HERITAGE INSTITUTE OF TECHNOLOGY

(An Autonomous Institution affiliated to MAKAUT, West Bengal)

DEPARTMENT

OF

MECHANICAL ENGINEERING

B.TECH. PROGRAMME

Curriculum and Detailed Syllabus

Release Version 1: JULY 2023

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(Applicable from 2023 admitted batch)

Table of Contents

1. Preamble ……. 3
2. Institutional Vision and Mission …… 4
3. Departmental Vision and Mission ……..... 4
4. Program Educational Objectives (PEO) of ME Department ……..... 5
5. Program Outcomes (POs) and Program Specific Outcomes (PSOs) of ME Department 6 - 7
6. Credit Summary …… 8
7. Curriculum Structure …… 9 - 17
8. Detailed Curriculum …… 18–143
9. APPENDIX – A …… 144
10. APPENDIX – B…… 146

Preamble

The new curriculum 2023 of B Tech in Mechanical Engineering has been restructured as per the model curriculum (2023) of AICTE and has been implemented from the academic session 2023 - 24. The revision has been effected after 5 batches under previous curriculum. While framing the curriculum/detailed syllabi, due care has been taken for incorporating the feedback of different stake holders and requirements laid down by NBA. The curricula of other eminent institute/universities were also taken as reference. The curriculum has been enriched by the inclusion of a number of new papers. Examples are 'Product Innovation and Entrepreneurship', 'Mechatronics, Robotics and Control' both theory and laboratory, all of which have been included as compulsory papers. 'Sports and Yoga', 'Design Thinking and Idea Lab' have been incorporated as per AICTE recommendation. Students will be encouraged to develop professional skill in the selected area of their choice by exercising options for newly included professional core papers like ' Mechanical Vibration' and 'Design for Manufacturing and Assembly'. 'Programming for Engineering Applications' will provide them a platform in MATLAB/PYTHON to gain expertise in solving engineering problems. Apart from these, all honours papers have been included as those from 'MOOCS' platform and the students will also be encouraged to take up courses in foreign languages which will be an added advantage in gaining opportunity for higher studies. Some of the regular courses in conventional field like Fluid Mechanics, Thermal engineering, Design and manufacturing have been retained in order to create a proper mix. Paper codes have also been changed from 'MECH xxxx' to 'MECxxxx' in order that a distinction between the papers from old curriculum and new curriculum can be made as there will be a period of parallel running. Before finalising the curriculum/syllabus, long discussions were held in BOS meetings with representation form academics, industry, alumni etc and thus the same was made ready.

Institutional Vision & Mission

VISION:

To prepare dynamic and caring citizens to meet the challenges of global society while retaining their traditional values.

MISSION:

- To prepare students with strong foundation in their disciplines and other areas of learning.
- To provide an environment for critical and innovative thinking, and to encourage life-long learning.
- To develop entrepreneurial and professional skills.
- To promote research and developmental activities and interaction with industry.
- To inculcate leadership qualities for serving the society.

Departmental Vision & Mission

VISION:

To prepare innovative, dynamic and responsible mechanical engineers who will contribute to national and international development while retaining their professional ethics and traditional values.

MISSION:

M1: To prepare mechanical engineers with sound skill and knowledge through a well-balanced curriculum.

M2: To enable free exchange of innovative ideas between teachers and students by creating a conducive environment.

M3: To motivate and foster inquisitiveness and entrepreneurial ideas in the mind of students through industry visits, internships and workshops.

M4: To inculcate qualities of team work, leadership, professional ethics and safety practices by group work activities.

Program Educational Objectives (PEOs) of B.Tech. in Mechanical Engineering Programme

Within 4-5 years of graduating from the B.Tech (Mechanical Engineering) programme of Heritage Institute of Technology, the students will.

PEO1. Prove themselves to be successful professionals in different industries in both private and public sectors in India/abroad.

PEO2. Be in a process of acquiring higher educational qualifications or be engaged in teaching/research activities.

PEO3. Exhibit qualities of team work, leadership and entrepreneurship.

Program Outcomes (POs)

Engineering Graduates will be able to:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs) of B.Tech. in Mechanical Engineering Programme

PSO1. Analysis, planning and management: Employ the knowledge of mechanical engineering to analyse, plan and manage an engineering activity.

PSO2. Design mechanical products and systems: Apply the knowledge of relevant fields of mechanical engineering to design products and systems.

PSO3. Manufacturing products: Select suitable materials, processes, and parameters for manufacturing quality products at competitive costs.

Credit Summary for B Tech programmes in Mechanical Engineering with effect from 2023-2024

Sl. No.	Course Type	Credit ME
1.	Humanities and Social Sciences including Management Courses	12
2.	Basic Science Courses	23
3.	Engineering Science Courses including Workshop, Drawing, Basics of Electrical / Mechanical / Computer, etc.	28.5
4.	Professional Core Courses	56.5
5.	Professional Elective Courses relevant to chosen Specialization / Branch	14
6.	Open Subjects – Electives from other Technical and/or Emerging Subjects	12
7.	Project Work, Seminar and Internship in industry or elsewhere	17
8.	Mandatory Courses (Non-credit) [Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Traditional Knowledge]	(NON-CREDIT)
	Total	**163**
9	Honours Courses (MOOCS or otherwise)	20
	Grand Total	**183**

Definition of Credit (as per National Credit Framework 2022):

- Total notional learning hours = 1200 Hours/ Year
- Minimum credits to be earned = 40/ Year
- 1 Credit = 30 notional learning hours

Range of Credits (as per AICTE):

- A student will be eligible to get B Tech degree with Honours if he/she completes an additional 20 credit points.
- These could be acquired through MOOCs. For details kindly refer to APPENDIX – A.
- A student will be eligible to get B.Tech. degree certificate, if he/ she acquires 100 MAR points in 4 years of their study.
- Lateral entry students must acquire 75 MAR points in their 3 years of study.
- For details kindly refer to APPENDIX – B.

Curriculum

1st Year 1st Semester

A. Theory							
Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
1	MTH1101	Mathematics-I	3	1	0	4	4
2	CHM1001	Chemistry I	3	0	0	3	3
3	CSE1001	Programming for Problem Solving	4	0	0	4	4
4	ELE1001	Basic Electrical Engineering	3	1	0	4	4
5	HUM1001	English for Technical Writing	2	0	0	2	2
Total Theory			**15**	**2**	**0**	**17**	**17**
B. Practical							
1	CHM1051	Chemistry I Laboratory	0	0	2	2	1
2	CSE1051	Programming for Problem Solving Laboratory	0	0	3	3	1.5
3	ELE1051	Basic Electrical Engineering Laboratory	0	0	2	2	1
4	HUM1051	English for Technical Writing Laboratory	0	0	2	2	1
Total Practical			**0**	**0**	**9**	**9**	**4.5**
Total of Semester			**15**	**2**	**9**	**26**	**21.5**

1st Year 2nd Semester

A. Theory							
Sl.	**Code**	**Subject**	**Contacts Periods/ Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	PHY1001	Physics I	3	0	0	3	3
2	MTH1201	Mathematics II	3	1	0	4	4
3	ECE1001	Introduction to Electronic Devices and Circuits	3	0	0	3	3
4	HUM1002	Universal Human Values and Professional Ethics	2	1	0	3	3
5	MEC1216	Sports and Yoga	2	0	0	2	0
Total Theory			**13**	**2**	**0**	**13**	**13**
B. Practical							
1	PHY1051	Physics I Laboratory	0	0	2	2	1
2	ECE1051	Introduction to Electronic Devices and Circuits Laboratory	0	0	2	2	1
3	MEC1051	Workshop/ Manufacturing Practices	1	0	3	4	2.5
4	MEC1052	Engineering Graphics & Design	1	0	3	4	2.5
Total Practical			**2**	**0**	10	12	7
Total of Semester			**13**	**2**	10	**25**	**20**

2nd Year 1st Semester

A. Theory							
Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
1	PHY2101	Physics – II	3	0	0	3	3
2	MTH2001	Mathematical Methods	3	1	0	4	4
3	MEC2101	Engineering Mechanics	3	1	0	4	4
4	MEC2102	Fluid Mechanics & Hydraulics	3	0	0	3	3
5	MEC2103	Engineering Thermodynamics	3	1	0	4	4
6	EVS2016	Environmental Science	2	0	0	2	0
Total Theory			**17**	**3**	**0**	**20**	**18**
B. Practical							
1	MEC2151	Machine Drawing Lab	0	0	3	3	1.5
2	MEC2152	Workshop Practice-II	0	0	3	3	1.5
3	MEC2153	Design Thinking and Idea Lab(ME)	0	0	2	2	1
Total Practical			**0**	**0**	**8**	**8**	**4**
Total of Semester			**17**	**3**	**8**	**28**	**22**

2nd Year 2nd Semester

A. Theory							
Sl.	**Code**	**Subject**	**Contacts Periods/ Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	MEC2201	Mechanics of Deformable Bodies	3	1	0	4	4
2	MEC2202	Fluid Machinery	3	0	0	3	3
3	MEC2203	Engineering Materials	3	0	0	3	3
4	MEC2204	Manufacturing Processes	3	0	0	3	3
5	MEC2205	Kinematics & Dynamics of Machines	3	1	0	4	4
6	MEC2206	Measurement and Metrology	3	0	0	3	3
Total Theory			**18**	**2**	**0**	**20**	**20**
B. Practical							
1	MEC2251	Material Testing Lab	0	0	3	3	1.5
2	MEC2252	Fluid Mechanics & Hydraulic Machines Lab	0	0	3	3	1.5
3	MEC2253	Measurement and Metrology Lab	0	0	2	2	1
Total Practical			**0**	**0**	**8**	**8**	**4**
Total of Semester			**18**	**2**	**8**	**28**	**24**

3rd Year 1st Semester

A. Theory							
Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
1	MEC3101	Machine Elements & System Design	3	0	0	3	3
2	MEC3102	Heat Transfer	4	0	0	4	4
3	MEC3103	Mechatronics, Robotics & Control	3	0	0	3	3
4	MEC3131- MEC3134	Professional Elective-I	3	0	0	3	3
	MEC3131 MEC3132 MEC3133 MEC3134	Refrigeration & HVA Electrical Machines Data Structure & RDBMS Programming for Engineering Applications					
5	MEC3141- MEC3145	Professional Elective-II	3	0	0	3	3
	MEC3141 MEC3142 MEC3143 MEC3144 MEC3145	Mechanical Vibration Turbo Machinery Aerodynamics Power Plant Engineering Design for Manufacturing & Assembly					
6	****	Open Elective-I (Emerging Field)	3	0	0	3	3
	MEC3121 MEC3122 MEC3123 MEC3124 CHE3122	Additive Manufacturing Computational Methods in Engineering Total Quality Management Industrial Engineering Industrial Safety and Hazards					
7	INC3016	Indian Constitution and Civil Society	2	0	0	2	0
Total Theory			**21**	**0**	**0**	**21**	**19**
B. Practical							
1	MEC3152	Thermodynamics & Heat Transfer Lab	0	0	2	2	1
2	MEC3153	Mechatronics, Robotics & Control Lab	0	0	2	2	1
3	MEC3155	Dynamics of Machines Lab	0	0	2	2	1
4	MEC3161- MEC3164	Professional Elective - I LAB	0	0	3	3	1.5
	MEC3161 MEC3162 MEC3163 MEC3164	Refrigeration & HVA Lab Electrical Machines Lab RDBMS Lab Programming for Engineering Applications Lab					
Total Practical			**0**	**0**	**8**	**8**	**4**
Total of Semester			**21**	**0**	**8**	**29**	**23**

3rd Year 2nd Semester

Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
A. Theory							
1	HUM3201	Economics for Engineers	3	0	0	3	3
2	MEC3201	Computer Aided Design & Analysis	3	0	0	3	3
3	MEC3202	Manufacturing & Automation	3	0	0	3	3
4	MEC3203	Product Innovation and Entrepreneurship	3	0	0	3	3
5	MEC3231 - MEC3233	Professional Elective - III	3	0	0	3	3
	MEC3231 MEC3232 MEC3233	Finite Element Method Computational Fluid Dynamics Renewable Energy Technology					
6	*****	Open Elective-II	3	0	0	3	3
	MEC3221 CIV3221 HUM3221	Optimization Techniques Project Planning and Management Elementary Spanish for Beginners					
Total Theory			**18**	**0**	**0**	**18**	**18**
B. Practical							
1	MEC3257	Computer Aided Design & Analysis Lab	0	0	3	3	1.5
2	MEC3261 - MEC3263	Professional Elective–III Lab	0	0	2	2	1
	MEC3261 MEC3262 MEC3263	Finite Element Method Lab Computational Fluid Dynamics Lab Energy Laboratory					
Total Practical			**0**	**0**	**5**	**5**	**2.5**
C. Sessional							
1	MEC3293	Seminar	0	0	4	4	2
2	MEC3295	Project-I	0	0	4	4	2
Total Sessional			**0**	**0**	**8**	**8**	**4**
Total of Semester			**18**	**0**	**13**	**31**	**24.5**

4th Year 1st Semester

A. Theory							
Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
1	HUM4101	Principles of Management	3	0	0	3	3
2	MEC4131 - MEC4140	Professional Elective-IV	3	0	0	3	3
	MEC4131 MEC4132 MEC4133 MEC4134 MEC4135	Maintenance Engineering Materials Handling Operations Research Automobile Engineering IC Engine					
3	****	Open Elective-III	3	0	0	3	3
	MEC4121 MEC4122 CIV4121 CIV4222 HUM4221	Micro and Nano Manufacturing Advanced Welding Technology An introduction to Concrete Technology Construction Materials Introduction to Industrial Sociology					
	MEC4123 MEC4124 MEC4125	Mechanical Handling of Materials Engineering Computational Techniques Quantitative Decision Making					
4	****	Open Elective-IV	3	0	0	3	3
	BTC4126 BTC4127 BTC4128	Biology for Engineers Biosensor Bioenergy and other Non-conventional Energy					
	MEC4128 MEC4129 MEC4130	Quality Control & Management Engineering Ecology and Environmental Engineering Modern Manufacturing Technology					
Total Theory			**12**	**0**	**0**	**12**	**12**
B. Practical							
1	MEC4151	Manufacturing & Automation Lab	0	0	2	2	1
Total Practical			**0**	**0**	**2**	**2**	**1**

C. Sessional							
Sl.	**Code**	**Subject**	**Contacts Periods/ Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	MEC4191	Industrial Training / Summer Internship	**-**	**-**	**-**	**-**	**2**
2	MEC4195	Project-II	0	0	6	6	3
Total Sessional			**0**	**0**	**6**	**6**	**5**
Total of Semester			**12**	**0**	**8**	**20**	**18**

4th Year 2nd Semester

Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
1	MEC4256	Design of an Industrial Product	0	0	4	4	2
2	MEC4295	Project-III	0	0	14	14	7
3	MEC4297	Comprehensive Viva-voce	-	-	-	-	1
Total Sessional			**0**	**0**	**18**	**18**	**10**
Total of Semester			**0**	**0**	**18**	**18**	**10**

DETAILED SYLLABUS

1st Year

Course Title: Mathematics-I					
Course Code: MTH1101					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	1	0	4	4

Course Outcomes:

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

MTH1101.1: Apply the concept of rank of matrices to find the solution of a system of linear simultaneous equations.

