). Transmission Control Protocol (TCP) – Overview of TCP, TCP segment header, Connection establishment &release, Connection management modeling, TCP retransmission policy, TCP congestion control. Application Layer –File Transfer Protocol (FTP), Domain Name System (DNS), Electronic mail, Multipurpose Internet Mail Extension (MIME), Simple Network Management Protocol (SNMP), World Wide Web(WWW) – Architectural overview.	9

**Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)**

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 = 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. (4x9 = 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	Explain the features of computer networks, protocols, and network Design models	K2
CO2	Describe the fundamental characteristics of the physical layer and identify the usage in network communication	K2
CO3	Explain the design issues of data link layer, link layer protocols, bridges and switches	K2
CO4	Illustrate wired LAN protocols (IEEE 802.3) and wireless LAN protocols (IEEE 802.11)	K2
CO5	Select appropriate routing algorithms, congestion control techniques, and Quality of Service requirements for a network	K3

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer Networks	Andrew S. Tanenbaum	PHI (Prentice Hall India)	4th Edition, 2003
2	Data Communication and Networking	Behrouz A Forouzan	Tata McGraw Hill	4th Edition, 2006

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer Networks – A Systems Approach	Larry L Peterson and Bruce S Dave	Morgan Kaufmann	5th Edition, 2011
2	Computer Networking and the Internet	Fred Halsall	Addison-Wesley	5th Edition, 2005
3	Computer Networking: A Top-Down Approach	James F. Kurose, Keith W. Ross	Pearson	6th Edition, 2012
4	TCP/IP Illustrated, Volume 1: The Protocols	W. Richard Stevens	Addison-Wesley	2005

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://onlinecourses.nptel.ac.in/noc22_cs19/preview
2	https://nptel.ac.in/courses/106105082
3	https://onlinecourses.nptel.ac.in/noc22_ee61/preview
4	https://onlinecourses.swayam2.ac.in/cec21_cs04/preview

SEMESTER S7**SIX SIGMA**

Course Code	25MRT752	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)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To provide a comprehensive understanding of quality management principles, including the evolution of Total Quality Management (TQM) and the contributions of key TQM pioneers, along with the application of quality tools and methodologies for continuous improvement.
2. To develop proficiency in Six Sigma methodologies and their practical applications in both manufacturing and service industries, emphasizing process capability, DMAIC phases, and achieving customer satisfaction through quality enhancement.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to the concept of quality - definition, quality quantified, dimensions of quality, TQM – definition, new and old cultures, Gurus of TQM – Deming, Juran, Shewhart, Crosby, Fiegenbaum, Ishikawa, Taguchi– their main contributions, Obstacles to TQM, Benefits of TQM.	9
2	TQM axioms – commitment, scientific knowledge and involvement, Deming’s fourteen points on quality management, Quality Council, Quality statements, customer satisfaction – customer perception of quality, customer retention, Employee involvement - motivation, empowerment, team and teamwork, suggestion system.	9

3	Continuous process improvement - Juran's quality trilogy, Seven basic tools of quality – flow chart or run chart, check sheet, histogram, Pareto diagram, cause and effect diagram, scatter diagram and control charts, Benchmarking, New management tools – affinity diagram, inter relationship digraphs, tree diagram, matrix diagram, prioritization matrices, Process Decision Program Chart (PDPC), activity network diagram	9
4	Six sigma –meaning- History of six sigma- working of six sigma-Process capability – meaning, significance and measurement – Six sigma roles and responsibilities- DMAIC process- Define phase-Measure phase- Analyse phase- Improve phase- Control phase- Case examples of DMAIC. Six sigma in manufacturing industries- Six sigma in service industries.	9

**Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)**

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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 basic concepts of quality highlighting the contributions by quality gurus	K2
CO2	Acquire knowledge on TQM axioms and focus on customer-centric approach with team work	K2
CO3	Acquire knowledge on TQM axioms and focus on customer-centric approach with team work	K2
CO4	Understand the various quality management systems	K2
CO5	Understand basic concepts and DMAIC phase of Six Sigma	K2

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Total Quality Management	Besterfield, D.H., Besterfield, C., Besterfield, G.H., Besterfield M	Pearson Education	5th Edition
2	The Management and Control of Quality	James, R.E., and William, M.L.	Cengage Learning	8th ed, 2010
3	Total Quality Management - Text and Cases	Janakiraman, B. and Gopal, R.K.	Prentice Hall India	1st edition, 2006

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	The Six Sigma Handbook	Pyzdek, T., and Keller, P	McGraw-Hill.	5th edition, 2018
2	Six Sigma Revealed	International Six sigma institute	International Six sigma institute	Free pdf

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	NPTEL, Total Quality Management - I, IIT Kanpur https://nptel.ac.in/courses/110104080

2	UDEMY, OHSAS 18001 (2.5 hours) https://www.udemy.com/complete-health-and-safety-auditor-course-ohsas-18001/
3	UDEMY, Quality Management System Auditor Course (3.5 hours) https://www.udemy.com/iso-90012015-quality-management-system-auditor-course/
4	NPTEL, Six Sigma, IIT Kharagpur https://nptel.ac.in/courses/110105123

SEMESTER S7**NANO ELECTRONICS**

Course Code	25MRT753	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)	25PHT103	Course Type	Theory

Course Objectives:

1. Provide students with a comprehensive understanding of the principles, technologies, and applications of nano-scale electronic devices and systems.
2. Develop a solid foundation in the fundamentals of nanotechnology and nanoelectronics and understand the implications of nanotechnology on future electronic systems and devices

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to nanotechnology, Limitations of conventional microelectronics, characteristic lengths in mesoscopic systems, Quantum mechanical coherence. Low dimensional structures - Quantum wells, wires and dots, Density of states of 1D and 2D nanostructures. Basic properties of square quantum wells of finite depth, parabolic and triangular quantum wells	9
2	Introduction to methods of fabrication of nano-layers: physical vapour deposition- evaporation & Sputtering, Chemical vapour deposition, Molecular Beam Epitaxy, Ion Implantation, Formation of Silicon Dioxide- dry and wet oxidation methods. Fabrication of nano particle- grinding with iron balls, laser ablation, reduction methods, sol gel, self assembly, precipitation of quantum dots.	9

3	Quantum wells, multiple quantum wells, Modulation doped quantum wells, concept of super lattices Kronig - Penney model of super lattice. Transport of charge in Nanostructures - Electron scattering mechanisms, Hot electrons, Resonant tunnelling transport, Coulomb blockade, Effect of magnetic field on a crystal. Aharonov-Bohm effect, the Shubnikov-de Hass effect.	9
4	Nanoelectronic devices - MODFETS, Single Electron Transistor, CNT transistors – Properties of graphene. Resonant tunnel effect, RTD, RTT, Hot electron transistors Quantum well laser, quantum dot LED, quantum dot laser	9

**Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)**

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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	Explain quantum mechanical effects associated with low dimensional semiconductors	K2
CO2	Explain different processes involved in the fabrication of nanoparticles and nanolayers	K2
CO3	Explain different techniques for characterizing nano layers and particles	K2
CO4	Explain the different transport mechanisms in nano structures	K2
CO5	Illustrate the operating principle of nanoscale electronic devices like SET, Resonant tunnelling devices, Quantum lasers etc.	K2

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Nanotechnology for Microelectronics and optoelectronics	J.M. Martinez-Duart, R.J. Martin Palma, F. Agulle Rueda	Elsevier Science	1st Edition, 2006
2	Nanotechnology and Nanoelctronics	W.R. Fahrner	Springer	1st Edition, 2005

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Nanoscience & Technology,	Chattopadhyay, Banerjee	PHI	2nd Edition, 2012
2	Introduction to Nanotechnology	Charles P. Poole Jr., Frank J. Owens	John Wiley & Sons	2nd Edition, 2022
3	Fundamentals of Nanoelectronics	George W. Hanson	Pearson Education	1st Edition, 2009
4	Nanoelectronics and nanosystems	K. Goser, P. Glosekotter, J. Dienstuhl	Springer	1st Edition, 2004

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://onlinecourses.nptel.ac.in/noc23_ee35/preview
2	https://onlinecourses.nptel.ac.in/noc22_ee121/preview
3	https://onlinecourses.nptel.ac.in/noc23_ph45/preview
4	https://onlinecourses.nptel.ac.in/noc21_ee59/preview

SEMESTER S7**THEORY OF METAL CUTTING**

Course Code	25MRT754	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)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To impart knowledge on the history, development, and selection of tool materials, along with an understanding of cutting tool geometry, machining processes, and the mechanics of metal cutting.
2. To equip students with the ability to analyze machining economics, evaluate tool life and wear, and apply advanced machining processes for efficient and effective material removal in manufacturing.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	History and development of tool materials - general requirements of tool materials-tool geometry systems of cutting tool nomenclature- single point and multipoint tools- different machining processes and selection of tools	9hrs
2	Mechanics of metal cutting- mechanism of chip formation – forces on cutting tool- Merchant's circle – tool dynamometers- tool force measurements- friction in metal cutting	9hrs
3	Temperature in machining – temperature distribution - effect of machining variables on temperature – measurement of temperature. Tool life and tool wear – effect of machining parameters on tool wear- selection, properties and application of cutting fluids..	9hrs
4	Economics of machining – choice of parameters – metal removal rates. advanced machining processes – introduction – operating principles – process parameters and application of USM,AJM,WJM,ECM,ECG,EDM,EBM,LBM,PAM and chemical milling.	9hrs

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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	To have a clear understanding of tool geometry and tool nomenclature	K2
CO2	To understand the mechanism of chip formation and cutting forces	K2
CO3	To study temperature in machining process and tool life and tool wear	K2
CO4	To understand the mechanics of economics of machining	K2

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Metal cutting principles,	Shaw M.C.,	Oxford university press	2nd edition 2005
2	Metal Cutting Theory and Practice	A. Bhattacharya	New Central Book Agency (P) Ltd	2nd edition, 2011

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fundamentals of metal machining and machine tools 2	Geoffrey Boothroyd,	Tata Mc Graw hill	3rd edition, 1988
2	Principles of metal cutting	Sen and Bhattacharya,	New central publishers.	1st edition 1986

SEMESTER S7**DYNAMICS & MACHINERY**

Course Code	25MRT756	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)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To provide students with a comprehensive understanding of the static and dynamic force analysis of mechanisms, including the application of principles such as D'Alembert's and the design of flywheels for energy efficiency in various engines.
2. To equip students with the skills to analyze and balance rotating and reciprocating systems, understand the effects of gyroscopic forces, and solve vibration problems in single-degree-of-freedom systems, ensuring stability in engineering applications.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Static and dynamic force analysis of mechanisms (four bar linkages only)- graphical method, virtual work method -D'Alembert's principle-equivalent dynamic systems reciprocating engine force analysis.	9
2	Energy Efficiency in Electricity Utilization: Flywheels-turning moment diagrams for steam engines-four stroke internal combustion engine and multi cylinder engines-coefficient of fluctuation of speed-coefficient of fluctuation of energy-design of flywheels.	9

3	Balancing: static balancing-dynamic balancing-balancing of several masses revolving in a single plane-several masses in different parallel planes-balancing of single cylinder reciprocating engines.Gyroscopic couple-effects on the stability of automobiles-two wheeler and four wheeler, stability of ships and air crafts	9
4	Vibration-free vibration of single degree of freedom systems-equation of motion Newton's method-energy method-natural frequency-undamped and damped systems alogarithmic decrement-forced vibration-response of SDOF systems to harmonic excitation-whirling of shaft-vibration absorber-transmissibility	9

**Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)**

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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	To perform static and dynamic force analysis of four-bar linkages using graphical and virtual work methods, including D'Alembert's principle for reciprocating engines.	K2
CO2	To design flywheels by analyzing turning moment diagrams and calculating fluctuations in speed and energy for various engines.	K3
CO3	To achieve static and dynamic balancing of rotating and reciprocating systems, ensuring smooth operation and stability of machinery.	K2
CO4	To analyze the effects of gyroscopic couples on vehicle stability and solve vibration problems in single-degree-of-freedom systems using various methods.	K3

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Theory of machines and mechanisms	Ballaney, P. L.	Khanna Publishers	2010
2	Theory of Machines	Rattan S S,	Tata McGraw-Hill Education	2005

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Kinematics and Dynamics of Machinery	Charles E Wilson and J Peter Sadler	Tata McGraw-Hill Education	2008
2	Theory of Mechanisms and Machines,	Amithabha Ghosh and Asok Kumar Malik,	East West Press	2011
3	Theory of Machines	Thomas Bevan	Pearson	2013

SEMESTER S7**DIGITAL IMAGE PROCESSING**

Course Code	25MRT755	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0 :0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Develop a comprehensive understanding of digital image processing techniques, including image enhancement, restoration, and compression, to effectively analyze and manipulate visual data.
2. Gain practical skills in implementing and evaluating various image segmentation methods, ensuring proficiency in both spatial and frequency domain approaches for diverse applications.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Digital Image Fundamentals: Steps in Digital Image Processing – Components – Elements of Visual Perception – simple image formation model. Relationships between pixels – Colour image fundamentals – RGB, HSI models, Review of matrix theory: row and column ordering- Toeplitz, Circulant matrices.	9

2	Image Enhancement: Spatial domain methods: point processing- intensity transformations, histogram processing. Spatial filtering- smoothing filters, sharpening filters. Frequency domain methods: low pass filtering, high pass filtering, homomorphic filter	9
3	Image Restoration: Degradation model, Unconstraint restoration and constraint restoration. Inverse filtering, Weiner filtering. Image Compression: Need for compression, Basics of lossless compression and lossy compression. Concept of transform coding, JPEG Image compression standard.	9
4	Image segmentation: Classification of Image segmentation techniques, Region approach - Region Growing, Region Split & Merge. Segmentation based on thresholding. Edge based segmentation-edge detection, Hough transform.	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Internal Ex	Evaluate	Analyse	Total
5	15	10	10	40

Criteria for Evaluation(Evaluate and Analyse): 20 marks
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 (8x3 =24marks)	2 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. - Each question carries 9 marks. (4x9 = 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	To study the image processing fundamentals and review of matrix theory.	K2
CO2	To study and interpret the various image enhancement techniques	K2
CO3	Analyze the various concepts of restoration techniques for image processing.	K3
CO4	Analyze basic image compression techniques.	K3
CO5	Illustrate image segmentation techniques	K2

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Digital Image Processing,	Rafel C Gonzalez, Richard E. Woods	Pearson Education	fourth edition 2018
2	Digital Image Processing	S Jayaraman, S Esakkirajan, T Veerakumar,	Tata Mc Graw Hill	2nd Edition 2020

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fundamentals of digital image processing	Anil K Jain	Pearson Education India	First Edition on 2015
2	Digital Image Processing	Kenneth R Castleman	Pearson Education India	1st edition on 2007
3	Digital Image Processing	William K. Pratt	John Wiley & Sons;	4th Edition on 2007

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://www.youtube.com/watch?v=DSGHkvQBMbs&list=PLuv3GM6-gsE08DuaC6pFUvFaDZ7EnWGX8&index=1
2	https://www.youtube.com/watch?v=bJjgyTQ-BT4&list=PLuv3GM6-gsE08DuaC6pFUvFaDZ7EnWGX8&index=32
3	https://www.youtube.com/watch?v=MrNafUqh860&list=PLuv3GM6-gsE08DuaC6pFUvFaDZ7EnWGX8&index=42
4	https://www.youtube.com/watch?v=j3_Ck5oP5oI&list=PLuv3GM6-gsE08DuaC6pFUvFaDZ7EnWGX8&index=56

SEMESTER S7**BASICS OF ROBOTICS & AUTOMATION**

Course Code	25MRT721	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)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To provide students with a comprehensive understanding of robotics, including robot structures, classifications, sensors, end effectors, kinematics, and robotic programming, along with the basics of PLC systems and their applications.
2. To equip students with practical skills in robotic motion control, sensor integration, and PLC programming, enabling effective automation and process control in industrial and research settings.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Robotics –Introduction –Basic Structure-Classification of Robot and Robotic System-Law of Robotics-Robot Motion- Wrist Configuration-Motion – Roll –Pitch-Yaw-Drives-Hydraulic Motors- DC Motor-Stepper Motor-PowerTransmission Systems	9
2	Sensors in Robotics: Position Sensor-Potentiometer-Encoders-LVDT- Velocity Sensor-Acceleration Sensor-Force- Pressure and Torque Sensor-Touch and Tactile Sensor-Proximity –Range and Sniff Sensor- Robot End Effectors-Types of End Effectors- Mechanical Gripper – Types of Gripper Mechanism.	9

3	Position Orientation-Frames-Mapping-Changing Description from Frames to Frames. Transformation arithmetic's-Translation-rotation- transformation- transforms equations- transformation of the vectors- Introduction to manipulations Forward Kinematics and inverse	9
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	Kinematics- D-H representation-Method of Robotic Programming (Qualitative Treatment Only).	
4	Basics of PLC-Advantage- Capabilities of PLC-Architecture of PLC - Types of PLC-Types of I/O Modules- Configuring of PLC. Simple process control programme using ladder logic- PLC arithmetic functions- Timer and Counters Requirement of communication networks in PLC – Connecting PLC to computer.	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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	Explain robot actuators and controls	K2
CO2	Summarize robot sensors for robotic application	K2
CO3	Explain the kinematics of robots and adaptive control	K2
CO4	Understand the basics of Programming Logic Circuits and programming Programmable Logic Circuits	K2

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Industrial Robotics-Technology, Programming and Applications	M.P Groover	McGraw-Hill USA	1986
2	Introduction to Robotics,	John Craig	Macmillan	1985
3	Process Control Instrumentation Tech	Curtis Johnson	8 TH Edition Prentice Hall	June 2005
4	Programmable Controllers	Petrezuella	McGraw Hills	1989

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Linear Integrated circuits	D Roy Choudhury and shaail B. jain	New age international Pvt.Ltd	2003
2	Mechatronics	Boltans w	Pearson Education	6th edition , published in 2023

SEMESTER S7**INDUSTRIAL HYDRAULICS & PNEUMATICS**

Course Code	25MRT722	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)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To understand various components of pneumatic and fluid power systems and their advantages
2. Applying the fundamental concepts of fluid power and pneumatic to obtain solution to engineering problems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basics of fluid power system, Components, Advantages and applications of Fluid power systems Fluid properties: specific weight, density and specific gravity, Pascal's Law and its application Continuity equation, Conservation Of Energy, Frictional losses in hydraulic pipelines - laminar and turbulent flow, Fluid power symbols.	9
2	Hydraulic pumps: Gear, Vane and Piston pumps, Pump performance, Characteristics and Selection - Sizing of pumps Hydraulic Motors- Limited Rotation Hydraulic Motors, Gear Motors, Vane Motors, Piston Motors, Hydraulic Motor Theoretical Torque, Power, And Flow Rate, Hydraulic Motor Performance	9

3	Hydraulic Valves- Direction control valves: Three way valve, Four way valves, Check valve and shuttle valve Actuation mechanisms in DCV Pressure control valves: Pressure relief, Pressure Reducing, Counter balance, Sequencing and Unloading Valves Flow control valves and its types Proportional Valves Servo valves: Mechanical type and Electrohydraulic servo valves.	9
4	Pneumatics: Air compressors, air treatment: Air filters, Dryer, Lubricator, pressure regulation, Compressor types, Pneumatics and Hydraulics, Properties Of Air, The Perfect Gas Laws, Fluid Conditioners, Air Control Valves, Pneumatic Actuators, Fluid Logic Control Systems - Introduction To Boolean Algebra, Laws Of Boolean Algebra, Illustrative Examples Using Boolean Algebra	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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 various components of fluid power systems, their advantages and select them for various applications.	K2
CO2	Design and simulate fluid power systems for automation of machine tools and other equipment's.	K3
CO3	Choose appropriate control valves for fluid power applications	K3
CO4	Select pneumatic components and fluid power actuators for low cost Automation	K2
CO5	Apply the fundamental concepts of fluid power and to obtain solution to engineering problems.	K3

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Hydraulics and Pneumatics	A. Parr	Elsevier	1999
2	Fluid Power with Applications	Anthony Esposito	Pearson New International Edition- Pearson	2013

3	Pneumatic System-Principles and Maintenance	S.R.Majumdar	McGraw Hill	2017.
4	Hydraulic and Pneumatics control	R.Srinivasan	McGraw Hill	2008

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Hydraulic control systems	H. E. Merritt	John Wiley& Sons, NewYork	1967
2	Basic fluid power	D. A. Peace	Prentice Hall	1987
3	Power Hydraulic	M. J. Pinches	Longman	1988

SEMESTER S7**PROJECT MANAGEMENT: PLANNING, EXECUTION,
EVALUATION AND CONTROL**

Course Code	25HUT704	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Understand and apply project management concepts and tools, including project planning, scheduling, and resource allocation, to manage project scope, cost, and time effectively.
2. Develop practical skills in project execution, risk management, and the use of project management software to ensure successful project evaluation, performance tracking, and closure.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Project Management:- Concept of a project-importance and challenges- classification of projects; Project management essentials-importance of project management-attributes of a good project manager-comparison: project management vs. general management; The project life cycle-phases of project life cycle; Establishing project priorities (scope, cost, time); Work break down structure; Capital budgeting process-planning-analysis- selection- financing-implementation-review.	6
2	Project Initiation and Planning:- Generation and screening of project ideas; Market and demand analysis-demand forecasting techniques-Qualitative and Quantitative; Market planning and marketing research process; Technical and financial analysis; Forms of Project organization; Human aspects of project management.	6