MTH1101.2: Develop the concept of eigen values and eigen vectors.

MTH1101.3: Combine the concepts of gradient, curl, divergence, directional derivatives, line integrals, surface integrals and volume integrals.

MTH1101.4: Analyze the nature of sequence and infinite series

MTH1101.5: Choose proper method for finding solution of a specific differential equation.

MTH1101.6: Describe the concept of differentiation and integration for functions of several variables with their applications in vector calculus.

Module I: [10L] Matrix

Inverse and rank of a matrix; Elementary row and column operations over a matrix; System of linear equations and its consistency; Symmetric, skew symmetric and orthogonal matrices; Determinants; Eigen values and eigen vectors; Diagonalization of matrices; Cayley Hamilton theorem; Orthogonal transformation.

Module II: [10L]

Vector Calculus:

Vector function of a scalar variable, Differentiation of a vector function, Scalar and vector point functions, Gradient of a scalar point function, divergence and curl of a vector point function, Directional derivative, and related problems on these topics.

Infinite Series:

Convergence of sequence and series; Tests for convergence: Comparison test, Cauchy's Root test, D' Alembert's Ratio test(statements and related problems on these tests), Raabe's test; Alternating series; Leibnitz's Test (statement, definition); Absolute convergence and Conditional convergence.

Module III: [10L]

First order ordinary differential equations:

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Ordinary differential equations of higher orders:

General linear ODE of order two with constant coefficients, C.F. & P.I., D-operator methods, Method of variation of parameters, Cauchy-Euler equations.

Module IV: [10L]

Calculus of functions of several variables:

Introduction to functions of several variables with examples, Knowledge of limit and continuity, Determination of partial derivatives of higher orders with examples, Homogeneous functions and Euler's theorem and related problems up to three variables,

Multiple Integration:

Concept of line integrals, Double and triple integrals. Green's Theorem, Stokes Theorem and Gauss Divergence Theorem;

Text Books

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2000.
2. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2006.
3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
5. K. F. Riley, M. P. Hobson, S. J. Bence. Mathematical Methods for Physics and Engineering, Cambridge University Press, 23-Mar-2006.
6. S. L. Ross, Differential Equations, Wiley India, 1984.
7. G.F. Simmons and S.G. Krantz, Differential Equations, McGraw Hill, 2007.
8. Vector Analysis (Schaum's outline series): M.R. Spiegel, Seymour Lipschutz, Dennis Spellman (McGraw Hill Education)
9. Engineering Mathematics: S. S. Sastry (PHI)
10. Advanced Engineering Mathematics: M.C. Potter, J.L. Goldberg and E.F. Abonfadel (OUP), Indian Edition.
11. Linear Algebra (Schaum's outline series): Seymour Lipschutz, Marc Lipson (McGraw Hill Education)

Course Title : Chemistry I					
Course Code : CHM1001					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

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

CHM1001.1: Knowledge of understanding the operating principles and reaction involved in batteries and fuel cells and their application in automobiles as well as other sectors to reduce environmental pollution.

CHM1001.2: An ability to design and conduct experiments, as well as to organize, analyzes, and interprets data.

CHM1001.3: An ability to analyze microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces for engineering applications.

CHM1001.4: Have knowledge of synthesizing nano materials and their applications in industry, carbon nano tube technology is used in every industry now-a-days.

CHM1001.5: Understanding of bulk properties and processes using thermodynamic considerations.

CHM1001.6: Elementary knowledge of IR, UV, NMR and X-ray spectroscopy is usable in structure elucidation and characterisation of various molecules. Knowledge of electronic effect and stereochemistry for understanding mechanism of the major chemical reactions involved in synthesis of various drug molecules.

Module I: [10L]

Atomic structure and Wave Mechanics:
Brief outline of the atomic structure, Duel character of electron, De Broglies's equation, the Heisenberg uncertainty principle, brief introduction of quantum mechanics, the Schrodinger wave equation, Hermitian operator, solution of the Schrodinger equation for particle in a one dimensional box, interpretation of the wave function Ψ, concept of atomic orbital.

Thermodynamics:
Carnot cycle, 2nd law of thermodynamics, entropy, Clausius inequality, free energy and work function, Clausius Clapeyron Equation, Chemical Potential, Activity and Activity coefficient. Gibbs Duhem Relation.

Spectroscopic Techniques & Application

Electromagnetic spectrum: EMR interaction with matter - absorption and emission of radiation. Principle and application of UV- visible and IR spectroscopy

Principles of NMR Spectroscopy and X-ray diffraction technique.

Module II: [10L]

Chemical Bonding

Covalent bond, VSEPR Theory, hybridization, molecular geometries, Dipole moment, Intermolecular forces, V.B. and M.O. theory and its application in Homo and Heteronuclear diatomic molecules, Band theory of solids, Pi- molecular orbital of ethylene and butadiene.

Periodicity

Effective nuclear charge, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electro-negativity, inert pair effect.

Ionic Equilibrium

Acid Base Equilibrium, Salt Hydrolysis and Henderson Equation, Buffer solutions, pH indicator, Common ion Effect, Solubility product, Fractional Precipitation .

Module III: [10L]

Conductance

Conductance of electrolytic solutions, Strong and Weak electrolytes, effect of temperature and concentration. Kohlrausch's law of independent migration of ions, transport numbers and hydration of ions. Application of conductance Acid-base and precipitation titration.

Electrochemical Cell

Thermodynamic derivation of Nernst equation, Electrode potential and its application to predict redox reaction; Standard Hydrogen Electrode, Reference electrode, cell configuration, half-cell reactions, evaluation of thermodynamic functions; Reversible and Irreversible cells; Electrochemical corrosion.

Electrochemical Energy Conversion: Primary & Secondary batteries, Fuel Cells.

Reaction dynamics

Rate Laws, Order & Molecularity; zero, first and second order kinetics. Pseudo-unimolecular reaction, Arrhenius equation.

Mechanism and theories of reaction rates (Transition state theory, Collision theory). Catalysis: Homogeneous catalysis (Definition, example, mechanism, kinetics).

Module IV: [10L]

Stereochemistry

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

Structure and reactivity of Organic molecule

Inductive effect, resonance, hyperconjugation, electromeric effect, carbocation, carbanion, free radicals, aromaticity.

Organic reactions and synthesis of drug molecule

Introduction to reaction mechanisms involving substitution, addition, elimination and oxidation-reduction reactions. Synthesis of commonly used drug molecules.

Text Books

1. Atkins' Physical Chemistry, P.W. Atkins (10th Edition)
2. Organic Chemistry, I. L. Finar, Vol-1 (6th Edition)
3. Engineering Chemistry, Jain & Jain,(16th Edition)
4. Fundamental Concepts of Inorganic Chemistry, A. K. Das, (2nd Edition)
5. Engineering Chemistry -I, Gourkrishna Dasmohapatra, (3rd Edition)

Reference Books

1. General & Inorganic Chemistry, R. P. Sarkar
2. Physical Chemistry, P. C. Rakshit, (7th Edition)
3. Organic Chemistry, Morrison & Boyd , (7th Edition)
4. Fundamentals of Molecular Spectroscopy, C.N. Banwell, (4th Edition)
5. Physical Chemistry , G. W. Castellan, (3rd Edition)
6. Basic Stereo chemistry of Organic Molecules, Subrata Sen Gupta, (1st Edition)

Course Title: Programming for Problem Solving					
Course Code: CSE1001					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	0	0	4	4

Course Outcomes:

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

CSE1001.1: Remember and understand the functionalities of the different hardware and software components present in a computer system, the standard representations of various types of data in a computer system.

CSE1001.2: Illustrate how a computer system with one way of representation can be converted to one another equivalent representation.

CSE1001.3: Construct flow charts for any arithmetic or logical problems in hand.

CSE1001.4: Remember and understand the C programming development environment, writing, compiling, debugging, linking and executing a C program using that development environment, basic syntax and semantics of C programming language and interpret the outcome of any given C program.

CSE1001.5: Use loop constructs, conditional branching, iteration, recursion to solve simple engineering problems.

CSE1001.6: Apply pointers, arrays, structures, files to formulate simple engineering problems.

Module I: [12L] Fundamentals of Computer

History of Computers, Generations of Computers, Classification of Computers.

Basic Anatomy of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices. Basic Concepts of Assembly language, High level language, Compiler and Assembler.

Binary & Allied number systems (decimal, octal and hexadecimal) with signed and unsigned numbers (using 1's and 2's complement) - their representation, conversion and arithmetic operations. Packed and unpacked BCD system, ASCII.IEEE-754 floating point representation (half- 16 bit, full- 32 bit, double- 64 bit).

Basic concepts of operating systems like MS WINDOWS, LINUX How to write algorithms & draw flow charts.

Module II: [12L] Basic Concepts of C

C Fundamentals:

The C character set identifiers and keywords, data type & sizes, variable names, declaration, statements. Operators & Expressions:

Arithmetic operators, relational and logical operators, type, conversion, increment and decrement operators, bit wise operators, assignment operators and expressions, precedence and order of evaluation. Standard input and output, formatted output -- printf, formatted input scanf.

Flow of Control:

Statement and blocks, if-else, switch-case, loops (while, for, do-while), break and continue, go to and labels.

Module III: [12L] Program Structures in C

Basic of functions, function prototypes, functions returning values, functions not returning values. Storage classes -

auto, external, static and register variables – comparison between them. Scope, longevity and visibility of variables.Cpreprocessor (macro, header files), command line arguments.

Arrays and Pointers:

One dimensional arrays, pointers and functions – call by value and call by reference, array of arrays. Dynamic memory usage– using malloc(), calloc(), free(), realloc(). Array pointer duality.

String and character arrays; C library string functions and their use.

Module IV: [12L] Data Handling in C

User defined data types and files:

Basic of structures; structures and functions; arrays of structures.

Files – text files only, modes of operation. File related functions – fopen(), fclose(), fscanf(), fprintf(), fgets(), fputs(), fseek(), ftell();

Text Books

1. Schaum's outline of Programming with C – Byron Gottfried
2. Teach Yourself C- Herbert Schildt
3. Programming in ANSI C – E Balagurusamy

Reference Books

1. C: The Complete Reference – Herbert Schildt
2. The C Programming Language- D.M.Ritchie, B.W. Kernighan

Course Title: Basic Electrical Engineering					
Course Code : ELE1001					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	1	0	4	4

Course Outcomes:

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

ELE1001.1: Analyse DC electrical circuits using KCL, KVL and network theorems like Superposition Theorem, Thevenin's Theorem, Norton's Theorem and Maximum Power Transfer Theorem.

ELE1001.2: Analyse DC Machines; Starters and speed control of DC motors.

ELE1001.3: Analyse magnetic circuits.

ELE1001.4: Analyse single and three phase AC circuits.

ELE1001.5: Analyse the operation of single phase transformers.

ELE1001.6: Analyse the operation of three phase induction motors.

Module-I: [11 L]

DC Network Theorem: Kirchhoff's laws, Nodal analysis, Mesh analysis, Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Star-Delta conversion.

Electromagnetism: Review of magnetic flux, Force on current carrying conductors, Magnetic circuit analysis, Self and Mutual inductance, B-H loop, Hysteresis and Eddy current loss, Lifting power of magnet.

Module-II [10L]

AC single phase system: Generation of alternating emf, Average value, RMS value, Form factor, Peak factor, representation of an alternating quantity by a phasor, phasor diagram, AC series, parallel and series-parallel circuits, Active power, Reactive power, Apparent power, power factor, Resonance in RLC series and parallel circuit.

Module-III [11 L]

Three phase system: Generation of three-phase AC power, Balanced three phase system, delta and star connection, relationship between line and phase quantities, phasor diagrams, power measurement by two wattmeter method.

DC Machines: Construction, EMF equation, Principle of operation of DC generator, Open circuit characteristics, External characteristics, Principle of operation of DC motor, speed-torque characteristics of shunt and series machine, starting of DC motor, speed control of DC motor.

Module-IV [10L]

Transformer: Construction, EMF equation, no load and on load operation and their phasor diagrams, Equivalent circuit, Regulation, losses of a transformer, Open and Short circuit tests, Efficiency, Introduction to three phase transformer.

Three-phase induction motor: Concept of rotating magnetic field, Principle of operation, Construction, Equivalent circuit and phasor diagram, torque-speed/slip characteristics, Starting of Induction Motor.

Text Books

1. Basic Electrical engineering, D.P Kothari & I.J Nagrath, TMH, Second Edition
2. Basic Electrical Engineering, V.N Mittle & Arvind Mittal, TMH, Second Edition
3. Basic Electrical Engineering, Hughes
4. Electrical Technology, Vol-I, Vol-II, Surinder Pal Bali, Pearson Publication
5. A Text Book of Electrical Technology, Vol. I & II, B.L. Theraja, A.K. Theraja, S. Chand & Company

Reference Books

1. Electrical Engineering Fundamentals, Vincent Del Toro, Prentice-Hall
2. Advance Electrical Technology, H. Cotton, Reem Publication
3. Basic Electrical Engineering, R.A. Natarajan, P.R. Babu, Sictech Publishers
4. Basic Electrical Engineering, N.K. Mondal, Dhanpat Rai
5. Basic Electrical Engineering, Nath & Chakraborti
6. Fundamental of Electrical Engineering, Rajendra Prasad, PHI, Edition 2005

Course Title : English for Technical Writing					
Course Code : HUM1001					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	2	0	0	2	2

Course Outcomes:

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

HUM1001.1: Communicate effectively in an official and formal environment

HUM1001.2: Use language as a tool to build bridges and develop interpersonal relations in multi-cultural environment

HUM1001.3: Use various techniques of communication for multiple requirements of globalized workplaces

HUM1001.4: Learn to articulate opinions and views with clarity.

HUM1001.5: Write business letters and reports.

HUM1001.6: Apply various communication strategies to achieve specific communication goals.

Module- I (6L)

Introduction to Phonology and Morphology

- Phonetics- Vowel and Consonant Sounds (Identification & Articulation)
- Word- stress, stress in connected speech
- Intonation (Falling and Rising Tone)
- Vocabulary Building-The concept of Word Formation

Module- II (6L)

Communication Skills

- The Basics of Business Communication- Process, types, levels
- Barriers to Communication Common obstacles to effective communication
- Approaches and Communication techniques for multiple needs at workplace: persuading, convincing, responding, resolving conflict, delivering bad news, making positive connections
- Identify common audiences and design techniques for communicating with each audience

Module- III (6L)

Organizational Communication

- Business Letters
- Organizational Communication: Agenda & minutes of a meeting, Notice, Memo, Circular
- Organizing e-mail messages, E-mail etiquette
- Techniques for writing precisely: Creating coherence, organizing principles –accuracy, clarity, brevity. Different styles of writing: descriptive, narrative, expository.