3	Project Scheduling and Resource Management:- Project time and cost estimation; Time Management- Developing Project Plan -Network Analysis using PERT/ CPM technique; Resource Management and Cost Management: Resource levelling- Scheduling and allocating project resources and costs.	6
4	Advanced Project Management and Closure:- Reducing Project duration - crashing project activities to speed up a project; Project Risk Management; Project Evaluation; Project progress and performance Management; Project closure and oversight; Introduction to various Project management software.	6

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Case Study/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	15	15	50

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 3 marks (6x3 =18marks)	2 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. Each question carries 8 marks. (4x8 = 32 marks)	50

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the essential concepts of project management, including project classification, the project life cycle, and the capital budgeting process.	K2
CO2	Perform market and demand analyses, apply forecasting techniques, and carry out technical and financial assessments for project viability.	K3
CO3	Develop detailed project schedules using PERT/CPM techniques and effectively manage project resources and costs.	K3
CO4	Apply methods for reducing project duration, manage project risks, and utilize project management software for project evaluation and closure.	K3

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

CO-PO Mapping Table:

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

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Projects Planning, Analysis, Selection, Implementation and Review	Prasanna Chandra	Tata McGraw –Hill	10 th Edition, 2024
2	Project Management: The Managerial Process	Erik W. Larson and Clifford F. Gray	McGraw-Hill Education	8th Edition, 2020
3	Project Management	Dennis Lock	Gower	10 th Edition, 2013

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Project Management for Engineering, Business, and Technology	John M. Nicholas and Herman Steyn	Routledge	6th Edition, 2021
2	Text book of Project management	Gopalakrishnan P & Ramamoorthy V E	Laxmi Publications	1 st Edition, 2022
3	Fundamentals of Project Management	K. Nagarajan	New Age International Publishers	6th Edition, 2019
4	Production and Operations management	R. Panneerselvam	PHI Learning Pvt. Ltd	3 rd Edition, 2012

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://www.youtube.com/watch?v=obzp6biyAN0
2	https://www.youtube.com/watch?v=dAJy-3A6lPM
3	https://onlinecourses.nptel.ac.in/noc24_mg01
4	https://onlinecourses.nptel.ac.in/noc24_mg01

MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SEVENTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH AND YEAR
Course Code: 25HUT704

Course Name: PROJECT MANAGEMENT PLANNING EXECUTION, EVALUATION AND CONTROL

Max. Marks: 50

PART A

Duration: 2 hours 30 minutes

Answer all questions. Each question carries 3 marks

		CO	Marks
1	What are the attributes of a good project manager?	CO1	(3)
2	Differentiate between Project Management and General Management.	CO1	(3)
3	Summarize the differences between qualitative and quantitative forecasting approaches.	CO2	(3)
4	Explain the human aspects of project management.	CO2	(3)
5	Outline the difference between resource levelling and resource allocation.	CO3	(3)
6	Explain the concept of crashing project activities.	CO4	(3)

PART B**Answer any one full question from each module. Each question carries 8 marks****Module 1**

9	a)	Explain the concept of project life cycle. Outline the different phases of project life cycle.	CO1	(4)
	b)	What do you mean by a project? What are the different types of projects?	CO1	(4)
10	a)	Discuss the various phases of capital expenditure of projects.	CO1	(3)
	b)	What do you mean by work break down structure in a project?	CO1	(3)
	c)	How do scope, cost and time interrelate in project management?	CO1	(2)

Module 2

11

a)

What do you mean by technical analysis in a project?

CO2

(3)

b)

The sales particulars of a company for a period of 8 years are given below:

CO2

(5)

Year	1	2	3	4	5	6	7	8
Sales	1160	1360	990	1270	1460	1450	1530	1480

Fit a simple regression for the above data. Forecast the demand for the 9th year.

12

a)

Explain briefly about the key steps in market and demand analysis in project management.

CO2

(4)

b)

Discuss the process of generating and screening the project ideas.

CO2

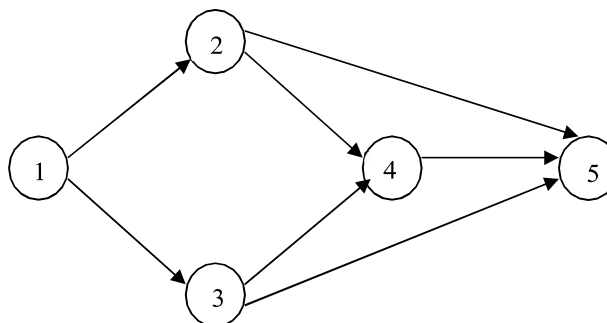
(4)

Module 3

13	a)	Explain total float and free float.	CO3	(2)
	b)	For the network shown below, determine the critical path, duration and the probability of completing the project in 35 days. Compute the slacks also.	CO3	(6)

Page 1 of 2

Activity	a	m	B
1-2	6	9	18
1-3	5	8	17
2-4	4	7	22
3-4	4	7	16
4-5	4	10	22
2-5	4	7	10
3-5	2	5	8



- 14 a) Differentiate between CPM and PERT. CO3 (2)
 b) A project schedule has the following characteristics. CO3 (6)

Activity	A	B	C	D	E	F	G	H	I	J
	-	A	A	A	D	D	E	F, G	C, H	B
Time(days)	6	4	2	2	3	3	2	1	3	5

From the above information, you are required to:

- Construct a network diagram.
- Determine the critical path and total project duration.
- Find out EST, EFT, LST and LFT

Module 4

- 15 a) Explain the significance of a project closure report and list its key components. CO4 (2)
 b) Consider the following project details CO4 (6)

Activity	Normal time (days)	Normal cost (Rs)	Crash time (days)	Crash cost (Rs)
1-2	6	700	4	840
1-3	12	300	10	First day Rs 60 Second day Rs 90
1-4	4	200	2	360
2-3	8	900	6	1000
2-4	4	600	2	760
2-5	15	100	8	380
3-5	8	500	8	-
4-5	6	400	4	500

If the indirect cost/day is Rs 150, find the optimal crashed project completion time

- 16 a) Mention any two project management software and explain how they differ? CO4 (3)
 b) What are the techniques used to measure the risk in investment? CO4 (3)
 c) What is the primary purpose of monitoring project progress? CO4 (2)

SEMESTER S7**SEMINAR**

Course Code	25MRS705	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:0:3	ESE Marks	-
Credits	2	Exam Hours	-
Prerequisites (if any)	None	Course Type	Seminar

Preamble

The course 'Seminar' is intended to enable a B. Tech graduate to read, understand, present and prepare report about an academic document. The learner shall search in the literature including peer reviewed journals, conference, books, project reports etc., and identify an appropriate paper/thesis/report in her/his area of interest, in consultation with her/his seminar guide. This course can help the learner to experience how a presentation can be made about a selected academic document and also empower her/him to prepare a technical report.

Course Objectives:

- To do a literature survey in a selected area of study.
- To understand an academic document from the literature and to give a presentation about it.
- To prepare a technical report.

Course Outcomes (COs)

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

CO1	Identify academic documents from the literature which are related to her/his areas of interest (Cognitive knowledge level: Apply).
CO2	Read and apprehend an academic document from the literature which is related to her/ his areas of interest (Cognitive knowledge level: Analyze).
CO3	Prepare a presentation about an academic document (Cognitive knowledge level: Create).

CO4	Give a presentation about an academic document (Cognitive knowledge level: Apply).
CO5	Prepare a technical report (Cognitive knowledge level: Create).

Mapping of course outcomes with program outcomes:

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

General Guidelines

- The Department shall form an Internal Evaluation Committee (IEC) for the seminar with academic coordinator for that program as the Chairperson/Chairman and seminar coordinator & seminar guide as members. During the seminar presentation of a student, all members of IEC shall be present.
- Formation of IEC and guide allotment shall be completed within a week after the University examination (or last working day) of the previous semester.
- Guide shall provide required input to their students regarding the selection of topic/ paper.
- Choosing a seminar topic: The topic for a UG seminar should be current and broad based rather than a very specific research work. It's advisable to choose a topic for the Seminar to be closely linked to the final year project area. Every member of the project team could choose or be assigned Seminar topics that covers various aspects linked to the Project area.
- A topic/paper relevant to the discipline shall be selected by the student during the semester break.
- Topic/Paper shall be finalized in the first week of the semester and shall be submitted to the IEC.
- The IEC shall approve the selected topic/paper by the second week of the semester.

- Accurate references from genuine peer reviewed published material to be given in the report and to be verified.

Evaluation Pattern

Total marks: 50, only CIE, minimum required to pass 25

- **Seminar Guide: 10 marks** (Background Knowledge – 5 (The guide shall give deserving marks for a candidate based on the candidate's background knowledge about the topic selected), Relevance of the paper/topic selected – 5).
- **Seminar Coordinator: 10 marks** (Seminar Diary – 5 (Each student shall maintain a seminar diary and the guide shall monitor the progress of the seminar work on a weekly basis and shall approve the entries in the seminar diary during the weekly meeting with the student), Attendance – 5).
- **Presentation: 20 marks to be awarded by the IEC** (Clarity of presentation – 5, Interactions – 5 (to be based on the candidate's ability to answer questions during the interactive session of her/his presentation), Overall participation – 5 (to be given based on her/his involvement during interactive sessions of presentations by other students), Quality of the slides – 5).
- **Report: 10 marks to be awarded by the IEC** (check for technical content, overall quality, templates followed, adequacy of references etc.).

SEMESTER S7**MAJOR PROJECT PHASE -I**

Course Code	25MRP706	CIE Marks	100
Teaching Hours/Week (L: T:P: R)	0:0:0:8	ESE Marks	-
Credits	4	Exam Hours	-
Prerequisites (if any)	None	Course Type	Project

Preamble:

The course 'Project Work' is mainly intended to evoke the innovation and invention skills in a student. The course will provide an opportunity to synthesize and apply the knowledge and analytical skills learned, to be developed as a prototype or simulation. The project extends to 2 semesters and will be evaluated in the 7th and 8th semester separately, based on the achieved objectives. One third of the project credits shall be completed in 7th semester and two third in 8th semester. It is recommended that the projects may be finalized in the thrust areas of the respective engineering stream or as interdisciplinary projects. Importance should be given to address societal problems and developing indigenous technologies.

Course Objectives

- To apply engineering knowledge in practical problem solving.
- To foster innovation in design of products, processes or systems.
- To develop creative thinking in finding viable solutions to engineering problems.

Course Outcomes (COs)

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

CO1	Model and solve real world problems by applying knowledge across domains (Cognitive knowledge level: Apply).
CO2	Develop products, processes or technologies for sustainable and socially relevant applications (Cognitive knowledge level: Apply).
CO3	Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks (Cognitive knowledge level: Apply).

CO4	Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms (Cognitive knowledge level: Apply).
CO5	Identify technology/research gaps and propose innovative/creative solutions (Cognitive knowledge level: Analyze).
CO6	Organize and communicate technical and scientific findings effectively in written and oral forms (Cognitive knowledge level: Apply).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	2	1	2	2	1	1	1	1	2
CO2	2	2	2		1	3	1	1		1	1
CO3								3	2	2	1
CO4					2		3	2	2	3	2
CO5	2	3	3	1	2						1
CO6					2		2	2	3	1	1

PROJECT PHASE I

Phase 1 Target

- Literature study/survey of published literature on the assigned topic
- Formulation of objectives
- Formulation of hypothesis/ design/ methodology
- Formulation of work plan and task allocation.
- Block level design documentation
- Seeking project funds from various agencies
- Preliminary Analysis/Modeling/Simulation/Experiment/Design/Feasibility study
- Preparation of Phase 1 report

Evaluation Guidelines & Rubrics

Total: 100 marks (Minimum required to pass: 50 marks).

- Project progress evaluation by guide: 30 Marks.
- Interim evaluation by the Evaluation Committee: 20 Marks.
- Final Evaluation by the Evaluation Committee: 30 Marks.
- Project Phase - I Report (By Evaluation Committee): 20 Marks.

(The evaluation committee comprises HoD or a senior faculty member, Project coordinator and project supervisor).

Evaluation by the Guide

The guide/supervisor shall monitor the progress being carried out by the project groups on a regular basis. In case it is found that progress is unsatisfactory it shall be reported to the Department Evaluation Committee for necessary action. The presence of each student in the group and their involvement in all stages of execution of the project shall be ensured by the guide. Project evaluation by the guide: 30 Marks. This mark shall be awarded to the students in his/her group by considering the following aspects:

Topic Selection: innovativeness, social relevance etc. (2)

Problem definition: Identification of the social, environmental and ethical issues of the project problem. (2)

Purpose and need of the project: Detailed and extensive explanation of the purpose and need of the project. (3)

Project Objectives: All objectives of the proposed work are well defined; Steps to be followed to solve the defined problem are clearly specified. (2)

Project Scheduling & Distribution of Work among Team members: Detailed and extensive Scheduling with timelines provided for each phase of project. Work breakdown structure well defined. (3)

Literature survey: Outstanding investigation in all aspects. (4)

Student's Diary/ Daily Log: The main purpose of writing a daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students' thought process and reasoning abilities. The students should record in the daily/weekly activity diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students. The daily/weekly activity diary shall be signed after

every day/week by the guide. (7)

Individual Contribution: The contribution of each student at various stages. (7)

EVALUATION RUBRICS for PROJECT Phase I: Interim Evaluation						
No	Parameters	Marks	Poor	Fair	Very Good	Outstanding
1-a	Topic identification, selection, formulation of objectives and/or literature survey. (Group assessment) [CO1]	10	The team has failed to come with a relevant topic in time. Needed full assistance to find a topic from the guide. They do not respond to suggestions from the evaluation committee and/or the guide. No literature review was conducted. The team tried to gather easy information without verifying the authenticity. No objectives formed yet.	The team has identified a topic. The originally selected topic lacks substance and needs to be revised. There were suggestions given to improve the relevance and quality of the project topic. Only a few relevant references were consulted/ studied and there is no clear evidence to show the team's understanding on the same. Some objectives identified, but not clear enough.	Good evidence of the group thinking and brainstorming on what they are going to build. The results of the brainstorming are documented and the selection of topic is relevant. The review of related references was good, but there is scope of improvement. Objectives formed with good clarity, however some objectives are not realistic enough.	The group has brainstormed in an excellent manner on what they were going to build. The topic selected is highly relevant, real world problem and is potentially innovative. The group shows extreme interest in the topic and has conducted extensive literature survey in connection with the topic. The team has come up with clear objectives which are feasible.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
1-b	Project Planning, Scheduling and Resource/ Tasks Identification and allocation. (Group assessment) [CO4]	10	No evidence of planning or scheduling of the project. The students did not plan what they were going to build or plan on what materials / resources to use in the project. The students do not have any idea on the budget required. The team has not yet decided on who does what. No project journal kept.	Some evidence of a primary plan. There were some ideas on the materials /resources required, but not really thought out. The students have some idea on the finances required, but they have not formalized a budget plan. Schedules were not prepared. The project journal has no details. Some evidence on task allocation among the team members.	Good evidence of planning done. Materials were listed and thought out, but the plan wasn't quite complete. Schedules were prepared, but not detailed, and needs improvement. Project journal is presented but it is not complete in all respect / detailed. There is better task allocation and individual members understand about their tasks. There is room for	Excellent evidence of enterprising and extensive project planning. Gantt charts were used to depict detailed project scheduling. A project management/version control tool is used to track the project, which shows familiarity with modern tools. All materials / resources were identified and listed and anticipation of procuring time is done. Detailed budgeting is done. All tasks were identified and incorporated in the schedule. A well-kept project journal shows evidence for all the above, in addition to the interaction with the project guide. Each member knows

					improvement.	well about their individual tasks.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 – 9 Marks)	(10 Marks)
Phase 1 Interim Evaluation Total Marks: 20						

EVALUATION RUBRICS for PROJECT Phase I: Final Evaluation

S I. N o.	Parameters	Marks	Poor	Fair	Very Good	Outstanding
1-c	Formulation of Design and/or Methodology and Progress. (Group assessment) [CO1]	5	None of the team members show any evidence of knowledge about the design and the methodology adopted till now/ to be adopted in the later stages. The team has not progressed from the previous stage of evaluation.	The students have some knowledge on the design procedure to be adopted, and the methodologies. However, the team has not made much progress in the design, and yet to catch up with the project plan.	The students are comfortable with design methods adopted, and they have made some progress as per the plan. The methodologies are understood to a large extent.	Shows clear evidence of having a well- defined design methodology and adherence to it. Excellent knowledge in design procedure and its adaptation. Adherence to the project plan is commendable.
			(0 – 1 Marks)	(2 – 3 Marks)	(4 Marks)	(5 Marks)
1-d	Individual and Teamwork Leadership (Individual assessment) [CO3]	10	The student does not show any interest in the project activities, and is a passive member.	The student show some interest and participates in some of the activities. However, the activities are mostly easy and superficial in nature.	The student shows very good interest in project, and takes up tasks and attempts to complete them. Shows excellent responsibility and team skills. Supports the other members well.	The student takes a leadership position and supports the other team members and leads the project. Shows clear evidence of leadership.

			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
1 - e	Preliminary Analysis/ Modeling / Simulation/ Experiment / Design/ Feasibility study	10	The team has not done any preliminary work with respect to the analysis/modeling/simulation/experiment/design/feasibility study/ algorithm development.	The team has started doing some preliminary work with respect to the project. The students however are not prepared enough for the work and they need to improve a lot.	There is some evidence to show that the team has done good amount of preliminary investigation and design/ analysis/ modeling etc. They can improve further.	Strong evidence for excellent progress in the project. The team has completed the required preliminary work already and are poised to finish phase I in an excellent manner. They have shown results to prove their progress.
	[CO1]		(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)

1-f	Documentati o n and presentation. (Individual & group assessment). [CO6]	5	The team did not document the work at all. The project journal/diary is not presented. The presentation was shallow in content and dull in appearance. The individual student has no idea on the presentation of his/her part.	Some documentation is done, but not extensive. Interaction with the guide is minimal. Presentation include some points of interest, but overall quality needs to be improved. Individual performance to be improved.	Most of the project details were documented well enough. There	The project stages are extensively documented in the report. Professional documentation tools like LaTeX were used to document the progress of the project along with the project journal. The documentation structure is well- planned and can easily grow into the project report. The presentation is done professionally and with great clarity. The individual's performance is excellent.
			(0 – 1 Marks)	(2 – 3 Marks)	(4 Marks)	(5 Marks)
Total		30	Phase - I Final Evaluation Marks: 30			

EVALUATION RUBRICS for PROJECT Phase I: Report Evaluation

Sl · N o.	Parameters	Marks	Poor	Fair	Very Good	Outstanding
1 - g	Report [CO6]	20	The prepared report is shallow and not as per standard format. It does not follow proper organization. Contains mostly Unacknowledged content. Lack of effort in preparation is evident.	Project report follows the standard format to some extent. However, its organization is not very good. Language needs to be improved. All references are not cited properly in the report.	Project report shows evidence of systematic documentation. Report is following the standard format and there are only a few issues. Organization of the report is good. Most of the references are cited properly.	The report is exceptionally good. Neatly organized. All references cited properly. Diagrams/Figures, Tables and equations are properly numbered, and listed and clearly shown. Language is excellent and follows standard styles.

			(0 - 7 Marks)	(8 - 12 Marks)	(13 - 19 Marks)	(20 Marks)
Phase - I Project Report Marks: 20						

SEMESTER 8

MECHATRONICS ENGINEERING

SEMESTER S8**BIO MECHATRONICS**

Course Code	25MRT861	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)	None	Course Type	Theory

Course Objectives:

1. To introduce students to basic biomedical engineering technology and different biological signals, their acquisition, measurements and related constraints.
2. Understand principles, techniques, procedures, and equipment used in bio-medical instrumentation.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Bio potential and bio electrodes: Cell structure – electrode – electrode potential- resting and action potential –Refractory period- Electrode electrolyte interface, Half-cell potential, Polarisable and Non-polarisable electrodes - Skin electrode interface – Bioelectrodes: Types of electrodes- Micro electrodes, Depth and Needle electrodes, Surface electrodes- Equivalent circuits of electrodes	9

2	Biopotential Recorders: Characteristics of the recording system, Electrocardiogram - Einthoven triangle, Standard 12-lead configurations - ECG Machine-Electroencephalography (EEG) –Brain waves, waveforms & measurements, Evoked potentials, Sleep stages, 10-20 electrodes placement system for EEG – EEG machine	9
3	Measurement of Physiological Parameters: Blood Pressure measurement- Blood Flow Meters: Need for blood flow meters, Electromagnetic blood flowmeters- Applications of electromagnetic blood flowmeters, Ultrasonic blood flowmeter: Ultrasonic blood flowmeter based on transit time principle, Doppler blood flowmeters-laser based Doppler blood flowmeters-Cardiac output measurements.	9
4	Physiological Assist Devices: Pacemakers, Defibrillators, Nerve and muscle stimulators, Heart lung machine- ventilators-Basic ideas of CT scanner- MRI scanner and ultrasonic scanner-Devices to protect against electrical hazards- Microshock and macroshock, Centralized patient monitoring system.	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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 the bio potential and bio electrodes	K2
CO2	Understand the Characteristics of the recording system	K2
CO3	Understand the measurement of Physiological Parameters	K2
CO4	Understand the Physiological Assist Devices	K2