Module- IV (6L)

Principles, techniques and skills for professional writing

- Logic in writing, thinking and problem-solving; applying deductive and inductive reasoning; Use of infographics in writing.
- Report Writing: Importance and Purpose, Types of Reports, Report Formats, Structure of Formal Reports, Writing Strategies. Interpreting data and writing reports
- Writing proposals and Statement of purpose

Text Books

1 Kumar, S. & Lata, P. Communication Skills, OUP, New Delhi 2011

2 Rizvi, Ashraf, M. Effective Technical Communication, Mc Graw Hill Education(India) Pvt. Ltd.Chennai, 2018

3 Raman, M. and Sharma, S., Technical Communication: Principles and Practice, 2nd Ed., 2011

Reference Books

1. Professional Writing Skills, Chan, Janis Fisher and Diane Lutovich. San Anselmo, CA: Advanced Communication Designs.
2. Hauppauge, Geffner, Andrew P. Business English, New York: Barron's Educational Series.

Course Title : Chemistry I Laboratory					
Course Code : CHM1051					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

Course Outcomes:

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

CHM1051.1: Knowledge to estimate the hardness of water which is required to determine the usability of water used in industries.

CHM1051.2: Estimation of ions like Fe^{2+}, Cu^{2+} and Cl^{-} present in water sample to know the composition of industrial water.

CHM1051.3: Study of reaction dynamics to control the speed and yield of various manufactured goods produced in polymer, metallurgical and pharmaceutical industries.

CHM1051.4: Handling physico-chemical instruments like viscometer, stalagmometer, pH-meter, potentiometer and conductometer.

CHM1051.5: Understanding the miscibility of solutes in various solvents required in paint, emulsion, biochemical and material industries.

CHM1051.6: Knowledge of sampling water can be employed for water treatment to prepare pollution free water

List of Experiments:

1. Estimation of iron using KMnO4: self indicator.
2. Iodometric estimation of Cu^{2+}.
3. Determination of Viscosity.
4. Determination of surface tension.
5. Adsorption of acetic acid by charcoal.
6. Potentiometric determination of redox potentials.
7. Determination of total hardness and amount of calcium and magnesium separately in a given water sample.
8. Determination of the rate constant for acid catalyzed hydrolysis of ethylacetate.
9. Heterogeneous equilibrium (determination of partition coefficient of acetic acid in n-butanol and water mixture).

10. Conductometric titration for the determination of strength of a given HCl solution against a standard NaOH solution.
11. pH-metric titration for determination of strength of a given HCl solution against a standard NaOH solution.
12. Determination of chloride ion in a given water sample by Argentometric method (using chromate indicator solution)

Reference Books:

1. Vogel's Textbook of Quantitative Chemical Analysis-G. H. Jeffery, J. Bassett, J. Mendham, R. C. Denney.
2. Advanced Practical Chemistry- S. C. Das
3. Practicals in Physical Chemistry- P. S. Sindhu

Course Title: Programming for Problem Solving Lab					
Course Code: CSE1051					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	3	3	1.5

Course Outcomes:

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

CSE1051.1: To write simple programs relating to arithmetic and logical problems.

CSE1051.2: To be able to interpret, understand and debug syntax errors reported by the compiler.

CSE1051.3: To implement conditional branching, iteration (loops) and recursion.

CSE1051.4: To decompose a problem into modules (functions) and amalgamating the modules to generate a complete program.

CSE1051.5: To use arrays, pointers and structures effectively in writing programs.

CSE1051.6: To be able to create, read from and write into simple text files

List of Experiments:

Software to be used: GNU C Compiler (GCC) with LINUX NB: Cygwin (Windows based) may be used in place of LINUX

Topic 1: LINUX commands and LINUX based editors

Topic 2: Basic Problem Solving

Topic 3: Control Statements (if, if-else, if-elseif-else, switch-case)

Topic 4: Loops - Part I (for, while, do-while)

Topic 5: Loops - Part II

Topic 6: One Dimensional Array

Topic 7: Array of Arrays

Topic 8: Character Arrays/ Strings

Topic 9: Basics of C Functions

Topic 10: Recursive Functions

Topic 11: Pointers

Topic 12: Structures

Topic 13: File Handling Estimation of iron using KMnO4: self indicator.

Text Books

1 Schaum's outline of Programming with C – Byron Gottfried
2 Teach Yourself C- Herbert Schildt
3 Programming in ANSI C – E Balagurusamy

Course Title : Basic Electrical Engg. Laboratory					
Course Code : ELE1051					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

Course Outcomes:

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

ELE1051.1: Get an exposure to common electrical apparatus and their ratings.

ELE1051.2: Make electrical connections by wires of appropriate ratings.

ELE1051.3: Understand the application of common electrical measuring instruments.

ELE1051.4: Understand the basic characteristics of different electrical machines

List of Experiments:

1. Characteristics of Fluorescent lamps
2. Characteristics of Tungsten and Carbon filament lamps
3. Verification of Thevenin's & Norton's theorem.
4. Verification of Superposition theorem
5. Verification of Maximum Power Transfer theorem
6. Calibration of ammeter and voltmeter.
7. Open circuit and Short circuit test of a single phase Transformer.
8. Study of R-L-C Series / Parallel circuit
9. Starting and reversing of speed of a D.C. shunt Motor
10. Speed control of DC shunt motor.
11. No load characteristics of D.C shunt Generators
12. Measurement of power in a three phase circuit by two wattmeter method

Course Title : English for Technical Writing Laboratory					
Course Code : HUM1051					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

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

HUM1051.1: Communicate in an official and formal environment.

HUM1051.2: Effectively communicate in a group and engage in relevant discussion.

HUM1051.3: Engage in research and prepare presentations on selected topics.

HUM1051.4: Understand the dynamics of multicultural circumstances at workplace and act accordingly.

HUM1051.5: Organize content in an attempt to prepare official documents.

HUM1051.6: Appreciate the use of language to create beautiful expressions

Detailed Syllabus

Module- I (6 hrs.)

The Art of Speaking

- Techniques for Effective Speaking
- Voice Modulation: Developing correct tone
- Using correct stress patterns: word stress, primary stress, secondary stress. Rhythm in connected speech
- Encoding Meaning Using Nonverbal Symbols,
- How to Improve Body Language
- Eye Communication, Facial Expression, Dress and Appearance
- Posture and Movement, Gesture, Paralanguage
- Encoding meaning using Verbal symbols: How words work and how to use words
- Volume, Pace, Pitch and Pause
- Structuring content for delivery in accordance with time, platform, and audience.

Module- II (6hrs.)

Group Discussion

- Nature and purpose and characteristics of a successful Group Discussion
- Group discussion Strategies: Getting the GD started, contributing systematically, moving the discussion along, promoting optimal participation, Handling conflict, Effecting closure

Module- III (6 hrs.)

- Interviewing
  Types of Interviews, Format for Job Interviews: One-to-one and Panel Interviews, Telephonic Interviews, Interview through video conferencing.
- Cover Letter & CV
- Interview Preparation Techniques, Frequently Asked Questions, Answering Strategies, Dress Code, Etiquette, Questions for the Interviewer, Simulated Interviews.

Module- IV (6 hrs.)

Professional Presentation Skills

- Nature and Importance of Presentation skills
- Planning the Presentation: Define the purpose, analyze the Audience, Analyze the occasion and choose a suitable title.
- Preparing the Presentation: The central idea, main ideas, collecting support material, plan visual aids, design the slides
- Organizing the Presentation: Introduction-Getting audience attention, introduce the subject, establish credibility, preview the main ideas, Body-develop the main idea, present information sequentially and logically, Conclusion-summaries, re-emphasize, focus on the purpose, and provide closure.
- Improving Delivery: Choosing Delivery methods, handling stage fright
- Post-Presentation discussion: Handling Questions-opportunities and challenges.

References:

1. Carter, R. And Nunan, D. (Eds), The Cambridge guide to Teaching English to Speakers of Other Languages, CUP, 2001
2. Edward P. Bailey, Writing and Speaking At Work: A Practical Guide for Business Communication, Prentice Hall, 3rd Ed., 2004
3. Munter, M., Guide to Managerial Communication: Effective Business Writing and Speaking, Prentice Hall, 5th Ed., 1999
4. R. Anand, Job Readiness For IT & ITES- A Placement and Career Companion, , McGraw Hill Education.2015
5. Malhotra, A., Campus Placements, McGraw Hill Education.2015

Course Title : Physics I					
Course Code : PHY1001					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

After completion of the course, students will be able to

PHY1001.1: To develop basic understanding of the modern science to the technology related domain.

PHY1001.2: Analytical & logical skill development through solving problems.

PHY1001.3: To impart idea of concise notation for presenting equations arising from mathematical formulation of physical as well as geometrical problems percolating ability of forming mental pictures of them.

PHY1001.4: Imparting the essence and developing the knowledge of controlling distant object like satellite, data transfer through optical fiber, implication of laser technology, handling materials in terms of their electrical and magnetic properties etc.

PHY1001.5: To understand how the systems under force field work giving their trajectories which is the basic of classical Field theory

PHY1001.6: To impart basic knowledge of the electric and magnetic behavior of materials to increase the understanding of how and why electronic devices work.

Module 1: [12L] Mechanics

Elementary concepts of grad, divergence and curl. Potential energy function; F=-grad V, Equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, Curl of a force field; Central forces ; conservation of angular momentum; Energy equation and energy diagrams; elliptical, parabolic and hyperbolic orbit; Kepler Problem; Application: Satellite manoeuvres .

Non-inertial frames of reference; rotating coordinate system; five term acceleration formula-centripetal and coriolis accelerations; applications: Weather system, Foucault pendulum.

Module II: [12L] Optics

Oscillatory Motion:

Damped harmonic motion – Over damped, critically damped and lightly damped oscillators; Forced oscillation andresonance. Electrical equivalent of mechanical oscillator, Wave equation, plane wave solution.

Optics:

Elementary features of polarization of light waves. Double refraction, Production and analysis of linearly, elliptic and Circularly polarized light, Polaroid and application of polarizations.: Polarimeter.

Laser & Fiber Optics::

Characteristics of Lasers, Spontaneous and Stimulated Emission of Radiation, Meta-stable State, Population Inversion, Lasing Action, Einstein's Coefficients and Relation between them, Ruby Laser, Helium-Neon Laser, Semiconductor Diode Laser, Applications of Lasers.

Fiber optics - principle of operation, numerical aperture, acceptance angle, Single mode, graded indexed fiber.

Module III: [12L] Electrostatics

Electrostatics in freespace

Calculation of electric field and electrostatic potential for a charge distribution, Divergence and curl of electrostatic field, Laplace's and Poisson's equation for electrostatic potential. Boundary conditions of electric field and electrostatic potential. Method of images, energy of a charge distribution and its expression in terms of electric field.

Electrostatics in a linear dielectric medium

Electrostatic field and potential of a dipole, Bound charges due to electric polarization, Electric displacement, Boundary conditions on displacement, Solving simple electrostatic problem in presence of dielectric – point charge at the centre of a dielectric sphere, charge in front of dielectric slab, Dielectric slab and dielectric sphere in uniform electric field.

Module IV: [12L]

Magnetostatics :

Biot-Savart law, divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; equation for vector potential and it's solutions for given current densities.

Magneto statics in a linear magnetic medium:

Magnetization and associated bound currents; Auxiliary magnetic field H; boundary conditions on B and H. Solving for magnetic field due to simple magnet like a bar magnet; Magnetic susceptibility; ferromagnetic, paramagnetic and diamagnetic materials; Qualitative discussion of magnetic field in presence of magnetic materials.

Faraday's Law:

Differential form of Faraday's law expressing curl of electric field in terms of time derivative of magnetic field and calculating electric field due to changing magnetic fields in quasi static approximation. Energy stored in a magnetic field.

Text Books

1. Theoretical Mechanics: M R Spiegel (Schaum Series) McGrow-Hill Book Company
2. Classical Mechanics: N C Rana and P S Joag Tata- McGrow-Hill Publishing Company Limited.
3. Vibrations and Waves: A P French, W W Norton and Company,
4. The Physics of Waves and Oscillations: N K Bajaj, Tata- McGrow-Hill Publishing Company Limited.
5. Optics: A Ghatak, Tata McGraw-Hill Publishing Company Limited.
6. Optics: E. Hecht, Addison Wesley
7. Fundamentals of Optics: F A Jenkins and H E White, McGrow-Hill Higher Education.
8. Atomic Physics (Modern Physics): S N Ghosal, S. Chand and Company.
9. Practical Quantum Mechanics: S Flugge, Springer (Reprint of the 1994 Edition)
10. Concepts of Modern Physics: A Baiser, Tata McGraw-Hill Publishing Company Limited.
11. Refresher Course in B.Sc. Physics – Vol1 and Vol 2 – C.L.Arora

Course Title: Mathematics II					
Course Code: MTH1201					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	1	0	4	4

Course Outcomes:

After completion of the course, students will be able to

MTH1201.1: Demonstrate the knowledge of probabilistic approaches to solve wide range of engineering problem.

MTH1201.2: Recognize probability distribution for discrete and continuous variables to quantify physical and engineering phenomenon.

MTH1201.3: Develop numerical techniques to obtain approximate solutions to mathematical problems where analytical solutions are not possible to evaluate.

MTH1201.4: Analyze certain physical problems that can be transformed in terms of graphs and trees and solving problems involving searching, sorting and such other algorithms.

MTH1201.5: Apply techniques of Laplace Transform and its inverse in various advanced engineering problems.

MTH1201.6: Interpret differential equations and reduce them to mere algebraic equations using Laplace Transform to solve easily.

Learning Objectives: The objective of this course is to familiarize the students with numerical techniques, integral transforms, graph theory and probability. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.

Module-I: [10L] Fundamentals of Probability

Random experiment, Sample space and events
Classical and Axiomatic definition of probability
Addition and Multiplication law of probability
Conditional probability
Bayes' Theorem
Random variables
General discussion on discrete and continuous distributions
Expectation and Variance
Examples of special distribution: Binomial and Normal Distribution

Module-II: [10L] Numerical Methods

Solution of non-linear algebraic and transcendental equations: Bisection Method, Newton-Raphson Method, Regula-Falsi Method.

Solution of linear system of equations: Gauss elimination method, Gauss-Seidel Method, LU Factorization Method, Matrix Inversion Method.

Solution of Ordinary differential equations: Euler's and Modified Euler's Method, Runge-Kutta Method of 4th order.

Module-III: [10L] Basic Graph Theory

Graphs: Digraphs, Weighted graph, Connected and disconnected graphs, Complement of a graph, Regular graph, Complete graph, Subgraph

Walks, Paths, Circuits, Euler Graph, Cut sets and cut vertices

Matrix representation of a graph, Adjacency and incidence matrices of a graph

Graph isomorphism

Bipartite graph

Definition and properties of a tree

Binary tree, Spanning tree of a graph, Minimal spanning tree, properties of trees

Algorithms: Dijkstra's Algorithm for shortest path problem, Determination of minimal spanning tree using DFS, BFS, Kruskal's and Prim's algorithms

Module-IV: [10L] Laplace Transformation

Basic ideas of improper integrals, working knowledge of Beta and Gamma functions (convergence to be assumed) and their interrelations.

Introduction to integral transformation

Functions of exponential order, Definition and existence of Laplace Transform (LT) (statement of initial and final value theorem only)

LT of elementary functions, Properties of Laplace Transformations, Evaluation of sine, cosine and exponential integrals using LT

LT of periodic and step functions

Definition and properties of inverse LT

Convolution Theorem (statement only) and its application to the evaluation of inverse LT

Solution of linear ODEs with constant coefficients (initial value problem) using LT

Text Books

1. Advanced Engineering Mathematics , E.Kreyszig, Wiley Publications
2. Introduction to Probability and Statistics for Engineers and Scientists, S.Ross, Elsevier
3. Introductory methods of Numerical Analysis, S.S. Sastry, PHI learning
4. Introduction to Graph Theory, D. B. West, Prentice-Hall of India
5. Engineering Mathematics, B.S. Grewal, S. Chand & Co

Course Title: Introduction to Electronics Devices & Circuits					
Course Code: ECE1001					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

After completion of the course, students will be able to

ECE1001.1: Categorize different semiconductor materials based on their energy bands and analyze the change in characteristics of those materials due to different types of doping.

ECE1001.2: Describe energy band of P-N Junction devices and solve problems related to P-N Junction Diode.

ECE1001.3: Design different application specific circuits using diodes.

ECE1001.4: Analyze various biasing configurations of Bipolar Junction Transistor.

ECE1001.5: Categorize different field-effect transistors and analyze their behavior.

ECE1001.6: Design and implement various practical electronic circuits

Module I [10 L]

Basic Semiconductor Physics:

Crystalline materials, energy band theory, Conductors, Semiconductors and Insulators, Concept of Fermi energy level, intrinsic and extrinsic semiconductors, mass action law, drift and diffusion currents in semiconductor, Einstein relation.

Diodes and Diode Circuits:

Formation of p-n junction, energy band diagram, forward & reverse biased configurations, V-I characteristics, DC load line, breakdown mechanisms - Zener and avalanche breakdown, voltage regulation using Zener diode.

Rectifier circuits: half wave & full wave rectifiers: ripple factor, rectification efficiency, rectifier output without and with filters. Light emitting diode.

Module II [8 L]

Bipolar Junction Transistors (BJT):

pnp & npn BJT structures, different operating modes of BJT, current components in BJT, dc current gains in CE & CB configurations and their interrelation, input & output V-I characteristics of CE & CB configurations. Concept of Biasing: DC load line, Q-point, basic concept of amplification using BJT.

Module III [9 L]

Field Effect Transistors (FET):

Classification of FET, basic structure and operation of Junction Field Effect Transistor (n-channel) along with its V-I characteristics.

Metal Oxide Semiconductor Field Effect Transistor (MOSFET): Enhancement & depletion type MOSFETs (for both n & p channel devices), drain & transfer characteristics.

Module IV [9 L]

Feedback in amplifiers:

Concept of feedback, different feedback topologies using block diagram only, effects of negative feedback (qualitative), Barkhausen criteria for sustained oscillation.

Operational Amplifier:

Usefulness of differential amplifier over single ended amplifier, ideal OPAMP characteristics, transfer characteristics of OPAMP, CMRR, slew rate, offset error voltages and current, concept of virtual ground

Basic circuits using OPAMP: Comparator, inverting and non-inverting amplifiers, voltage follower, adder, subtractor, integrator, differentiator.

Text Books

1. Boylestad & Nashelsky: Electronic Devices & Circuit Theory
2. R.A Gayakwad:Op Amps and Linear IC's, PHI
3. D. Chattopadhyay, P. C Rakshit : Electronics Fundamentals and Applications

Reference Books

1. Adel S. Sedra, Kenneth Carless Smith: Microelectronics Engineering
2. Millman & Halkias: Integrated Electronics.
3. Salivahanan: Electronics Devices & Circuits.
4. Albert Paul Malvino: Electronic Principle

Course Title: Universal Human Values and Professional Ethics					
Course Code: HUM1002					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	2	1	0	3	3

Course Outcomes:

After completion of the course, students will be able to

HUM1002.1: Appreciate the essential complementarily between 'values and 'skills' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.

HUM1002.2: Develop a Holistic perspective towards life and profession

HUM1002.3: Develop a correct understanding of the Human reality and the rest of existence

HUM1002.4: Appreciate the relationship of values in terms of ethical human conduct.

HUM1002.5: Understand the importance of trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

HUM1002.6: Differentiate between the characteristics and activities of different orders and study the mutual fulfilment among them.

Detailed Syllabus

Module 1: [6L] Introduction to Value Education

Understanding Values: Historical perspective to the development of values and its importance for the integration and harmony of the self and body

Understanding Human being as the Co-existence of the Self and the Body

Exploring Harmony of Self with the Body

Distinguishing between the Needs of the Self and the Body

Understanding and appreciating basic human aspirations-Maslow's Hierarchy of Needs Theory

Strategies, Methods to Fulfil the Basic Human Aspirations

Continuous Happiness and Prosperity – the Basic Human Aspirations

Module 2: [10L] Harmony in the Family and Society

The self as a social being starting with the family as the smallest unit—the process of socialisation.

Development of the self in relation to the society – Cooley's and Mead's theories of socialization.

Self and Integrated personality-Morality, Courage and Integrity

Conflict of interest at home and society and its resolution through the implementation of the Human Values

Societal Values – Justice, Democracy and Rule of law

Establishing harmony in the society with the help of ethical conduct based on values- Ethics of Rights and Duties, Ethics of care, Ethics justice and Fairness, Work Ethics and quality of life at work.

Value crisis- disharmony in relationships, understanding harmony in the society

Solutions - contribution of the individual in establishing harmony in the society.

'Trust' and 'Respect'--the Foundational Values in Relationship

Exploring the Feeling of Trust and Respect

Module 3: [10L] Implications of the Holistic Understanding – a Look at Professional Ethics

Ethics and Ethical Values

Principles and theories of ethics--Consequential and non-consequential ethics, Utilitarianism, Kant's theory and other non-consequential perspectives

Professional Ethics- Right understanding of Professional Ethics

Canons of professional Ethics

Technology – various perspectives-its use, overuse and misuse

Privacy, data security and data protection, Artificial intelligence-harmony or disharmony, misinformation, deep fake, cyber-crime - a sociological perspective.

Code of Ethics, Violation of code of ethics, Whistle blowing, Institutionalising Ethics

Vision for the Universal Human Order, Exploring Systems to fulfill Human Endeavour's

Module 4: [10L] Harmony in the Nature/Existence

Understanding Harmony in the Nature -Ecological Ethics

Sustainable development- Definition and Concept

Strategies for sustainable development- Small is beautiful, Slow is Beautiful Sustainable Development- The Modern Trends

Sustainable Development Goals- Case studies and Best practices

Exploring the Four Orders of Nature -Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature

The Holistic Perception of Harmony in Existence

Text Books

1. A Foundation Course in Human Values and Professional Ethics, R.R. Gaur, R. Asthana, G.P. Bagaria, Excel Books Pvt. Ltd. New Delhi
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews

Course Title : Sports and Yoga					
Course Code : MEC1216					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	2	0	0	2	0

Course Outcomes:

After completion of the course, students will be able to

MEC1216.1: Understand the importance of sound health and fitness principles as they relate to better health.
MEC1216.2: Learn breathing exercises and healthy fitness activities
MEC1216.3: Perform yoga movements in various combination and forms.
MEC1216.4: Improve personal fitness through participation in sports and yogic activities.
MEC1216.5: Identify and apply injury prevention principles related to yoga and physical fitness activities.
MEC1216.6: Demonstrate an understanding of sound nutritional practices as related to health and physical performance.

Course Contents:
Module I:

Introduction to Physical Education

- Meaning & definition of Physical Education
- Aims & Objectives of Physical Education
- Changing trends in Physical Education

Historical Background

- Ancient & Modern Olympics (Summer & Winter)
- Olympic Symbols, Ideals, Objectives & Values
- Awards and Honours in the field of Sports in India (Dronacharya Award, Arjuna Award, Dhayanchand Award, Rajiv Gandhi Khel Ratna Award etc.)

Healthy Lifestyle

- Meaning & Importance of Physical Fitness & Wellness
- Components of Physical fitness
- Components of Health related fitness
- Components of wellness
- Preventing Health Threats through Lifestyle Change
- Concept of Positive Lifestyle

Module II

Fundamentals of Anatomy & Physiology in Physical Education, Sports and Yoga

- Define Anatomy, Physiology & Its Importance
- Effect of exercise on the functioning of Various Body Systems. (Circulatory System,
- Respiratory System, Neuro-Muscular System etc.)

Kinesiology, Biomechanics & Sports

- Meaning & Importance of Kinesiology & Biomechanics in Physical Edu. & Sports
- Newton's Law of Motion & its application in sports.
- Friction and its effects in Sports.

Postures

- Meaning and Concept of Postures.
- Causes of Bad Posture.
- Advantages & disadvantages of weight training.
- Concept & advantages of Correct Posture.
- Common Postural Deformities – Knock Knee; Flat Foot; Round Shoulders; Lordosis, Kyphosis, Bow Legs and Scoliosis.
- Corrective Measures for Postural Deformities

Module III:

Yoga

- Meaning & Importance of Yoga
- Elements of Yoga
- Introduction - Asanas, Pranayama, Meditation & Yogic Kriyas
- Yoga for concentration & related Asanas (Sukhasana; Tadasana; Padmasana & Shashankasana)
- Relaxation Techniques for improving concentration - Yog-nidra

Yoga & Lifestyle

- Asanas as preventive measures.
- Hypertension: Tadasana, Vajrasana, Pavan Muktasana, Ardha Chakrasana,
- Bhujangasana, Sharasana.
- Obesity: Procedure, Benefits & contraindications for Vajrasana, Hastasana, Trikonasana,
- Ardh Matsyendrasana.
- Back Pain: Tadasana, Ardh Matsyendrasana, Vakrasana, Shalabhasana, Bhujangasana.
- Diabetes: Procedure, Benefits & contraindications for Bhujangasana, Paschimottasana,
- Pavan Muktasana, Ardh Matsyendrasana.
- Asthema: Procedure, Benefits & contraindications for Sukhasana, Chakrasana,
- Gomukhasana, Parvatasana, Bhujangasana, Paschimottasana, Matsyasana.

Module IV

Training and Planning in Sports

- Meaning of Training
- Warming up and limbering down
- Skill, Technique & Style
- Meaning and Objectives of Planning.
- Tournament – Knock-Out, League/Round Robin & Combination.

Psychology & Sports

- Definition & Importance of Psychology in Physical Edu. & Sports
- Define & Differentiate Between Growth & Development
- Adolescent Problems & Their Management
- Emotion: Concept, Type & Controlling of emotions
- Meaning, Concept & Types of Aggressions in Sports
- Psychological benefits of exercise.
- Anxiety & Fear and its effects on Sports Performance
- Motivation, its type & techniques.
- Understanding Stress & Coping Strategies.

Doping

- Meaning and Concept of Doping
- Prohibited Substances & Methods
- Side Effects of Prohibited Substances

Sports Medicine

- First Aid – Definition, Aims & Objectives.
- Sports injuries: Classification, Causes & Prevention.
- Management of Injuries: Soft Tissue Injuries and Bone & Joint Injuries

Text Books

1. Modern Trends and Physical Education by Prof. Ajmer Singh.
2. Light On Yoga by B.K.S. Iyengar.
3. Health and Physical Education – NCERT (11th and 12th Classes)

Course Title: Physics I Laboratory					
Course Code: PHY1051					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

Course Outcomes:

After completion of the course, students will be able to

PHY1051.1: To gain practical knowledge by applying the experimental methods to correlate with the Physics theory.

PHY1051.2: To learn the usage of electrical and optical systems for various measurements.

PHY1051.3: Apply the analytical techniques and graphical analysis to the experimental data.

PHY1051.4: Understand measurement technology, usage of new instruments and real time applications in engineering studies.

PHY1051.5: To develop intellectual communication skills and discuss the basic principles of scientific concepts in a group.

✓ **Minimum of six experiments taking at least one from each of the following four groups:**

Group 1: Experiments in General Properties of matter

1. Determination of Young's modulus by Flexure Method
2. Determination of bending moment and shear force of a rectangular beam of uniform cross- section.
3. Determination of modulus of rigidity of the material of a rod by static method
4. Determination of rigidity modulus of the material of a wire by dynamic method.
5. Determination of coefficient of viscosity by Poiseulle's capillary flow method.

Group 2: Experiments in Optics

1. Determination of dispersive power of the material of a prism
2. Determination of wavelength of light by Newton's ring method.
3. Determination of wavelength of light by Fresnel's biprism method.
4. Determination of the wavelength of a given laser source by diffraction method

Group 3: Electricity & Magnetism experiments

1. Determination of dielectric constant of a given dielectric material.
2. Determination of resistance of ballistic galvanometer by half deflection method and study of variation of
3. logarithmic decrement with series resistance.
4. Determination of the thermo-electric power at a certain temperature of the given thermocouple.
5. Determination of specific charge (e/m) of electron.

Group 4: Quantum Physics Experiments

1. Determination of Planck's constant.
2. Determination of Stefan's radiation constant.
3. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.
4. Determination of Rydberg constant by studying Hydrogen/ Helium spectrum.
5. Determination of Hall co-efficient of semiconductors.
6. Determination of band gap of semiconductors.
7. To study current-voltage characteristics, load response, areal characteristics and spectral response of photo voltaic solar cells.

Text Books

1. Optics – Eugene Hecht Pearson Education India Private Limited
2. Introduction to Electrodynamics, David J. Griffiths, Pearson Education India Learning Private Limited
3. Waves and Oscillations by N.K. Bajaj
4. Principles of Physics, 10ed, David Halliday, Robert Resnick Jearl Walker , Wiley
5. Electricity, Magnetism, and Light, Wayne M. Saslow, Academic Press
6. Classical mechanics, Narayan Rana, Pramod Joag, McGraw Hill Education
7. Introduction to Classical Mechanics, R Takwale, P Puranik, McGraw Hill Education
8. Optics, Ghatak, McGraw Hill Education India Private Limited
9. Refresher Course in B.Sc. Physics – Vol1 and Vol 2 – C.L.Arora

Course Title : Introduction to Electronics Devices & Circuits Laboratory					
Course Code : ECE1051					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

Course Outcomes:

After completion of the course, students will be able to

ECE1051.1: The students will correlate theory with diode behavior.

ECE1051.2: They will design and check rectifier operation with regulation etc.

ECE1051.3: Students will design different modes with BJT and FET and check the operations.

ECE1051.4: They will design and study adder, integrator etc. with OP-AMPs.