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Textbook of Medical Physiology	Arthur C.Guyton	PrismBooks(Pvt)Ltd &W.B.Saunders Company	12th edition, 2012
2	Bio Medical Instrumentation	Dr.Arumugam M	Anuradha agencies Publications	2nd edition, 2002
3	Handbook of Medical Instrumentation	Khandpur R S	Tata McGraw Hill, New Delhi.	2004

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Electronics in Medicine and Biomedical Instrumentation	Nandini K	Jog PHI	Second Edition 2013
2	Instrument transducer – An introduction to their performance and design	Hermann K P Neubert	Clarendon Press	1975
3	Biomedical sensors – Fundamentals and application	Harry N Norton	Noyes Publications	1982
4	Principles of applied biomedical instrumentation	L.A Geddes , L.E. Baker	<u>Wiley india Pvt. Ltd</u>	third addition, 2008

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://onlinecourses.nptel.ac.in/noc22_bt33/preview
2	https://onlinecourses.nptel.ac.in/noc22_ee87/preview
3	https://onlinecourses.swayam2.ac.in/nou23_bt05/preview
4	https://nptel.ac.in/courses/102106094

SEMESTER S8**HYBRID & ELECTRIC VEHICLES**

Course Code	25MRT862	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)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. Introduces the fundamental concepts of electric, hybrid and autonomous vehicles, drive trains, electrical machines used, energy storage devices, charging systems and different communication protocols.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies. Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies.	9

2	Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles. DC Drives: Review of Separately excited DC Motor control – Speed and torque equations - Independent control of orthogonal flux and torque - Closed loop control of speed and torque (block diagram only). PMSM Drives: PMSM motor basics – Independent control of orthogonal flux and torque (concept only)- Field Oriented Control (FOC) – Sensored and sensorless control (block diagram only).	9
3	Energy Storage: Introduction to energy storage requirements in Hybrid and Electric Vehicles- Battery based energy storage systems, Battery Management System, Types of battery- Fuel Cell based energy storage systems- Supercapacitors-Hybridization of different energy storage devices. Overview of Electric Vehicle Battery Chargers - On-board chargers, Electric Vehicle Supply Equipment (EVSE) - Grid to EVSE to On-board chargers to battery pack power flow block schematic diagrams – Types of charging stations - AC Level 1 & 2, DC - Level 3 – V2G concept-Types of Connectors - CHAdeMO, CCS Type1 and 2, GB/T - PIN diagrams and differences.	9
4	Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics. Vehicle Communication protocols : Need & requirements - Functions of Control Pilot (CP) and Proximity Pilot (PP) pins, Communication Protocols - CAN, LIN, FLEXRAY (Basics only)- Power line communication (PLC) in EV.	9

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

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 (8x3 = 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. (4x9 = 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	Explain the basic concepts of Conventional, Electric, Hybrid EV and describe different configurations of electric and hybrid electric drive trains	K2
CO2	Discuss the propulsion unit for electric and hybrid vehicles	K2
CO3	Compare various energy storage and EV charging systems	K2
CO4	Select drive systems and various communication protocols for EV	K2

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Hybrid Electric Vehicles – Principles and applications with practical perspectives	Chris Mi, M A Masrur, D W Gao	Wiley	2011
2	Electric and Hybrid Vehicles: Design Fundamentals	Iqbal Hussein	CRC Press	2003

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Electric Vehicle Technology Explained	James Larminie, John Lowry	Wiley	2003
2	Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design,	Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi	CRC Press	2004

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://nptel.ac.in/courses/108/103/108103009/
2	https://nptel.ac.in/courses/108/102/108102121/
3	https://nptel.ac.in/courses/108/106/108106170/
4	https://nptel.ac.in/courses/108/103/108103009/

SEMESTER S8**OPERATIONS MANAGEMENT**

Course Code	25MRT863	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)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. This course is designed to facilitate the students to acquire knowledge about operations management concepts, tools and techniques.
2. This course covers system concept of production, facility location analysis, facility layout, line balancing, demand forecasting, aggregate planning, material requirement planning and production scheduling.
3. It empowers the students to amalgamate their knowledge and thus inculcate the skills needed to apply these concepts, tools and techniques in industry.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Operations Management: Objectives, Operations Management: Functions and Scope, Types of Production Systems, process planning, make or buy decisions, process reengineering, Operations Strategy. Facility Planning, Factors Affecting Plant Location, Plant Location: Case Study, location analysis techniques – location factor rating–center of gravity technique – load distance technique.	9

2	Capacities and facilities: capacity planning, facility layout – objectives, types of layout – process layout – product layout – fixed position layout – cellular layout, systematic layout, planning, layout design procedures – CRAFT – CORELAP – ALDEP. Assembly line balancing: methods for line balancing – rank positional weight method –COMSOAL.	9
3	Demand forecasting: need and uses of forecasting, components of forecasting demand, time series methods – moving average – weighted moving average – exponential smoothing – adjusted exponential smoothing – linear regression – seasonal adjustments, forecast accuracy. Aggregate planning: aggregate planning strategies	9
4	Materials requirement planning: objectives, master production schedule, bill of materials, evolution from MRP to manufacturing resource planning (MRP II). production scheduling: objectives – processing characteristics and constraints – performance measures, Gantt chart, single machine scheduling	9

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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 operations, production system and perform facility location analysis.	K2
CO2	Impart knowledge of facility layout, layout planning and perform line balancing.	K2
CO3	Compute demand forecast and forecast accuracy.	K2
CO4	Understand the Knowledge of aggregate planning and materials requirement planning.	K2
CO5	Impart Knowledge on Production Scheduling techniques.	K2

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Operations Management	Roberta S. Russell and Bernard W. Taylor III	John Wiley & Sons, Inc., Seventh Edition	2011
2	Production and Operations Management	R. Paneerselvam	PHI	2010

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Operations Management	Heizer and Render	Pearson Education	Eleventh Edition
2	Operations Management: A Quantitative Approach	P. B. Mahapatra	PHI	2010
3	Quantitative Models in Operations and Supply Chain Management	G. Sreenivasan,	, P H I	SECOND EDITION

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/112/107/112107238/ https://youtu.be/_VJkKZFuRvE
2	https://youtu.be/pcpp2rmAMx8 https://youtu.be/-aGk5-yx340
3	https://youtu.be/Ic_El2DkpjA
4	https://youtu.be/1kU8HG5Y9Kc

SEMESTER S8**ERGONOMICS**

Course Code	25MRT864	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)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. Equip students with the knowledge and skills to design ergonomic workspaces that reduce the risk of musculoskeletal disorders, improve posture, and ensure physical well-being by understanding human anatomy, anthropometry, and biomechanics.
2. Enable students to design optimal lighting, acoustic, and visual environments to minimize visual fatigue, eye strain, and auditory discomfort, while improving overall comfort and productivity in various work settings.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Humanise work, Basis Body Mechanics, Anatomy of Spine and Pelvis for postures, Stability and Postural Adaptation, Musculoskeletal Disorders in Work Spaces, Behavioural Aspects of Postures, Sources of Human Variability, Principles of Applied Anthropometry, Application of Anthropometry in Design, Design for Everyone, Personal Space.	9

2	Design of Standing and Sitting, Workstation Design, Work Surface Design, Visual Display Units, Guidelines for Design of Static and Repetitive Works, Ergonomic Interventions, Handle Design, Keyboard Design, Anatomy and Biomechanics of Manual Handling, Prevention of Injuries in Manual Handling, Design of Manual Handling Task, Carrying.	9
3	Muscle Structure - Function and Capacity, Factors Affecting Physical Work Capacity, Applied Physiology in Work Space, Measurement of Physiological Cost of Work, Comfort and the Indoor Climate, Protection Against Extreme Climates.	9
4	Eye Vision, Measurement of Light, Lighting Design Consideration, Visual Fatigue, Eye Strain and Near Work, Indoor Lighting – Psychological Aspects, Measurement of Sound, Ear Protection, Design of Acoustic Environment, Industrial Noise Control, Design of Visual Displays, Design of Audio Displays, Design of Controls, Combining Displays and Controls, Virtual Environment.	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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 how to design workspaces that reduce musculoskeletal disorders and enhance productivity.	K2
CO2	Understand principles for creating effective and comfortable standing, sitting, and manual handling workstations.	K2
CO3	Understand how to optimize lighting, acoustics, and visual environments to minimize fatigue and discomfort.	K2
CO4	Understand how to measure physiological work costs and design workspaces that ensure comfort and accommodate diverse human needs.	K2

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to human factors and ergonomics	R.S Bridger	CRC Press Tylor and Francis group	4th edition, 2018
2	ERGONOMICS in the Automotive Design Process	Vivek D. Bhise	CRC press Tylor and francis group	2nd edition, 2024

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Human factors method for improving performance in the process industries	Dennis Attwood , et.al	John wiley and sons Inc. Publications	2006
2	A guide to human factors and ergonomics	Martin Helander	CRC press Tylor and francis group	2nd edition, 2005

SEMESTER S8**INDUSTRIAL INSTRUMENTATION**

Course Code	25MRT865	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs.30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To familiarize the students about various types of temperature, pressure, level, pH, density, viscosity, turbidity and conductivity measurement systems

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Measurement of Temperature Definitions and units- Standards of temperature – Thermometry and pyrometry- Thermocouples- Peltier effect- Thomson effect- Seebeck effect- Types of thermocouples (Chromel- copper. Chromel- alumel.copper- constantan, iron-constantan, platinum-rhodium- platinum) Cold junction compensation-Signal conditioning for thermocouple- Thermowells— Thermopiles- Resistance thermometers- Principle of operation- Platinum RTD- Construction of RTDs- Lead compensation- 3wire method – 4 wire method- Thermistors – Quartz crystal sensors- Expansion thermometers- Bimetallic thermometers – Liquid filled thermometers- Gas filled thermometers- Vapor pressure thermometers- Pyrometry- Stefan Boltzmann’s law- Black body radiation- Total radiation pyrometers-Optical radiation pyrometers-Disappearing filament photo electric pyrometer Conductivity Measurement Theory of operation, Two electrode cells, Four electrode measurement, electrodeless cell	9

2	Measurement of Pressure Introduction – units and definitions – standards of pressure – bellows type pressure sensors: motion balance and force balance pressure sensors, C-bourdon, spiral and helical bourdon pressure sensors-Diaphragm or capsule type sensors: motion balance and force balance pressure sensors-Differential pressure elements: dry, force balance and dry, motion balance-Electronic pressure sensors: strain gauge, Capacitance, Potentiometric, Resonant wire, Piezoelectric, Magnetic and Optical transducers, High-Pressure sensors: Dead-Weight piston gauge, Bulk modulus cells, Manometers: U tube manometer – inclined manometer- ring balanced type manometer, Micromanometers. Vacuum pressure measuring elements- McLeod gauge – ionization gauges – Knudsen gauge – momentum transfer gauges- thermal conductivity gauges – Pirani's gauge.	9
3	Level measurement Bubblers-Capacitance level sensors-Level switches; field effect and diaphragm switch, Differential pressure level detector: electronic d/p transmitters, displacer level detectors: torque tube displacer, interface measurement, Float level devices: float level switch ,Laser level detectors: triangular measurement, time-of-reflection measurement. Level gauges: Flat glass gauge, magnetic level gauge, remote reading gauge, Optical level devices; Light reflection, transmission and refraction. Radar level transmitters: time-of flight determination, radiation level sensor; continuous level measurement, Ultrasonic level measurement, Resistance tape level measurement, Rotating paddle switch	9

4	Density Measurement Displacement and float type, hydrometer, hydrostatic densitometers. Radiation densitometer, vibrating densitometer, gas densitometers. pH measurement Theory-Measurement electrodes -Fibre-optic pH measurement-digital pH meters- amplifiers for pH electrodes. Viscosity measurement Laboratory types: Rotational, Saybolt, Redwood, Falling ball and Capillary tube viscometers. Industrial types –Capillary type of viscosity measurements- Falling piston-float viscometer –Oscillating blade. Turbidity measurement Forward scattering type, scattered light detectors, backscatter turbidity analyzer	9
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Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

<i>Attendance</i>	<i>Internal Ex</i>	<i>Evaluate</i>	<i>Analyse</i>	<i>Total</i>
5	15	10	10	40

Criteria for Evaluation(Evaluate and Analyse): 20 marks

A micro project with a maximum of 3 students to design and implement a Soft Computing System or model should be given, and the evaluation should be evaluating Bloom's knowledge level. Micro-projects related to Instrumentation and Control Engineering with Society, Sustainability, and ethics in content should be given more weightage.

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 (8x3 =24marks)	2 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. Each question carries 9 marks. (4x9 = 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	Explain working principle and measurement techniques of various types of temperature measuring and conductivity measuring instruments	K2
CO2	Discuss working principle and measurement techniques of various types of pressure measuring instruments.	K2
CO3	Explain working principle and measurement techniques of various types of level measuring instruments	K2
CO4	Describe working principle and measurement techniques of various types of density, pH, viscosity and turbidity measuring instruments.	K2
CO5	Design and develop an industrial instrumentation project	K4

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3										3
CO2	3										3
CO3	3										3
CO4	3										3
CO5	3	3	2	1	3			3	3	2	3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
S l · N o	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Instrument Engine ers Handbook	Liptak.B.G	Chilton book.co.	Fourth, Volume 1, 2003

2	Instrument technology	Jones.E.B	Scientific Pub	Volume1, Edition3, 1974
3	Instrumentation Reference Book	Walt Boyes	Elsevier	4/e.2010
4	Applied Instrumentation in Process Industries	Andrew and Williams	Gulf publications	Volume 1,2. Edition2, 1979

Reference Books				
S l . N o	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Mechanical and Industrial Measurements	Jain.R.K	Khanna Publishers	Edition11, 1995
2	Principles of Industrial Instrumentation	Patranabis.D	Tata McGraw Hill	Edition2, 2008
3	Measurement System	Doebelin.E.O	McGraw hill	Edition4, 1990

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/content/storage2/112/103/112103261/MP4/mod10lec28.mp4 https://archive.nptel.ac.in/content/storage2/112/103/112103261/MP4/mod10lec29.mp4 https://archive.nptel.ac.in/content/storage2/112/103/112103261/MP4/mod10lec27.mp4
2	https://archive.nptel.ac.in/content/storage2/112/103/112103261/MP4/mod08lec21.mp4 https://archive.nptel.ac.in/content/storage2/112/103/112103261/MP4/mod08lec22.mp4 https://archive.nptel.ac.in/content/storage2/112/103/112103261/MP4/mod08lec23.mp4
3	https://archive.nptel.ac.in/content/storage/103/105/103105130/MP4/mod10lec46.mp4 https://archive.nptel.ac.in/content/storage/103/105/103105130/MP4/mod10lec47.mp4 https://archive.nptel.ac.in/content/storage/103/105/103105130/MP4/mod10lec48.mp4 https://archive.nptel.ac.in/content/storage/103/105/103105130/MP4/mod10lec49.mp4
4	https://archive.nptel.ac.in/content/storage/103/105/103105130/MP4/mod11lec54.mp4 https://archive.nptel.ac.in/content/storage/103/105/103105130/MP4/mod11lec55.mp4

SEMESTER S8**AUTOTRONICS**

Course Code	25MRT831	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)	None	Course Type	Theory

Course Objectives:

1. To understand the fundamentals and control of automobiles using electronic equipment.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Automotive fundamentals: The engine, components, drive train, starting & charging systems operation, ignition system, suspension systems, brakes, steering system. Sensors and actuators for power train and chassis systems: Introduction, working principle, throttle position, Manifold absolute pressure (MAP), lambda sensor, detonation, emission.	9
2	SI Engine Management: Feedback carburettor system, throttle body injection and multi point fuel injection system, injection system controls, advantage of electronic ignition systems, three way catalytic converter, group and sequential injection techniques. Working of the fuel system components. Advantages of electronic ignition systems CI Engine Management: Parameters affecting combustion, noise and emissions in CI engines. Pilot, main, advanced, post injection and retarded post injection layout of the Common Rail Fuel Injection system, working of components like fuel injector, fuel pump, rail pressure limiter, flow limiter, EGR valve control in electronically controlled systems.	9

3	Safety and comfort : Antilock Braking System (ABS), Electronic Stability Control (ESC), Roll Stability Control (RSC), traction control system, adaptive cruise control, electric power steering, electronic clutch, electronic suspension system, airbags. Electric vehicles and hybrid vehicles: Introduction, electric vehicle development, system layout, basic system components, fuel cell, electric vehicle, hybrid vehicle: series hybrid vehicle, parallel hybrid vehicle, CNG electric hybrid vehicle.	9
4	Vehicle Intelligence: Introduction, basic structure, vision based autonomous road vehicles, architecture for dynamic vision system, features, applications, application of mobile robot vision to a vehicle information system, object detection, collision warning and avoidance system, low tire pressure warning system.	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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	Acquire knowledge on various electronic controls, sensors and actuators used in automobiles	K2
CO2	Obtain an overview of components, sub-systems, and basics of engine management employed in today's automotive industry.	K2
CO3	Apply fundamental knowledge for design of safety systems like airbags, ABS, etc. in automobiles.	K3
CO4	Comprehend the basic system components and their functions of electric and hybrid vehicles. Acquire a fundamental knowledge on intelligence vehicle systems.	K3

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year

1	Automobile electrical and electronic systems	Tom Denton	BH Publications	3rd Ed., 2004
2	Automobile Electrical & Electronic Equipments	Young, Griffiths	Butterworths	
3	Automotive Electronics Design Fundamental	Najamuz Zaman	Springer,	1st Ed., 2015
4	Fundamentals of Motor Vehicle Technology on Chassis and Body Electronics	Hillier's	Nelson	5th Ed.

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Automotive Technology	Jack Erjavec, Robert Scharff	Delmar publications Inc	1992
2	Electric and Hybrid-electric vehicles	Ronald K. Jurgan	SAE	2002
3	Vision-based Vehicle Guidance	Ichiro Masaki	Springer Verlag, Newyork	1992
4	Class room manual for automotive service and system	Jay Webster	Delmer	1995

SEMESTER S8**ADVANCED AUTOMATION**

Course Code	25MRT832	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)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. Make students familiar with automation and control technologies in modern manufacturing.
2. Determine the modern application of automation systems in manufacturing industry.
3. Provide knowledge on the elements of modern manufacturing systems.
4. Examine the mechanisms of CMM and FMS.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Production system facilities-Manufacturing support systems - Automation in production systems-manual labor in production systems - automation principles and strategies USA principle-ten strategies of Automation and Production Systems - Automation Migration strategy-manufacturing industries and products-manufacturing operations-processing and assembly operations-product / production relationships. Classification of manufacturing systems	9

2	Elements of an automated system-advanced automation functions - safety monitoring-maintenance and repair diagnostics - capabilities of computer control and levels of industrial process control-computer process monitoring-direct digital control-numerical control and robotics- PLC. Components of a manufacturing system - production machines - material handling system.	9
3	Automation levels - part or product variety - Type I type II and type III manufacturing systems. Part families - parts classification and coding-features and examples of part classification and coding systems - production flow analysis-cellular manufacturing - application of group technology. Inspection metrology-coordinate measuring machines - CMM construction - CMM operation and planning - CMM applications and benefits.	9
4	Machine vision - image acquisition and digitizing - machine vision applications. Flexible manufacturing systems - types of FMS - FMS components - workstations - material handling and storage systems - computer control systems - human resources - FMS applications and benefits - FMS planning and implementation issues - FMS planning and design issues - FMS operational issues. Comparison of lean and agile manufacturing.	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

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 (8x3 =24marks)	- 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. (4x9 = 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 the principles of automation systems and to determine the relationship between product and production.	K2
CO2	Analyse the different elements of automation system and to find the importance of control systems in automation.	K3
CO3	Classify the manufacturing systems, what are the components of manufacturing systems and understand about CMM.	K2
CO4	Explain about Machine vision in manufacturing system and FMS.	K2

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1		1							
CO2	3	2	1	2							2

CO3	3	3									
CO4	3	2	3	2							2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Automation, Production Systems and Computer – Integrated Manufacturing	Mikell P Groover,	Pearson Education	2001

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	CAD/CAM and CIM	Radhakrishnan, P Subramanian	Wiley Eastern	2003
2	Advanced Automation Techniques in Adaptive material processing	XiaoQi Chen, Rajagopalan Devanathan, Aik Meng Fong	World Scientific, first edition	2002
3	Principles of automation and Advanced Manufacturing System	Dr. KC Jain, Sanjay Jain	Khanna Publishers	2004

SEMESTER S8**ORGANIZATIONAL BEHAVIOUR AND BUSINESS COMMUNICATION**

Course Code	25HUT803	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	ESE Marks	50
Credits	1	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To expose the students to the fundamentals of Organizational Behaviour (OB) and Business communication
2. To become familiar with working with people, nature of organizations, communication, leadership and motivation of people.
3. To help students develop a conceptual understanding of OB theories
4. To enable the students to put the ideas and skills of OB into practice