List of Experiments

1. Familiarization with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT) and electronic equipment like DC power supplies, multi-meters etc.
2. Familiarization with measuring and testing equipment like CRO, Signal generators etc.
3. Study of I-V characteristics of Junction diodes.
4. Study of I-V characteristics of Zener diodes.
5. Study of Half and Full wave rectifiers with Regulation and Ripple factors.
6. Study of I-V characteristics of BJTs in CB mode
7. Study of I-V characteristics of BJTs in CE mode
8. Study of I-V characteristics of Field Effect Transistors.
9. Determination of input-offset voltage, input bias current and Slew rate of OPAMPs.
10. Determination of Common-mode Rejection ratio, Bandwidth and Off-set null of OPAMPs.
11. Study of OPAMP circuits: Inverting and Non-inverting amplifiers, Adders, Integrators and Differentiators.

Course Name: Workshop /Manufacturing Practices					
Course Code: MEC1051					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	1	0	3	4	2.5

Course Outcomes:

After completion of the course, students will be able to

MEC1051.1: Follow the various safety practices in workshop and personal protective elements.

MEC1051.2: Identify tools, work material and measuring instruments useful for fitting, carpentry and sheet metal practices.

MEC1051.3: Operate machine tools, components and processes to prepare jobs of specific shape and size.

MEC1051.4: Acquire knowledge of foundry process and casting of a product.

MEC1051.5: Perform welding, brazing and soldering processes.

MEC1051.6: Assemble a simple product.

Syllabus:

(i) Lectures: [13 hours]

Detailed contents

1. Introduction on Workshop and familiarization with safety norms **(1 lecture)**
2. Carpentry and Fitting **(2 lectures)**
3. Sheet metal **(1 lecture)**
4. Metal casting **(1 lecture)**
5. Welding (arc welding & gas welding), brazing and soldering **(2 lectures)**
6. Manufacturing Methods- machining (Lathe, Shaping and Milling) **(4 lectures)**
7. Additive manufacturing **(1 lecture)**
8. Assembling of a product **(1 lecture)**

(ii) Workshop Practice: [39 hours]

1. Safety practices in workshop	**(3 hours)**
2. Carpentry shop	**(3 hours)**
3. Fitting shop	**(6 hours)**
4. Foundry shop	**(3 hours)**
5. Machine shop	**(9 hours)**
6. Welding shop-Arc welding	**(3 hours)**
7. Sheet metal shop and brazing	**(6 hours)**
8. Soldering operation	**(3 hours)**
9**.** Assembling of a product	**(3 hours)**

Text Books

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy, "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu, "Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice HallIndia, 1998.
5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House,2017

Course Title : Engineering Graphics and Design					
Course Code : MEC1052					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	1	0	3	4	2.5

Course Outcomes:

After going through the course, the students will be able to

MEC1052.1: Explain the basic concept of engineering drawing.

MEC1052.2: Use engineering drawing tools (conventional / modern tools).

MEC1052.3: Apply the various standards and symbols followed in engineering drawing.

MEC1052.4: Implement the concept of projections used in engineering graphics.

MEC1052.5: Relate the concept of sections to determine its true shape.

MEC1052.6: Appraise the use of an engineering drawing software.

Lecture Plan [13 L]

1. Importance and principles of engineering drawing (1 L)
2. Lettering (1 L)
3. Concepts of Scale, dimensioning and Conic sections (3 L)
4. Introduction to concept of projection (Projections of points, lines and surfaces) (3 L)
5. Definitions of different solids and their projections (1 L)
6. Section of solids and sectional view (1 L)
7. Isometric projection (1 L)
8. Introduction to CAD (1 L)
9. Viva-voce (1 L)

Detailed contents of Laboratory hours [39 hours]

Module 1: Introduction to Engineering Drawing covering (**3 hours**)

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lines, lettering & dimensioning, Conic sections like Ellipse (General method only); Involute; Scales – Plain, Diagonal.

Module 2: Orthographic Projections covering (**9 hours**)

Principles of Orthographic Projections - Conventions - Projections of Points and lines inclined to both planes; Projections on Auxiliary Planes. Projection of lamina.

Module 3: Projections of Regular Solids covering, (**6 hours**)

Those axes inclined to both the Planes- Auxiliary Views.

Module 4: Sections and Sectional Views of Right Angular Solids covering (**3 hours**)

Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Sectional orthographic views of geometrical solids.

Module 5: Isometric Projections covering (**6 hours**)

Principles of Isometric projection -Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions.

Module 6: Overview of Computer Graphics covering, (**3 hours**)

Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids.

Module 7: Customization& CAD Drawing (**3 hours**)

Consisting of set up of the drawing page and the printer, including scale settings, setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles.

Module 8: Annotations, layering & other functions covering (**3 hours**)

Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command;

orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation.

Module 9: Demonstration of a simple team design project that illustrates (3 hours)

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame.

Text Books

1. Bhatt, N.D., Panchal V.M. & Ingle P.R., (2014) "Elementary Engineering Drawing"; Charotan Publishing House
2. Narayana, k.L. and Kannaaiah P "Engineering Graphics"; TMH
3. Lakshminarayanan, V. and Vaish Wanar, R.s "Engineering Graphics" Jain Brothers.
4. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education.
5. Agarwal B. & Agarwal C. M. (2012), Engineering graphics, TMH Publications

DETAILED SYLLABUS

2nd Year

Course Title: Physics II					
Course Code: PHY2101					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

After completion of the course, students will be able to

PHY2101.1: Understanding angular momentum, kinetic energy and motion of a rigid body with applications in mechanical systems.

PHY2101.2: Understanding calculus of variation as a core principle underlying majority of the physical laws: Newton's laws, Laplace equation (electrostatics and fluid mechanics), wave equation, heat conduction equation, control theory and many other.

PHY2101.3: Appreciating dynamical equations as a consequence of variational extremization of the action functional along with the use of the Euler-Lagrange equation to understand the behaviour of simple mechanical systems.

PHY2101.4: Appreciating the ubiquity of oscillation physics-from pendulum and spring-mass systems to electrical circuit and movement of piston, and comprehending the small motion of a system around stable equilibrium through the notion of normal modes—the meaning of eigenvalue problem in oscillation physics.

PHY2101.5: An elucidation of the basic principles of fluid mechanics through the study of mass conservation, momentum balance, and energy conservation applied to fluids in motion.

PHY2101.6: A basic understanding of the mechanics of deformable bodies through a study of the concepts of normal and shear stresses and strains, following a review of the principles of statics.

Module I: [10L] Rigid Body Dynamics

Angular Momentum, Kinetic Energy, Moment and Product of Inertia, Principal Moments of Inertia, Parallel and Perpendicular Axis Theorems, Examples.

Module II: [10L] Lagrangian and Hamiltonian Mechanics

Principle of Least Action, Virtual Work, Euler-Lagrange Equations, Cyclic Coordinates, Configuration Space, Examples: Simple and Double Pendulum and Atwood Machine. Conservation Laws. Hamilton Equations of Motion.

Module III: [10L] Small Oscillations

Small Oscillations of Conservative Systems. Lagrangian and Lagrange Equations of Motion. The Eigenvalue Equation and the Principal Axis Transformation.

Module IV: [10L] Fluid Mechanics

Differential Equation of Motion of Fluid Flow, Continuity Equation, Momentum Equation, Euler, Bernoulli and Navier Stokes Equations, Problems and Examples. Integral Form of Continuity and Momentum Equations

Text Books

1. Classical Mechanics by N. Rana and P. Joag Tata McGraw Hill
2. Classical Mechanics by John Taylor, University Science Books
3. The Variational Principles of Mechanics by Cornelius Lanzos, Dover Publications
4. Schaums Outline of Theoretical Mechanics by M. Spiegel, McGraw Hill
5. Theory of Elasticity by S. P. Timoshenko and J. N. Goodier 3rd Ed. McGraw Hill
6. A Physical Introduction to Fluid Mechanics by A. Smits, John Wiley & Sons

Course Title: Mathematical Methods					
Course Code: MTH2001					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	1	0	4	4

Course Outcomes:

After completion of the course, students will be able to

MTH2001.1: Construct appropriate mathematical models of physical systems.
MTH2001.2: Recognize the concepts of complex integration, Poles and Residuals in the stability analysis of engineering problems.
MTH2001.3: Generate the complex exponential Fourier series of a function and make out how the complex Fourier coefficients are related to the Fourier cosine and sine coefficients.
MTH2001.4: Interpret the nature of a physical phenomena when the domain is shifted by Fourier Transform e.g. continuous time signals and systems.
MTH20011.5: Develop computational understanding of second order differential equations with analytic coefficients along with Bessel and Legendre differential equations with their corresponding recurrence relations.
MTH2001.6: Master how partial differentials equations can serve as models for physical processes such as vibrations, heat transfer etc.

Module I: [12L] Functions of Complex Variables:

Complex numbers and its geometrical representation.

Functions of a complex variable – Limits, Continuity, and Differentiability.

Analytic Functions, Cauchy- Riemann equations, Necessary and sufficient conditions for analyticity of complex functions (Statement only), Harmonic functions.

Line Integral on complex plane, Cauchy-Goursat theorem, Cauchy's Integral Formula. Taylor's and Laurent's series expansion.

Zeros, Different types of Singularities. Definitions of poles and residues, Residue Theorem, Evaluation of real integrals using residue theorem.

Basic concepts of operating systems like MS WINDOWS, LINUX How to write algorithms & draw flow charts.

Module II: [12L] Fourier Series, Integrals and Transforms

Definite Integral, Orthogonality of Trigonometric Functions, Power Series and its convergence.

Periodic Functions, Even and Odd Functions, Dirichlet's Conditions, Euler Formulas for Fourier coefficients, Fourier series representation of a function, e.g. Periodic square wave, Half wave rectifier, Unit step function. Half Range series, Parseval's Identity.
Fourier Integral theorem, Fourier transform, Fourier sine and cosine transform, Linearity, Scaling, Frequency Shifting and Time shifting properties, Convolution Theorem.
Discussion of some physical problems: e.g. Forced oscillations.

Module III: [12L] Series Solutions to Ordinary Differential Equations and Special Functions

Series solution of ODE: Ordinary point, Singular point and Regular Singular point, series solution when = is an ordinary point, Frobenius method.
Legendre's Equation, Legendre's polynomials and its graphical representation.
Bessel's equation, Bessel's function of first kind and its graphical representation.
Finite Difference Method and its application to Boundary Value Problem.

Module IV: [12L] Partial Differential Equations

Introduction to partial differential equations, Formation of partial differential equations, Linear and Nonlinear pde of first order, Lagrange's and Charpit's method of solution.
Second order partial differential equations with constant coefficients , Illustration of wave equation, one dimensional heat equation, Laplace's equation, Boundary value problems and their solution by the method of separation of variables. Solution of Boundary value problems by Laplace and Fourier transforms.

Text Books

1. Complex Variables and Applications ; Brown Churchill ; MC Graw Hill
2. Complex Variable; Murrey R. Spiegel; Schaum's Outline Series
3. Theory of Functions of a Complex Variable; Shanti Narayan, P. K. Mittal; S. Chand
4. Larry C. Andrew, B. K. Shivamoggi; Integral Transforms for Engineers and Applied Mathematicians ;Macmillan
5. Fourier Analysis with Boundary Value Problem; Murrey R. Spiegel; Schaum's Outline Series
6. Mathematical Methods; Potter, Merle C., Goldberg, Jack.; PHI Learning
7. Ordinary and Partial Differential Equations ; M. D. Raisinghania; S. Chand
8. Elements of Partial Differential Equation; Ian Naismith Sneddon; Dover Publications
9. Advanced Engineering Mathematics; Kreyszig; Willey
10. Higher Engineering Mathematics; B. V. Ramana; Tata McGraw-Hill

Course Title: Engineering Mechanics					
Course Code: MEC2101					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	1	0	4	4

Course Outcomes:

After completion of the course, students will be able to

MEC2101.1: Describe basic concepts of vector, force and moment as applied to engineering mechanics.
MEC2101.2: Solve problems on particles and rigid bodies using the concept of static equilibrium.
MEC2101.3: Interpret friction phenomenon, calculate frictional forces for bodies in contact and virtual work.
MEC2101.4: Calculate the centre of gravity and moment of inertia of the given geometry.
MEC2101.5: Select suitable method for solving problems on kinematics, and kinetics of particles.
MEC2101.6: Implement the principles of work-energy, impulse-momentum and general plane motion for analysis of dynamic systems.

Module I: [12L] Vector Algebra and Concept of Force & Equilibrium

Importance of Mechanics in Engineering; Definition of Mechanics; Concepts of particles & rigid bodies.

Vector and scalar quantities; Vector algebra –definition and notation; Types of vectors – equal, equivalent, free, bound, sliding; Scalar multiplication of vectors ; Resolution of vectors in Cartesian co–ordinate system; Unit vector, unit co–ordinate vectors; Direction cosines; Addition/ subtraction of vectors in components form. Dot & Cross product and the application; Important vector quantities (position vector, displacement vector).

Force, Type of forces – collinear, concurrent, parallel, concentrated, distributed; Moment of a force about a point and about an axis, moment of a couple; Representation of force and moments in items of unit vectors. Principle of transmissibility of force (sliding vector); Varignon's theorem for a system of concurrent forces with proof; Resolution of a force by its equivalent force-couple system; Resultant of forces.

Concept and equilibrium of forces in two dimensions-; Active and reactive forces, different types of reaction forces; Free body concept and diagram Equations of equilibrium (2D); Three concurrent forces-- Lami's theorem.

Module II: [12L] Analysis of Structure, Concept of Friction and Virtual Work

Analysis of Structure - Truss & Frame.

Equilibrium analysis in 3D.

Concept of friction: Laws of Coulomb's friction; Angle of friction, angle of repose, coefficient of friction -- static and kinetic. Rolling Friction.

Principle of Virtual Work and its applications.

Module III: [12L] CG & MI, Introduction to Dynamics

Distributed force system; Centre of gravity; Centre of mass & centroid; Centroid of an arc; Centroid of plane areas – triangle, circular sector, quadrilateral and composite area consisting of above figures.

Area moment of inertia: Moment of inertia of a plane figure; Polar moment of inertia of a plane figure; Radius of gyration, Parallel axes theorem.

Introduction to dynamics: Kinematics & kinetics.

Rectilinear motion of particles with uniform & non – uniform acceleration.

Plane curvilinear motion of particles: normal and tangential components. Polar coordinate system, Translation and rotation.

Module IV: [12L] Kinetics of Particles

Kinetics of particles: Newton's laws of motion; D'Alembert's principle and free body diagram;

General Plane motion, Principle of work & energy; Principle of conservation of energy.

Impulse momentum theory: Conservation of linear and angular momentum.

Text Books

1. Engineering Mechanics:- Statics by J. L. Meriam & L.G Kriage, 7th Edition, John Wiley & Sons, Inc
2. Engineering Mechanics:- Dynamics by J. L. Meriam & L.G Kriage, 7th Edition, John Wiley & Sons, Inc
3. Engineering Mechanics by Timoshenko , Young and Rao , 4th Edition, TMH

Reference Books

1. Fundamentals of Engineering Mechanics by Nag & Chanda – Chhaya Prakashani.
2. Engineering Mechanics:- Statics and Dynamics by I.H. Shames, P H I

Course Title: Fluid Mechanics & Hydraulics					
Course Code: MEC2102					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

After completion of the course, students will be able to

MEC2102.1: Examine and use different properties of fluid.