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Organizational Behaviour: Definition, Evolution of the Concept of OB, Contributions to OB by major behavioural science disciplines, Challenge and Opportunities for OB managers, Models of OB study (Custodial Model, Supportive Model, Collegial Model, Human Value Model)	6
2	Individual Behaviour-Attitudes and Job Satisfaction, Components of Attitude, Personality and Values, Personality Determinants, Types of Values, Perception, Factors influencing perception. Group Behaviour, Formation of Group, Group decision making, creating effective teams, Culture, Culture's function	6
3	Motivation and Leadership Concept of motivation, Definition, Theories of Motivation, Maslow's need Theory, Theory X and Theory Y, Two Factor Theory, Vroom's Expectancy Theory. Concept of Leadership, Theories of leadership, Traits of good Leader, Difference between Leader and Manager	6

4	Business communication- Functions, Types and process of communication- downward, upward communication- Interpersonal and Group Communication- - Choices of Communication Channel-Cross functional communication- Conflict management communication Modern forms of business communication- Global communication	6
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Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	15	15	50

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 3 marks (6x3 =18marks)	2 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. Each question carries 8 marks. (4x8 = 32 marks)	50

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the models and frameworks of organizational behaviour and business communication	K2
CO2	Develop the team working and decision-making capacity by assessing the influence of Individual and Group Behaviour towards the organizational Goal	K3

CO3	Apply and analyse the Theories of motivation and leadership in an organisation	K3 & K4
CO4	Explore the business communication methods for organizational effectiveness	K3

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

CO-PO Mapping Table:

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

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Organizational Behaviour	Kavita Singh	Vikas Publications	3e-2015
2	Organizational Behavior	Robbins, Timothy Judge, Seema Sanghi	Pearson	18e-2018
3	Organizational Behavior: Improving Performance and Commitment in the Workplace	Jason Colquitt, Jeffery A. LePine, and Michael J. Wesson	McGraw-Hill Education	2018
4	Business Communication: Essential Strategies for 21st Century Managers	Shalini Verma	Vikas Publishing House	2e-2014

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Organizational Behaviour- An Evidence-Based Approach	Fred Luthans, Brett C. Luthans, Kyle W. Luthans	McGraw Hill Inc	13 ^e -2015
2	Organizational Behaviour	John Newstrom and Keith Davis	Tata McGraw Hill	11e - 2011

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	www.algonquincollege.com/ccol/courses/organizational-behaviour/
2	www.algonquincollege.com/ccol/courses/organizational-behaviour/
3	www.algonquincollege.com/ccol/courses/organizational-behaviour-3
4	https://www.imi.edu/delhi/organizational_behaviour_human_resources

MODEL QUESTION PAPER				
JYOTHI ENGINEERING COLLEGE (AUTONOMUS) EIGHT SEMESTER B. TECH DEGREE EXAMINATION, MONTH AND YEAR				
Course Code: 25HUT803				
Course Name: Organizational Behaviour and Business Communication				
Max. Marks: 50			Duration:	2 hours 30 minutes
		PART A		
		Answer all questions. Each question carries 3 marks	CO	Marks
1		Explain the stages in the evolution of the Concept of OB	CO1	(3)
2		What are the models of OB study?	CO1	(3)
3		List and explain the components of Attitude	CO2	(3)
4		Describe the factors influencing perception.	CO2	(3)
5		How does the motivation and leadership are connected?	CO3	(3)
6		What are the functions of business communication	C04	(3)
PART B				
Answer any one full question from each module. Each question carries 8 marks				
		Module 1		
9	a)	Challenges and opportunities in Organizational Behaviour.	CO1	(2)
	b)	Explain the major Behavioural Science that contribute to Organizational Behaviour	CO1	(4)
	c)	Describe and compare any two Models of Organizational Behaviour	CO1	(2)
10	a)	Describe the Dynamics of People and Organization	CO1	(2)
	b)	With illustration explain Organizational structure of a Government College.	CO1	(4)
	c)	How OB and psychology are interconnected?	CO1	(2)
		Module 2		
11	a)	Conflict management communication- Explain in detail	CO2	(2)
	b)	Describe the foundations of Group Behaviour	CO2	(4)
	c)	Define Group – Classification and its properties	CO2	(2)
12	a)	“Organization Climate has an impact on productivity”- Justify the statement.	CO2	(4)
	b)	Narrate the importance of Cross-Cultural management	CO2	(2)

	c)	As a new employee being appointed to the organization how will you manage the stress in the hectic job?	CO2	(2)
		Module 3		
13	a)	Explain the Two Factor Theory of Motivation Compare it with Vroom's Expectancy Theory	CO3	(3)
	b)	Explain the factors influencing Perceptual process	CO3	(3)
	c)	List and explain the Traits of good Leader	CO3	(2)
14	a)	Describe the theories of leadership	CO3	(4)
	b)	Sources of Organizational Conflict- Explain	CO3	(2)
	c)	Narrate the ethics of Power and Politics in Organizations	CO3	(2)
		Module 4		
15	a)	Distinguish downward and upward communication	CO4	(3)
	b)	Differentiate Interpersonal communication and Group communication in an organization	CO4	(2)
	c)	How does the communication influence organization effectiveness	CO4	(3)
16	a)	Illustrate the Modern forms of business communication	CO4	(2)
	b)	What are the Choices of Communication Channel	CO4	(2)
	c)	How will you set Cross functional communication in an organization	CO4	(4)

SEMESTER S8

MAJOR PROJECT-PHASE II

Course Code	25MRP806	CIE Marks	100
Teaching Hours/Week (L: T:P: R)	0:0:0:8	ESE Marks	-
Credits	4	Exam Hours	-
Prerequisites (if any)	None	Course Type	Project

Preamble

The course 'Project Work' is mainly intended to evoke the innovation and invention skills in a student. The course will provide an opportunity to synthesize and apply the knowledge and analytical skills learned, to be developed as a prototype or simulation. The project extends to 2 semesters and will be evaluated in the 7th and 8th semester separately, based on the achieved objectives. One third of the project credits shall be completed in 7th semester and two third in 8th semester. It is recommended that the projects may be finalized in the thrust areas of the respective engineering stream or as interdisciplinary projects. Importance should be given to address societal problems and developing indigenous technologies.

Course Objectives

- To apply engineering knowledge in practical problem solving.
- To foster innovation in design of products, processes or systems.
- To develop creative thinking in finding viable solutions to engineering problems.

Course Outcomes [COs]

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

CO1	Model and solve real world problems by applying knowledge across domains (Cognitive knowledge level: Apply).
CO2	Develop products, processes or technologies for sustainable and socially relevant applications (Cognitive knowledge level: Apply).
CO3	Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks (Cognitive knowledge level: Apply).
CO4	Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms (Cognitive knowledge level: Apply).
CO5	Identify technology/research gaps and propose innovative/creative solutions (Cognitive knowledge level: Analyze).
CO6	Organize and communicate technical and scientific findings effectively in written and oral forms (Cognitive knowledge level: Apply).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	2	1	2	2	1	1	1	1	2
CO2	2	2	2		1	3	1	1		1	1
CO3								3	2	2	1
CO4					2		3	2	2	3	2
CO5	2	3	3	1	2						1
CO6					2		2	2	3	1	1

MAJOR PROJECT PHASE II
Phase 2 Targets

- In depth study of the topic assigned in the light of the report prepared under Phase - I;
- Review and finalization of the approach to the problem relating to the assigned topic.
- Preparing a detailed action plan for conducting the investigation, including teamwork.
- Detailed Analysis/ Modeling / Simulation/ Design/ Problem Solving/Experiment as needed.
- Final development of product/ process, testing, results, conclusions and future directions.
- Preparing a paper for Conference Presentation/ Publication in Journals, if possible.
- Presenting projects in Project Expos conducted by the University at the cluster level and/ or state level as well as others conducted in India and abroad.
- Filing Intellectual Property Rights (IPR) if applicable.
- Preparing a report in the standard format for being evaluated by the Department Assessment Board.
- Final project presentation and viva voce by the assessment board including the external expert.

Evaluation Guidelines & Rubrics

Total: 100 marks (Minimum required to pass: 50 marks).

- Project progress evaluation by guide: 20 Marks.
- Two interim evaluations by the Evaluation Committee: 30 Marks (15 marks for each evaluation).
- Final evaluation by the Final Evaluation committee: 30 Marks
- Quality of the report evaluated by the evaluation committee: 20 Marks

(The evaluation committee comprises HoD or a senior faculty member, Project coordinator and project supervisor. The final evaluation committee comprises Project coordinator, expert from Industry/research/academic Institute and a senior faculty from a sister department).

Evaluation by the Guide

The guide/supervisor must monitor the progress being carried out by the project groups on regular basis. In case it

is found that progress is unsatisfactory it should be reported to the Department Evaluation Committee for necessary action. The presence of each student in the group and their involvement in all stages of execution of the project shall be ensured by the guide. Project evaluation by the guide: 20 Marks. This mark shall be awarded to the students in his/her group by considering the following aspects:

Project Scheduling & Distribution of Work among Team members: Detailed and extensive Scheduling with timelines provided for each phase of project. Work breakdown structure well defined. (3)

Literature survey: Outstanding investigation in all aspects. (3)

Student's Diary/ Daily Log: The main purpose of writing daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students' thought process and reasoning abilities. The students should record in the daily/weekly activity diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students. The daily/weekly activity diary shall be signed after every day/week by the guide. (4)

Individual Contribution: The contribution of each student at various stages. (5)

Completion of the project: The students should demonstrate the project to their respective guide. The guide shall verify the results and see that the objectives are met. (5)

EVALUATION RUBRICS for PROJECT Phase II: Interim Evaluation – 1

No.	Parameters	Marks	Poor	Fair	Very Good	Outstanding
2-a	Novelty of idea, and Implementation scope [CO5] [Group Evaluation]	3	The project is not addressing any useful requirement. The idea is evolved into a non-implementable one. The work presented so far is lacking any amount of original work by the team.	Some of the aspects of the proposed idea can be implemented. There is still lack of originality in the work done so far by the team. The project is a regularly done theme/topic without any freshness in terms of specifications, features, and/or improvements.	Good evidence of an implementable project. There is some evidence for the originality of the work done by the team. There is fresh specifications/features/improvements suggested by the team. The team is doing a design from fundamental principles, and there is some independent learning and engineering ingenuity.	The project has evolved into incorporating an outstandingly novel idea. Original work which is not yet reported anywhere else. Evidence for ingenious way of innovation which is also Implementable. Could be a patentable / publishable work.
			(0–0.6 Marks)	(1.2–1.8 Marks)	(2.4 Marks)	(3 Marks)
2-b	Effectiveness of task distribution among team members. [CO3] [Group Evaluation]	3	No task distribution of any kind. Members are still having no clue on what to do.	Task allocation done, but not effectively, some members do not have any idea of the tasks assigned. Some of the tasks were identified but not followed individually well.	Good evidence of task allocation being done, supported by project journal entries, identification of tasks through discussion etc. However, the task distribution seems to be skewed, and depends a few members heavily than others. Mostly the tasks are being followed by the individual members.	Excellent display of task identification and distribution backed by documentary evidence of team brainstorming, and project journal entries. All members are allocated tasks according to their capabilities, and as much as possible in an equal manner. The individual members are following the tasks in an excellent manner.
			(0–0.6 Marks)	(1.2–1.8 Marks)	(2.4 Marks)	(3 Marks)
	Adherence to		Little or no evidence of continued planning or scheduling of the project. The students did not stick	There is some improvement in the primary plan prepared during phase I. There were some ideas on the materials	Good evidence of planning done and being followed up to a good extent after phase I.	Excellent evidence of enterprising and extensive project planning and follow-up since phase I. Continued use of project management/version control

2-c	project schedule. [CO4] [Group Evaluation]	3	to the plan what they were going to build nor plan on what materials / resources to use in the project. The students do not have any idea on the budget required even after the end of phase - I. No project journal kept or the journal.	/resources required, but not really thought out. The students have some idea on the finances required, but they have not formalized a budget plan. Schedules were not prepared. The project journal has no useful details on the project.	Materials were listed and thought out, but the plan wasn't followed completely. Schedules were prepared, but not detailed, and needs improvement. Project journal is presented but it is neither complete nor updated regularly.	tool to track the project. Material procurement if applicable is progressing well. Tasks are updated and incorporated in the schedule. A well-kept project journal showed evidence for all the above, in addition to the interaction with the project guide.
			(0–0.6 Marks)	(1.2–1.8 Marks)	(2.4 Marks)	(3 Marks)

2-d	Interim Results. [CO6] [Group assessment]	3	There are no interim results to show.	The team showed some interim results, but they are not complete / consistent to the current stage, Some corrections are needed.	The interim results showed were good and mostly consistent/correct with respect to the current stage. There is room for improvement.	There were significant interim results presented which clearly shows the progress.
			(0–0.6 Marks)	(1.2–1.8 Marks)	(2.4 Marks)	(3 Marks)
2-e	Presentation [Individual assessment]	3	Very poor presentation and there are no interim results. The student has no idea about the project proposal.	The presentation is average, and the student has only a feeble idea about the team work.	Good presentation. Student has good idea about the team's project. The overall presentation quality is good.	Exceptionally good presentation. Student has excellent grasp of the project. The quality of presentation is outstanding.
			(0–0.6 Marks)	(1.2–1.8 Marks)	(2.4 Marks)	(3 Marks)
Phase-II Interim Evaluation - 1 Total Marks: 15						

EVALUATION RUBRICS for PROJECT Phase II: Interim Evaluation – 2						
No	Parameters	Marks	Poor	Fair	Very Good	Outstanding
2-f	Application of engineering knowledge [CO1] [Individual Assessment]	6	The student does not show any evidence of applying engineering knowledge on the design and the methodology adopted. The student's contribution in application of engineering knowledge in the project is poor.	The student appears to apply some basic knowledge, but not able to show the design procedure and the methodologies adopted in a comprehensive manner.	The student is able to show some evidence of application of engineering knowledge in the design and development of the project to a good extent.	Excellent knowledge in design procedure and its adaptation. The student is able to apply knowledge from engineering domains to the problem and develop solutions.
			(0 – 1 Marks)	(2 – 3 Marks)	(5 Marks)	(6 Marks)
2-g	Involvement of individual members [CO3] [Individual Assessment]	3	No evidence of any Individual participation in the project work.	There is evidence for some amount of individual contribution, but is limited to some of the superficial tasks.	The individual contribution is evident. The student has a good amount of involvement in core activities of the project.	Evidence available for the student acting as the core technical lead and has excellent contribution to the project.
			(0–0.6 Marks)	(1.2–1.8 Marks)	(2.4 Marks)	(3 Marks)
2-h	Results and inferences upon execution [CO5] [Group Assessment]	3	None of the expected outcomes are achieved yet. The team is unable to derive any inferences on the failures/issues observed. Any kind of observations or studies are not made.	Only a few of the expected outcomes are achieved. A few inferences are made on the observed failures/issues. No further work suggested.	Many of the expected outcomes are achieved. Many observations and inferences are made, and attempts to identify the issues are done. Some suggestions are made for further work.	Most of the stated outcomes are met. Extensive studies are done and inferences drawn. Most of the failures are addressed and solutions suggested. Clear and valid suggestions made for further work.
			(0–0.6 Marks)	(1.2–1.8 Marks)	(2.4 Marks)	(3 Marks)

2-i	Documentati on and presentation. .[CO6] [Individual assessment]	3	The individual student has no idea on the presentation of his/her part. The presentation is of poor quality.	Presentation's overall quality needs to be improved.	The individual's presentation performance is satisfactory.	The individual's presentation is done professionally and with great clarity. The individual's performance is excellent.
			(0–0.6 Marks)	(1.2–1.8 Marks)	(2.4 Marks)	(3 Marks)
Phase-II Interim Evaluation - 2 Total Marks: 15						

EVALUATION RUBRICS for PROJECT Phase II: Final Evaluation						
No	Parameters	Marks	Poor	Fair	Very Good	Outstanding
2-j	Engineering knowledge. [CO1] [Group Assessment]	7	The team does not show any evidence of applying engineering knowledge on the design and the methodology adopted.	The team is able to show some of the design procedures and the methodologies adopted, but not in a comprehensive manner.	The team is able to show evidence of application of engineering knowledge in the design and development of the project to a good extent. There is scope for improvement.	Excellent knowledge in design procedure and its adaptation. The team is able to apply knowledge from engineering domains to the problem and develop an excellent solution.
			(0 – 1 Marks)	(3 – 4 Marks)	(6 Marks)	(7 Marks)
2-k	Relevance of the project with respect to societal and/or industrial needs. [Group Assessment] [CO2]	4	The project as a whole does not have any societal / industrial relevance at all.	The project has some relevance with respect to social and/or industrial application. The team has however made not much effort to explore further and make it better.	The project is relevant to society and/or industry. The team is mostly successful in translating the problem into an engineering specification and managed to solve much of it.	The project is exceptionally relevant to society and/or industry. The team has made outstanding contributions while solving the problem in a professional and/ or ethical manner.
			(0 - 1 Marks)	(2 Marks)	(3 Marks)	(4 Marks)

2-i	Innovation / novelty / Creativity [CO5] [Group Assessment]	4	The project is not addressing any useful requirement. The idea evolved into a non-implementable one. The work presented so far is lacking any amount of original work by the team.	Some of the aspects of the proposed idea appear to be practical. There is still a lack of originality in the work done. The project is a regularly done theme/topic without any freshness in terms of specifications, features, and/ or improvements.	Good evidence of an implementable project. There is some evidence for the originality of the work done by the team. There are fresh specifications/features/improvements suggested by the team. The team is doing a design from fundamental principles, and there is some independent learning and engineering ingenuity. Could be translated into a product / process if more work is done.	The project has evolved into incorporating an outstandingly novel idea. Original work which is not yet reported anywhere else. Evidence for ingenious ways of innovation which are also Implementable. Could be a patentable publishable work.
			(0 - 1 Marks)	(2 Marks)	(3 Marks)	(4 Marks)
2-m	Quality of results / conclusions / solutions. [CO1] [Group Assessment]	7	None of the expected outcomes are achieved. The team is unable to derive any inferences on the failures/issues observed. Any kind of observations or studies are not made.	Only a few of the expected outcomes are achieved. A few inferences are made on the observed failures/issues. No further work suggested.	Many of the expected outcomes are achieved. Many observations and inferences are made, and attempts to identify the issues are done. Some suggestions are made for further work.	Most of the stated outcomes are met. Extensive studies are done and inferences drawn. Most of the failures are addressed and solutions suggested. Clear and valid suggestions made for further work.
			(0 – 1 Marks)	(3 – 4 Marks)	(6 Marks)	(7 Marks)

2-n	Presentation - Part I Preparation of slides. [CO6] [Group Assessment].	4	The presentation slides are shallow and in a clumsy format. It does not follow proper organization.	Presentation slides follow professional style formats to some extent. However, its organization is not very good. Language needs to be improved. All references are not cited properly, or acknowledged. Presentation slides need to be more professional.	Presentation slides follow a good style format and there are only a few issues. The organization of the slides is good. Most of the references are cited properly. The flow is good and the team presentation is neatly organized. Some of the results are not clearly shown. There is room for improvement.	The presentation slides are exceptionally good. Neatly organized. All references cited properly. Diagrams/Figures, Tables and equations are properly numbered, and listed. Results/inferences clearly highlighted and readable.
			(0 - 1 Marks)	(2 Marks)	(3 Marks)	(4 Marks)
	Presentation - Part II: Individual Communication [CO6] [Individual Assessment].	4	The student is not communicating properly. Poor response to questions.	The student is able to explain some of the content. The student requires a lot of prompts to get to the idea. There are language issues.	Good presentation/communication by the student. The student is able to explain most of the content very well. There are however, a few areas where the student shows lack of preparation. Language is better.	Clear and concise communication exhibited by the student. The presentation is outstanding. Very confident and tackles all the questions without hesitation. Exceptional traits of communicator.
			(0 - 1 Marks)	(2 Marks)	(3 Marks)	(4 Marks)
Phase-II Final Evaluation, Marks: 30						
EVALUATION RUBRICS for PROJECT Phase II: Report Evaluation						
Sl. No.	Parameters	Marks	Poor	Fair	Very Good	Outstanding

2-o	Report [CO6]	20	The prepared report is shallow and not as per standard format. It does not follow proper organization. Contains mostly unacknowledged content. Lack of effort in preparation is evident. References are not cited. Unprofessional and inconsistent formatting.	The project report follows the standard format to some extent. However, its organization is not very good. Language needs to be improved. All references are not cited properly in the report. There is a lack of formatting consistency.	The project report shows evidence of systematic documentation. The report is mostly following the standard style format and there are only a few issues. The organization of the report is good. Mostly consistently formatted. Most of the references/sources are cited/ acknowledged properly.	The report is exceptionally good. Neatly organized. All references cited properly. Diagrams/Figures, Tables and equations are properly numbered, and listed and clearly shown. Language is excellent and follows professional styles. Consistent formatting and exceptional readability.
			(0 - 7 Marks)	(8 - 12 Marks)	(13 - 19 Marks)	(20 Marks)
Phase - II Project Report Marks: 20						