MEC2102.2: Apply the fundamental laws to solve problems in fluid statics.

MEC2102.3: Analyze fluid flow problems with application of fluid kinematics and fluid dynamics principles in engineering systems.

MEC2102.4: Describe the concept of boundary layer growth and boundary layer separation.

MEC2102.5: Relate different flow parameters for viscous flow through pipe and evaluate different losses in pipe flow.

MEC2102.6: Implement the dimensional analysis method for fluid flow problems and evaluate the effects of drag and lift force on submerged bodies.

Module I: [9L]

Definition of fluid and importance of fluid mechanics; Concept of Continuum; Fluid properties: density, specific weight, specific volume, specific gravity.

Viscosity: definition, causes of viscosity, Newton's law of viscosity, Ideal and Real fluids; No-slip condition, dimensional formula and units of viscosity, kinematic viscosity; Variation of viscosity with temperature. Newtonian and Non-Newtonian fluids with Rheology diagram; Compressibility and Bulk modulus of elasticity. Difference between compressible and incompressible fluids.

Fluid statics: Pascal's Law; Basic Hydrostatic Law and its proof; Variation of pressure with depth in incompressible fluid, piezometric head, pressure head; Unit and scales of pressure measurement. Measurement of fluid pressure: Piezometer, Manometers - Simple and Differential U-tube manometer, Inverted tube manometer, inclined tube manometer. Characteristics and choice of manometric fluid.

Module II: [10L]

Hydrostatic thrust on submerged plane and curved surfaces;

Fluid kinematics: Definition; Flow field and description of fluid motion (Eulerian & Lagrangian method), steady and unsteady flow, uniform and non-uniform flow-examples.

Acceleration of a fluid particle- local acceleration, convective acceleration,

Stream line, Stream tube, Path line; Equation of streamline and path line. Velocity potential function and stream function.
Concept of control volume, Continuity equation in finite (1-D) and differential form in 3-D Cartesian coordinate system.

Module III: [10L]

Fluid dynamics: Euler's equation of motion; Bernoulli's equation and its significance; Bernoulli's Equation for a real fluid with applications in flow measurement (Venturimeter, Orifice meter, Pitot tube).

Application of linear momentum to control volume-linear momentum equation, analysis of force exerted by a fluid stream on a solid boundary- thrust on pipe bends etc.

Boundary layer theory: concept of boundary layer; boundary layer thickness, displacement thickness, momentum thickness, growth of boundary layer, Boundary layer separation.

Dimensional analysis and Buckingham Pi theorem.

Module IV: [10L]

Characteristics of Laminar and Turbulent flow; Reynolds experiment, critical Reynolds number, Laminar flow through pipe- Hagen-Poiseuille equation.

Flow through closed conduits: Darcy Weisbach equation; concept of friction factor in a pipe flow, Variation of friction factor with Reynolds Number; Moody's diagram and its use; Minor losses- at sudden expansion, at sudden contraction, at bends, at valves, and fittings etc. Concept of flow potential and flow resistance. Pipes connected in series and parallel.

Flow of fluid around submerged bodies: basic concept and expression of drag and lift; Pressure drag, friction drag, streamlined body, bluff body.

Text Books

1. Introduction to Fluid Mechanics and Fluid Machines- Som, Biswas and Chakraborty, TMH, 4e
2. Fluid Mechanics and Machinery-C.S.P Ojha, R. Berndtsson, P.N. Chandramouli, OUP, 1e
3. Fluid Mechanics – Fox, Mcdonald & Pritchard, Wiley, 8e
4. Mechanics of Fluids- B Massey, Taylor & Francis, 8e

Reference Books

1. Fluid Mechanics – Dr. A.K. Jain, Khanna Publishers, 11e
2. A Textbook of Fluid Mechanics and Hydraulic Machines– R. K. Bansal, Laxmi Publications (P) Ltd.

Course Title: Engineering Thermodynamics					
Course Code: MEC2103					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	1	0	4	4

Course Outcomes:

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

MEC2103.1: Define and describe thermodynamic systems as well as thermodynamic processes.

MEC2103.2: Interpret different processes to examine work transfer and heat transfer and their correlation.

MEC2103.3: Apply energy conservation and analyze various thermodynamic processes as well as those involving steam by relating property values from steam table.

MEC2103.4: Differentiate qualitatively between heat transfer & work transfer to compare heat engines/different air standard cycles and apply the concepts of entropy and available energy.

MEC2103.5: Examine the working of reciprocating compressor and basics of thermal power generation.

MEC2103.6: Judge the efficiencies of Rankine cycles and air standard cycles.

Module I: [13L]

Basic concepts of Thermodynamics: Introduction; Definition of Thermodynamic systems; Open, closed and isolated systems; Control mass and control volume; State; Definition of properties: intensive, extensive & specific properties; Macroscopic and microscopic and microscopic point of view, concept of continuum.

Thermodynamic equilibrium: Change of state; Thermodynamic processes; Quasi-static processes; Thermodynamic cycles; Zeroth law of Thermodynamics - concept of temperature.

Heat & Work: Definition and units of Thermodynamic work; Work transfer-displacement work for a simple compressible system, path function, Pdv work in various quasi-static processes(isothermal, isobaric, adiabatic, polytropic, isochoric); Free expansion; Net work done by a system in a cycle

Definition and units of heat; Heat transfer-a path function; Similarities and dissimilarities between heat and work.

First law of Thermodynamics: For a closed system executing a cycle; Concept of stored energy; Energy as a property, different forms of stored energy, internal energy, first law for a non-flow process. Definition of enthalpy; C_p, C_v

Module II: [13L]

First law for an open system: Flow energy, steady flow energy equation; Examples of steady flow devices (nozzle and diffuser, turbine, pump, compressor, heat exchanger, throttling device); PMM-I.

Pure substance: Definition, properties of pure substance; Phases of pure substance; Phase transformation processes of pure substances — critical point, triple point; Property (phase) diagrams of water — T-v, P- v, P- T, T- s, h-s diagrams; P v T surface for water; Property tables of pure substances — compressed liquid, saturated, wet and superheated vapour, use of saturated and superheated steam table and Mollier diagram.

Module III: [13L]

Second law of Thermodynamics: Qualitative difference between heat and work; Definition of source & sink: cyclic heat engine, heat pump and refrigerator, thermal efficiency of heat engine, C.O.P of heat pump and refrigerator; Kelvin-Plank and Clausius statements of second law; Equivalence of the two statements. PMM-II

Reversible process; Irreversible process; Factors for irreversibility; Carnot cycle and Carnot efficiency; Carnot theorem, corollaries; Thermodynamic temperature scale; Reversible heat engine and heat pump.

Entropy: Clausius Inequality: Entropy as a property; T-s plot for reversible isothermal, adiabatic, isochoric & isobaric processes. Tds equation and calculation of entropy change of ideal gases for various processes; Concept and uses of entropy, Entropy principle. Introduction to available energy.

Module IV: [13L]

Air standard Cycles and introduction to I C Engines: Air standard cycles — Otto cycle, Diesel cycle, Dual combustion cycle;

P-v, T-s plots; Efficiency, net work done, mean effective pressure; Principles of 4-stroke S I engine and C I engine; Engine nomenclature.

Reciprocating air compressor: Compression process, work of compression, Single stage reciprocating compressor, volumetric efficiency, isothermal and adiabatic efficiency of a compressor; Multistage compression, advantages, ideal intermediate pressure.

Vapour power Cycle: Carnot cycle and its practical difficulties; Basic Rankine cycle with steam; Mean temperature of heat addition, steam rate, heat rate; Reheat cycle; Regenerative cycle.

Text Books

1. Engineering Thermodynamics- 5e, Nag, P.K. – TMH
2. Fundamentals of Thermodynamics- 6e, Sonntag, Borgnakke & Van Wylen, Wiley India

Reference Books

1. Thermodynamics- an Engineering approach - 6e, Cengel & Boles, TMH
2. Principles of Engineering Thermodynamics -7e, Moran, Shapiro, Boettner, Bailey. Wiley India

Course Title: Environmental Sciences					
Course Code: EVS2016					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	2	0	0	2	0

Course Outcomes:

After completion of the course, students will be able to

EVS2016.1: Understand the natural environment and its relationships with human activities.

EVS2016.2: Characterize and analyze human impacts on the environment.

EVS2016.3: Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems.

EVS2016.4: Educate engineers who can work in a multi-disciplinary environment to anticipate and address evolving challenges of the 21st century.

EVS2016.5: Understand and implement scientific research strategies, including collection, management, evaluation, and interpretation of environmental data.

EVS2016.6: Design and evaluate strategies, technologies, and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments.

Module I: [6L] Socio Environmental Impact

Basic ideas of environment and its component, Population growth: exponential and logistic; resources; sustainable development.

Concept of green chemistry, green catalyst, green solvents, Environmental disaster and social issue, environmental impact assessment, environmental audit, environmental laws and protection act of India.

Module II: [6L] Air Pollution

Structures of the atmosphere, global temperature models Green house effect, global warming; acid rain: causes, effects and control.

Lapse rate and atmospheric stability; pollutants and contaminants; smog; depletion of ozone layer; standards and control measures of air pollution.

Module III: [6L] Water Pollution

Hydrosphere; pollutants of water: origin and effects; oxygen demanding waste; thermal pollution; pesticides; salts. Biochemical effects of heavy metals; eutrophication: source, effect and control.

Water quality parameters: DO, BOD, COD. Water treatment: surface water and waste water.

Module IV: [6L]

Land Pollution

Land pollution: sources and control; solid waste: classification, recovery, recycling, treatment and disposal.

Noise Pollution

Noise: definition and classification; noise frequency, noise pressure, noise intensity, loudness of noise, noise threshold limit value; noise pollution effects and control.

Text Books

1. Gour Krishna Das Mahapatra, Basic Environmental Engineering and Elementary Biology,
   Vikas Publishing House P. Ltd.
2. A. K. De, "Environmental Chemistry", New Age International.
3. A. K. Das, Environmental Chemistry with Green Chemistry, Books and Allied P. Ltd

Reference Books

1. S. C. Santra, Environmental Science, New Central Book Agency P. Ltd
2. D. De, D. De, Fundamentals of Environment & Ecology, S. Chand & Company Ltd

Course Title: Machine Drawing Lab					
Course Code: MEC2151					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	3	3	1.5

Course Outcomes:

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

MEC2151.1: Apply limits and tolerances to assemblies and choose appropriate fits.

MEC2151.2: Prepare part drawings with geometric dimensioning and tolerances.

MEC2151.3: Assign machining and surface finish symbols.

MEC2151.4: Convert an isometric view into a multi-view projection of an object in drafting software.

MEC2151.5: Convert a multi-view projection into an isometric view of an object in drafting software.

MEC2151.6: Prepare a GA drawing of various machine components.

Module I: [6P] Application of General Dimensions and Tolerances (GD&T) using AutoCAD

- General overview on GD&T.
- Different types of dimensional tolerances and its representations.
- Placement of various dimensional tolerances in machine drawing using AutoCAD.

Module II: [9P] Conversion of Isometric view to Multi view projection using AutoCAD

- Conversion of Isometric view to Multi view projections using AutoCAD.

Module III: [12P] Part Modelling using Solid Modelling Software

- Basic concepts of conversion of Multi view projection to Isometric projection/view.
- Introduction to SolidWorks GUI and its file system.
- Discussion on sketch tools.
- Various solid modelling tools used in Part Module of SolidWorks.
- Assignment of material properties and rendering properties in SolidWorks.

Module IV: [12P] Assembly and drafting using Solid Modelling Software

- An introductory discussion on various processes of assembling parts in Assembly Module.
- Various tools to do assembly and to create exploded view and analysis of interference between parts of an assembly
- Creating templates for drafting along with other settings for automated drafting.
- Automated drafting with generation of sectional view, detailed view and Bill of Materials (BOM).

Text Books

1. Text Book of Machine Drawing, K. C. John, PHI Learning, 1e, 2009
2. Machine Drawing, K. L. Narayana, New Age International, 4e, 2012
3. AutoCAD 2024 for Engineers and Designers, Basic and Intermediate Sham Tickoo, BPB Publication, 1e, 2024
4. SolidWorks 2022 for Designers by Prof. Sham Tickoo, 20th Edition, CADCIM Technologies.

Reference Books

1. IS 2079 (Guide for selection of fits), IS-919 (Recommendations for limits and fits in engineering).
2. Beginner's Guide to SolidWorks 2024 – Level-I by Alejandro Reyes, SDC Publication.
3. Beginner's Guide to SolidWorks 2024 – Level-II by Alejandro Reyes, SDC Publication.

Course Title: Workshop Practice-II					
Course Code: MEC2152					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	3	3	1.5

Course Outcomes:

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

MEC2152.1: Explain different manufacturing processes used in workshop and safety precautions to be followed during operations.

MEC2152.2: Demonstrate various machining operations on Lathe, Milling and Shaper machines to convert a raw material into desired product.

MEC2152.3: Distinguish between Tungsten Inert Gas Welding, Metal Inert Gas Welding and Spot Welding processes and apply the knowledge to join various components.

MEC2152.4: Make a wooden Pattern and Cast a component using the pattern.

MEC2152.5: Produce a sheet metal fabricated component.

MEC2152.6: Prepare various components with the aid of forging applications.

List of Jobs to be carried out

1. To prepare a job involving various operations in lathe machine as per the drawing given.
2. To prepare an inspection report (concept of tolerance to be understood) mentioning drawing dimension and measured dimension of the prepared job in lathe machine.
3. To manufacture a spur gear in milling machine as per the specification given.
4. To cut a keyway in a shaft and the spur gearmanufacturedin milling machine,
5. To prepare key and assemble with shaft and the spur gearmanufacturedin milling machine,
6. To prepare a wooden pattern as per drawing given.
7. To prepare a sand mould including gating system using the manufactured wooden pattern and cast the same.
8. To prepare a chisel as per drawing from a hexagonal bar.
9. To prepare an air conditioning duct as per drawing from a sheet metal.
10. Fabricate a sheet metal component using spot welding.
11. Fabricate two pieces of metal using TIG and MIG welding.

Text Books:

1. "Elements of Workshop Technology" Vol 1 & 2, Hajra Choudhury, Media Promoters & Publishers Pvt. Ltd.
2. "A course in Workshop Technology" Vol 1 & 2, B.S. Raghuwanshi, Dhanpat Rai & Co.

Course Title: Design Thinking and Idea Lab (ME)					
Course Code: MEC2153					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

Course Outcomes:

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

MEC2153.1: Analyze learning &emotional experience, and Inspect emotional expressions to better understand users while designing innovative products.

MEC2153.2: Develop new ways of creative thinking and Learn the innovation cycle of Design Thinking process for developing innovative products.

MEC2153.3: Propose real-time innovative& sustainable engineering product designs and Choose appropriate frameworks, strategies, techniques during prototype development.

MEC2153.4: Learn useful mechanical fabrication and electronic system programming, control.

MEC2153.5: Learn necessary skills to build useful and standalone system/ project/prototype and protection of creation (Intellectual Property).

- **Design Thinking:**

Unit 1: An Insight to Learning

Understanding the Learning Process, Kolb's Learning Styles, Assessing and Interpreting.

Unit 2: Basics of Design Thinking

Definition of Design Thinking, Objective of Design Thinking, Sustainability, Stages of Design Thinking Process (explain with examples) – Empathize, Define, Ideate, Prototype, Test.

Unit 3: Process of Product Design

Process of Engineering Product Design, Design Thinking Approach, Stages of Product Design, Benchmarking, Basics of IPR.

Unit 4: Proof of Concept (POC) and Prototype

What is POC? Why POC? What is Prototype? Why Prototype? Concept of Rapid Prototype Development process.

Unit 5: Re-Design & Re-Create

Focus on User Experience, Address "ergonomic challenges, User focused design, **Final Presentation – "Solving Practical Engineering Problem through Innovative Product Design & Creative Solution".**

- **Idea Lab:**

Unit 6: Introduction to basic hand tools

Tape measure, combination square, Vernier caliper, hammers, fasteners, wrenches, pliers, saws, tube cutter, chisels, vice and clamps, tapping and threading, Adhesives, etc.

Unit 7: Introduction to Power tools

Power saws, jigsaw, belt sander, bench grinder, rotary tools, various types of drill bits, etc.

Unit 8: Introduction to 3D Scanning and Printing

3D scanning of surface geometry, Point cloud data generation, surface modification and 3D printing of scanned geometry using FDM 3D printer.

Unit 9: Profile cutting

2D profile cutting/engraving in acrylic / cardboard / MDF board using Laser cutter / CNC router.

Unit 10: Mechanical Fabrication

Basic Welding, Brazing, Soldering, turning, drilling, etc.

Unit 11: Electronic control

Electronic circuit building blocks including common sensors. Arduino/programmable circuit board programming and use (Signal generation, PWM, I/O, delay, Serial communication, Stepper/Servo motor control, etc.).

Unit 12: Design and implementation of a capstone project involving embedded hardware, software and machined or 3D printed enclosure.

Text Books

1. E Balaguruswamy, Developing Thinking Skills (The way to Success), Khanna Book Publishing Company, 1st edition.
2. Practical Electronics for Inventors. Paul Sherz and Simon Monk. McGraw Hill. ISBN-13: 978-1259587542, 4th edition.
3. Simon Monk, Programming Arduino Getting Started with Sketches, McGraw Hill Professional, 3rd edition.

Reference Book

1. The Big Book of Maker Skills: Tools & Techniques for Building Great Tech Projects. Chris Hackett. Weldon Owen, ISBN-13: 978-1681884325, 1st edition.

Online Resources:

1. https://www.arduino.cc/reference/en/
2. https://www.espressif.com/sites/default/files/documentation/esp32_technical_reference_manual_en.pdf
2. https://www.raspberrypi.com/documentation/

Course Title: Mechanics of Deformable Bodies					
Course Code: MEC2201					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	0	0	4	4

Course Outcomes:

After completion of the course, students will be able to

MEC2201.1: Define different types of stresses / strains and analyze relationships among them.

MEC2201.2: Classify and analyze statically determinate and indeterminate problems.

MEC2201.3: Examine circular members in torsion and members subject to flexural loadings.

MEC2201.4: Determine the principal stresses and orientations of principal planes for structural members.

MEC2201.5: Assess and analyze the governing differential equation for the elastic curve of a beam.

MEC2201.6: Interpret the concept of buckling as being a kind of instability and evaluate columns subjected to axial loads.

Module 1: [13L] Stress & Strain under Axial Loads

Stress: General Concepts, Method of Sections, Definition of Stress, Normal and shear stresses, Definition of strain, Normal and Shear Strains.

Stress Analysis of Axially Loaded Bars: Statically Determinate and Indeterminate Problems, Thermal Stresses.

Stress-Strain Relationships, Generalized Hooke's Law for isotropic materials, Poisson's ratio, relationships between Young's modulus, shear modulus and bulk modulus.

Strain energy in tension, compression.

Module 2: [13L] Beams Statics

Relationships Between Loads, Shear Forces, and Bending Moments, shear force & bending moment diagrams, differential equations of equilibrium for a beam element, symmetric beam bending, beams of composite cross section and shear stresses in bending, strain energy in bending, Shearing Stresses in Thin walled members, Un-symmetric loading of Thin walled members (concept of Shear Center)

Transformation of Plane stresses, Principal stresses, Maximum shear stresses, Mohr's circle for Plane stress. Thin-walled pressure vessels. Transformation of Plane Strain, Mohr's Circle for Plain Strain, Measurement of Strain: Strain Rosette

Module 3: [13L] Beam Deflection

Beam Deflections: deflections by simple integration, method of superposition, energy methods, Castigliano's theorems. Statically determinate and indeterminate problems on beam deflections.

Module 4: [13L] Torsion & Columns

Torsion of circular shafts, angular deflection, strain energy in torsion, torsional stress in Solid and Hollow shafts, combined bending and torsion.

Columns: Buckling of columns, Critical Euler loads for columns with pinned ends and with other different end restraints, eccentric loading of short struts, Euler's curve, empirical column formulae- (i) straight line (ii) parabolic (iii) Rankine Gordon.

Analysis of slender column using Johnson's Formula.

Text Books

1. Mechanics of Materials – Ferdinand P. Beer, E. Russell Johnston & John T. Dewolf, McGraw Hill, 8e, 2020
2. Elements of Strength of Materials- S.P. Timoshenko & D.H. Young, East West press, 5e, 2011
3. Strength of Materials- D. Nag & A. Chanda, Wiley India, 2e, 2012
4. Strength of Materials- R. Subramanian, Oxford University press, 3e, 2016

Reference Books

1. Engineering Mechanics of Solids- E.P. Popov & T.A. Balan, Pearson Education Asia, 2e, 2010
2. Mechanics of Materials- R. C. Hibbeler, Prentice Hall, 11e, 2023
3. Introduction to Solid Mechanics by I. H. Shames, JM Pitarresi, Prentice Hall, 3e, 2009

Course Title: Fluid Machinery					
Course Code: MEC2202					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

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

MEC2202.1: Identify and explain different types of fluid machines and their components.

MEC2202.2: Apply the working principle of rotodynamic machines for evaluating different flow parameters.

MEC2202.3: Interpret losses in fluid machines and evaluate different efficiencies.

MEC2202.4: Analyze performance characteristics of various fluid machines.

MEC2202.5: Examine different components and working principle of positive displacement machine.

MEC2202.6: Describe different processes and phenomena involving operation of fluid machines.

Module I: [10L]

Introduction: Definition and application of fluid machines. Classification under different categories (based on principle of operation, direction of energy transfer, type of fluid used).

Rotodynamic Machines: Classification- Pump and Turbines. Radial, Axial and Mixed flow type machines.

Centrifugal Pump: General pumping system – Suction pipe with strainer and foot valve, delivery pipe. Main components of centrifugal pump and their functions-Impeller eye, impeller blade, Volute or scroll casing, Front and Back shroud.

Principle of Energy Transfer, Rotor work, Velocity diagram.

Basic equation of energy transfer in Rotodynamic machines- expression for Euler head.

Head vs discharge relationship: Ideal head and actual head developed. Shut-off head, manometric head, No swirl condition; effect of outlet blade angle (BCV, FCV, Radial) on head developed. Comparison of radial, axial and mixed flow pump in terms of head developed and discharge.

Different losses in a centrifugal pump and efficiencies.

Module II: [9L]

Priming of a centrifugal pump. Characteristics curves of centrifugal pump: Main characteristics, Operating characteristics and Muschel curves.

System resistance curve with expression for a general pumping system- suction head, delivery head and static head; Matching of pump and system characteristics curves. Operating point and design point. Multi staging of centrifugal pump-Series and parallel operation under different conditions.

Principle of similarity in rotodynamic machine and model testing.

Module III: [10L]

Hydraulic Turbines: Classification- Impulse Turbine: Pelton Turbine- Main components and their functions, velocity triangle and work done. Wheel efficiency, Hydraulic efficiency, Overall efficiency.

Reaction turbine: Radial flow reaction turbine-Francis Turbine: main components and their functions; inward and outward radial flow turbine, velocity diagram; Some definitions (Speed ratio, flow ratio, discharge). Net Head across a reaction turbine; Theory and use of different types of draft tube

Axial flow reaction turbine-Propeller and Kaplan turbines, component parts: construction and operation; Difference between Francis and Kaplan Turbine.

Characteristics curves of impulse and reaction turbines: Main characteristics, Operating characteristics and Muschel curves.

Module IV: [10L]

Positive Displacement Machine: Reciprocating Pump- Main components; Working principle- discharge, work done and power required to drive; slip of reciprocating pump. Variation of velocity and acceleration in the suction and delivery pipes due to acceleration of the piston. Effect of variation of velocity on friction in the suction and delivery pipes; Air vessel.

Cavitation in Pump and Turbine: Causes and effects; NPSH, Thoma's cavitation factor and critical cavitation factor. Methods to avoid cavitation.

Specific speed of pump and turbine. Unit quantities in hydraulic machines.

Text Books

1. Introduction to Fluid Mechanics and Fluid Machines- Som, Biswas and Chakraborty, TMH, 4e
2. Hydraulic Machines – Dr. Jagdish Lal, Metropolitan Book Co. Pvt. Ltd, Reprint 2011.
3. Mechanics of Fluids- B Massey, Taylor & Francis, 8e

Reference Books

1. Fluid Mechanics – Dr. A.K. Jain, Khanna Publishers, 11e
2. A Textbook of Fluid Mechanics and Hydraulic Machines– R. K. Bansal, Laxmi Publications (P) Ltd.

Course Title: Engineering Materials					
Course Code: MEC2203					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

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

MEC2203.1: Explain the relationship between process, microstructure and properties of a material

MEC2203.2: Explain the effects of atomic structure and microstructure and their defects on the properties of materials

MEC2203.3: Explain the microstructure and properties of material at different temperature, composition using phase diagram

MEC2203.4: Describe the heat treatment processes and their effect on ferrous and nonferrous material

MEC2203.5: Discuss properties, microstructure and application of different ferrous and nonferrous metals and alloys

MEC2203.6: Discuss the properties, applications and making processes of different polymers, ceramics and composites

Module I: [12L]

Introduction: Material Science its importance in engineering, Relationship between process, microstructure, properties and performance

Classification of Materials -metals, polymers and elastomers (visco-elastic materials), ceramics, composites; Advanced materials semiconductors, smart materials, nano-materials;

Brief concept of atomic structure, Atomic bonding in solids bonding forces and energies; Ionic/covalent/metallic bonding.

Crystal structure: Fundamental concepts; unit cells; seven crystal systems; single crystal, polycrystalline and non-crystalline materials; Metallic crystal structures FCC, BCC, & HCP structures, atomic packing factor; Isotropy & Anisotropy.

Imperfections and defects in Metals: Point defects due to vacancy & impurities, alloys, solid solutions; linear defects, interfacial defects, grain boundaries, grain growth, grain structure, slip, plastic deformation of polycrystalline material, twining, recovery, recrystallization and grain growth.

Module II: [10L]

Phase Diagrams: Definition and basic concepts; solubility limit; phase Equilibrium, one component phase diagram, binary phase diagram, interpretation of phase diagrams.

Iron-carbon system: Allotropy of iron, iron-iron carbide phase diagram, properties and uses.

Heat Treatment: Heat treatment processes, Annealing, Quenching, Normalizing, Tempering; Precipitation or Age Hardening

Module III: [8L]

Properties of Materials:

Mechanical Properties: Engineering Stress Strain diagram, Modulus, yield strength, tensile strength, plastic deformation, true stress and strain, Ductility; Resilience; Toughness, Hardness, Strain hardening

Classification of Metals and Alloys- compositions, properties and uses:

Ferrous alloys: Plain carbon steel, alloy steels, cast iron and its types.

Non-ferrous alloys: Copper alloys, Aluminum alloys, Nickel alloys, Magnesium alloy.

Module IV: [9L]

Polymers & Elastomers: Polymer molecular structures, Polymerization, Thermoplastics & Thermosets; characteristics of polymers, Uses of polymers and elastomers.

Ceramic Materials: Common ceramic materials and their characteristics; Sintering and vitrification process; Properties and applications.

Composite Materials: Reinforcement types, Polymers matrix, Metal matrix and ceramic matrix composites and their applications

Text Books

1. Materials Science and Engineering by W. D. Callister and adapted by R. Balasubraniam, Wiley India, 9e, 2010.
2. Engineering Materials and Metallurgy by R. Srinivasan, Tata McGraw Hill, 2e.
3. Materials Science and Engineering by V. Raghavan, Prentice Hall India, 5e.

Reference Books

1. Engineering Materials Properties & Selection by Budinski & Budinski, Prentice Hall India, 9e.
2. A Textbook of Material Science and Engineering by R. K. Rajput, S. K. Kataria & Sons, 4e, 2013.
3. Mechanical Metallurgy by George E Dieter, McGraw Hill, 3e.

Course Title: Manufacturing Processes					
Course Code: MEC2204					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

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

MEC2204.1: Describe the basic ideas of different manufacturing processes & related equipments.

MEC2204.2: Acquire working knowledge of sand casting process.

MEC2204.3: Select the proper welding process for manufacturing a product.

MEC2204.4: Familiarize with different forming processes and their specific applications.

MEC2204.5: Apply the basic knowledge of principle of machining.

MEC2204.6: Analyze mechanism of machining.

Module I: [10L] Introduction to manufacturing processes and casting process

Manufacturing processes, classification of manufacturing processes.

Casting: definition, ferrous and non ferrous casting, example of cast products.

Sand casting: pattern, types of pattern, materials, allowances, mould making procedure; definition & meaning of different terms, cope & drag and gating system.

Properties of moulding sand: moulding sand composition, effect of grain size, clay & water content on moulding sand properties.

Core: definition & use, core making with oven/no baking, core prints & chaplets.

Defects in sand casting and remedies.

Process and utility of die casting, investment casting, slash casting and centrifugal casting.

Module II: [10L] Welding process

Welding: definition, different metal welding processes, types of joints.

Gas welding: process, oxy-acetylene flame, gas welding equipment.

Electric arc welding: principle of arc formation, arc welding equipment- AC and DC machine, electrodes.

Manual metal arc welding procedure: edge preparation, current and voltage setting, electrode movement, down hand, horizontal and overhead welding.

TIG & MIG welding: process and application. Resistance welding: spot welding and butt/seam welding. Causes and remedy of welding defects, NDT methods.

Module III: [9L] Forming process

Elastic & plastic deformation of perfect crystal, effect of mechanical working on mechanical properties, hot & cold working, recrystalization process.

Forging: definition, application, forging methods: smith forging, drop forging, press forging & machine forging, forging defects.

Rolling: definition, hot & cold rolling, rolled products- sections & flats, rolling load & torque, rolling stand: 2 Hi, 3Hi, 4Hi & cluster mill.

Extrusion: process & product, hot & cold extrusion, forward & backward extrusion, impact extrusion.

Wire drawing: process & products; drawing dies, drawing machine.

Press work: definition of process & different operations like shearing, blanking, piercing, notching, drawing (cupping), coining & embossing.

Module IV: [10L] Machining process

Machining: Basic principle, purpose, definition and requirements.

Geometry of single point turning tools in ASA and ORS systems, significance of rake and clearance angles, Conversion of tool angles from one system to another.

Chip formation mechanism, yielding and brittle fracture, chip reduction coefficient, cutting ratio, shear angle and cutting strain.

Built-up edge formation: cause, type and effects, orthogonal cutting and oblique cutting.

Types of machining chips.

Text Books

1. Manufacturing Technology, Foundry, Forming & Welding-P.N Rao. Vol. 1, 3e, 2012
2. Manufacturing Science-A Ghosh & A Mallick, 2e, 2010
3. Manufacturing Engineering & Technology-S Kalpakjian; Pub: Addison Wesley. 5e, 2013

Reference Books

1. Materials & Processes in manufacturing-E.P Degarmo, Black & Kohser, Pub: Wiley, 10e
2. Processes & Materials of manufacturing-R.A Lindberg, 2e, 1978

Course Title: Kinematics & Dynamics of Machines					
Course Code: MEC2205					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	1	0	4	4

Course Outcomes:

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

MEC2205.1: Explain the construction, working and function of different types of mechanisms

MEC2205.2: Analyze displacement, velocity and acceleration of different mechanisms

MEC2205.3: Find out the effect of inertia of rotating elements of machine

MEC2205.4: Find out the effect of inertia on reciprocating elements of machine

MEC2205.5: Reduce the unwanted effect of inertia from rotating elements of machine

MEC2205.6: Reduce the unwanted effect of inertia from reciprocating elements of machine

Module I: [14L] Introduction to Mechanisms

Introduction to mechanisms, Difference between Machine and Mechanism; Degree of freedom (Mobility), Kutzbach criterion, Grubler's criterion, Four bar chain and its inversions, Grashoff's law, Slider crank chain and its inversions, Double slider crank chain and its inversions. Gear train, Cam

Lower Pair Mechanisms: Straight line generating Mechanisms, Hook joint- single and double, Steering gear mechanisms – Ackerman, Davis

Module II: [14L] Analysis of Mechanisms

Four bar chain: Displacement, velocity and acceleration analysis

Slider crank mechanism: Displacement, velocity and acceleration analysis

Gear and gear train: Terminologies, different types of gears, motion analysis of gear train - Simple, compound, Epicyclic gear train

Cam Mechanisms: Cam and Followers, Motion analysis: Displacement, velocity and acceleration, Cam profile design

Module III: [14L] Dynamic Analysis of Mechanisms

Dynamic analysis of Mechanism: Inertia force and inertia torque in Mechanism; Dynamic Equivalent System; correction couple (torque); Turning moment diagram and flywheel design.

Gyroscope: Gyroscopic Torque; Gyroscopic effects on Aero-plane; Gyroscopic Effects on Naval Ship; Stability of an Automobile; Stability of Two-wheel Vehicles.

Un-balancing: Unbalancing due to rotating and reciprocating masses in a machine

Module IV: [10L] Elimination of Unbalancing factors

Static and dynamic balancing - single and several masses in different planes, primary and secondary balancing of reciprocating masses, Balancing of single and multi-cylinder engines, Governors and Gyroscopic effects.

Text Books

1. Theory of Machines – S S Rattan, Tata McGraw Hill, 4e, 2014.
2. Theory of Machines – R. S. Khurmi and J. K. Gupta, S. Chand Technical, 14e, 2005.

Reference Books

1. Theory of Machines and Mechanisms – Uicker, Pennock and Shigley, Oxford University Press, 3e, 2009.
2. Kinematics and Dynamics of Machinery – R. L. Norton, McGraw Hill Education, 1e, 2009.
3. The Theory of Machines through Solved Problems – J. S. Rao, New Age International Publication, 1e, 2012.
4. Mechanism and Machine Theory – Ashok G. Ambekar, PHI Learning, 1e, 2007.
5. Theory of Mechanisms & Machines (3rd edition) – Ghosh and Mallik; East West Press, 3e, 2006.

Course Title: Measurement and Metrology					
Course Code: MEC2206					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

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

MEC2206.1: Classify various measuring techniques.

MEC2206.2: Demonstrate the structure and characteristics of measuring instruments.

MEC2206.3: Implement the concept of interchangeability, limits, fits and tolerance in engineering drawing, manufacturing and assembly.

MEC2206.4: Apply the knowledge of surface finish and its measurement for design, manufacturing and inspection of engineering components.

MEC2206.5: Define and understand the working principle of transducers.

MEC2206.6: Select and operate measuring instruments such as LVDT, Strain Gauge, Piezoelectric load cell, Thermometer, Thermocouple, and Optical Pyrometer as necessitated by the engineering application.

Module I: [10L]

Introduction: Definition and importance of Metrology & Measurement; Methods of measurements – direct, indirect, comparison, substitution, transposition, deflection and null measurement; Errors in measurement – absolute, relative, parallax, alignment, loading, dynamic and calibration error.

Linear Metrology: Use of Vernier calliper, Vernier height and depth gauge, micrometer.

Angular Metrology: Use of protractor, Vernier bevel protractor, angle gauges, sine bar and slip gauges.

Comparators: Definition, use and essential features of Comparators; working principle and application of (i) mechanical comparator- dial indicator, (iii) Pneumatic comparator- Back pressure Bourdon gauge, (iv) Optical comparator-profile projector.

Module II: [10L]

Measuring Instruments: Functional elements of an instrument- sensing, conversion, manipulation, data transmission and presentation. Characteristics of an instrument- accuracy, precision, repeatability, reproducibility, sensitivity, readability and uncertainty analysis.

Limits, Fits and Tolerances: Interchangeability of components; concept of limits, tolerances and fits; hole basis and shaft basis system of fits; Tolerance analysis in manufacturing and assembly; Go and No Go limit gauges.

Module III: [10L]

Measurements of Forms: Definition- Straightness, Flatness Parallelism, Squareness, Roundness, Cylindricity and Concentricity. Measurement of forms: (i) Level using spirit-level; (ii) Flatness using interferrometry (Newton's rings); (iii) Parallelism, cylindricity and concentricity using dial indicator; (iv) Geometry by coordinate measuring machine (CMM). Alignment and testing methods.

Measurement of Surface Finish: Terminologies- surface roughness, roughness (primary texture), waviness (secondary texture), form, lay, flaws, sampling length. Numerical evaluation of surface roughness: peak-to-valley height (Rz), Root mean square value (RMS), centre line average (CLA, Ra). Working principle of a Talysurf.

Module IV: [9L]

Transducers - Definition, primary and secondary transducers, active and passive transducers.

Principle of operation: (i) displacement measurement by LVDT; (ii) measurement of force by strain-gauge load cell and piezoelectric load cell; (iii) measurement of temperature by liquid-in-glass thermometer, thermocouples, optical pyrometer.

Text Books

1. N. V. Raghavendra & L. Krishnamurthy, Engineering Metrology & Measurement, Oxford University Press.
2. R. Rajendra, Principles of Engineering Metrology, Jaico Pub. House.
3. M.Mahajan, A text book of metrology, Dhanpat Rai & Co.
4. Bewoor and Kulkarni, Metrology & Measurement, TMH

Reference Books

1. E.O. Doebelin and D.N. Manik, Measurement Systems– Application and Design, Tata McGraw Hill.
2. Beckwith, Lienhard and Marangoni, Mechanical Measurements, Pearson.
3. R.K. Jain, Metrology, Khanna Publication, New Delhi.

Course Title: Material Testing Lab					
Course Code: MEC2251					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	3	3	1.5

Course Outcomes:

After completing the course students will be able to:

MECH2251.1: Investigate the material properties under tensile and torsional loading conditions experimentally.

MECH2251.2: Demonstrate experimentally the brittle fracture under impact load.

MECH2251.3: Using a strain gauge for measurement of strain and subsequently **evaluating** the modulus of elasticity for members subjected to bending.

MECH2251.4: Evaluate the hardness of the materials **using** different hardness test methods.

MECH2251.5: Distinguish experimentally the deflection of leaf and helical spring.

MECH2251.6: Identify metal cracks and **examine** the metallographic structure.

List of Experiments:

1. Tensile test of a mild steel specimen.
2. Impact Test – Charpy and Izod.
3. Drawability test of sheet metal by Cupping
4. Fatigue test of a typical sample.
5. Torsion test of a mild steel specimen.
6. Bending of cantilever beam using a strain gauge.
7. Bending test of simply supported beam
8. Hardness Test (Brinell hardness, Rockwell hardness and Vicker's hardness).
9. Determination of coefficient of friction.
10. Deflection of a leaf spring.
11. Determination of stiffness of a close coiled helical spring.
12. Identification of surface cracks by Dye Penetration Test of given sample.
13. Identification of surface and sub-surface cracks by Magnetic particle inspection (MPI) Test.
14. Sample preparation and metallographic observation of ferrous, non-ferrous metals and alloys.

Reference Books:

1. Nag, D., Chanda, A. (2018) Strength of Materials, Second Edition, Wiley India Pvt. Ltd., New Delhi, India.
2. Timoshenko, S.P., Young, D.H. (2011) Elements of Strength of Materials, Fifth Edition, Rekha Printers Pvt. Ltd., Affiliated by East West Press Pvt. Ltd., New Delhi, India.
3. Hibbeler, R.C. (2018) Mechanics of Materials, Ninth Edition (S.I. units), Pearson India Education Services Pvt. Ltd., Noida, India.
4. Bhandari, V.B. (2015) Design of Machine Elements, Third Edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi, India.

Course Title: Fluid Mechanics & Hydraulic Machines Lab					
Course Code: MEC2252					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	3	3	1.5

Course Outcomes:

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

MEC2252.1: Identify different flow patterns and regimes in a pipe.

MEC2252.2: Evaluate coefficient of discharge of flow measuring devices.

MEC2252.3: Implement the method of airflow velocity measurement using Pitot static tube.

MEC2252.4: Examine the validity of Bernoulli's equation and Stokes' law.

MEC2252.5: Demonstrate practical understanding of major and minor losses in internal pipe flow.

MEC2252.6: Analyze the performance of Pelton turbine, Francis turbine and Centrifugal pump.

List of Experiments / Jobs to be carried out during the semester

1. Characteristics of Laminar & Turbulent flow.
2. Verification of Bernoulli's Equation.
3. Determination of Coefficient of Discharge of Flow Measuring Devices in pipe flow.
4. Pipe friction characteristics in different flow regimes for flow through pipes.
5. Study of minor losses in pipe fittings apparatus.
6. Determination of Coefficient of Discharge of V-Notch & Rectangular Weir.
7. Determination of airflow velocity by a Pitot Static Tube.
8. Performance test of a Centrifugal Pump.
9. Performance test of a Pelton Turbine.
10. Performance test of a Francis Turbine.
11. Verification of Stokes' Law.
12. Performance test of centrifugal pumps in parallel operation.
13. Performance test of centrifugal pumps in series operation.

Reference Books:

1. ‘Fluid Mechanics with Laboratory Manual’ by B. Majumdar, PHI Publication.
2. ‘Fluid Mechanics’ by Frank M White, McGraw-Hill Publication.
3. ‘Mechanics of Fluids’ by B. Massey, CRC Press Publication.
4. ‘Fluid Mechanics (Including Hydraulic Machines)’ by A. K. Jain, Khanna Publication.

Course Title: Measurement and Metrology Lab					
Course Code: MEC2253					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

Course Outcomes:

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

MEC2253.1: Measure linear dimensions using Vernier Caliper, Outside Micrometer. Vernier Height Gauge & Depth Micrometer.

MEC2253.2: Test internal dimensions using Inside Tubular Micrometer and Telescopic Gauge.

MEC2253.3: Measure precision angles using Sine Bar, Vernier Bevel Protractor and Angle Gauge.

MEC2253.4: Check linear and angular dimensions of precision components and profiles using Profile Projector.

MEC2253.5: Identify parallelism, cylindricity and concentricity of components using dial indicator.

MEC2253.6: Compare surface finish.

List of Experiments:

1. Measurement of linear dimensions of a rectangular block by Vernier Caliper and Outside Micrometer.
2. Measurement of the diameter of a hole by Inside Tubuler Micrometer and Telescopic Gauge.
3. Linear measurement using Vernier Height Gauge & Depth Micrometer.
4. Precision Angular measurement using Sine Bar.
5. Angular measurement using Vernier Bevel Protractor and Angle Gauge.
6. Measurement of thread profile of a bolt/ file by Profile Projector.
7. Measurement using Thread gauge, Radius gauge, Angle gauge and Feeler gauge.
8. Measurement of parallelism, cylindricity and concentricity of components using dial indicator.
9. Measurement of surface finish.
10. Measurement of air velocity across an air duct using anemometer.

Reference Books

1. N. V. Raghavendra & L. Krishnamurthy, Engineering Metrology & Measurement, Oxford University Press.
2. R. Rajendra, Principles of Engineering Metrology, Jaico Pub. House.
3. Bewoor and Kulkarni, Metrology & Measurement, TMH.

DETAILED SYLLABUS

3rd Year

Course Title: Machine Elements and System Design					
Course Code: MEC3101					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

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

MEC3101.1: Understand the solution process of a design problem following the correct mode of failure and relevant theory of failure with proper selection of materials and manufacturing process.

MEC3101.2: Assess properly a machine design problem under variable loading in accordance with all the relevant principles and theories.

MEC3101.3: Execute the process of designing of a threaded fastener, a welded joint, a helical spring and a leaf spring as per standard rules.

MEC3101.4: Determine proper dimensions and specifications of transmission shaft, keys, flanges and bearings as per the standard practices and codes.

MEC3101.5: Perform the correct process of designing of various torque transmitting elements and drives like gears and gear-drives, belt drives and chain drives following proper methodologies.

MEC3101.6: Analysis efficiently various vibration problems and different case studies regarding designing of various machine components which would enable them to implement their knowledge in solving their present design problems.

Module I: [10L]

Fundamental concepts in Machine Design

Philosophy of Machine Design: A brief overview, Engineering Materials: Study of properties and method of selection Roll of manufacturing in Machine Design; Force analysis and calculation of stresses in machine elements; Various Modes of Failures, various Theories of Failure and concept of Factor of Safety; Detailed discussion on Maximum Principal Stress theory, Maximum Shear Stress theory and Distortion Energy Theory (von Misses).

Design against cyclic loadings

Stress concentration- its causes and remedies, Measurement of Stress Intensity Factor (SIF) of various objects under various load and boundary conditions ; Various types of cyclic loadings and stresses, Fatigue failure and endurance limit, Detailed discussion on rotating beam experiment and characteristics of S-N diagram ; Design under reversed stresses for finite as well as infinite life using S-N diagram, Cumulative design in fatigue; Design under fluctuating stresses for finite as well as infinite life using Soderberg and Modified Goodman diagram.

Module II: [10L]

Design of Fasteners and Springs

Various types of fastening components- Temporary and Permanent, Various types of threaded fasteners, Different threads with their technical specifications; Simple analysis of a bolted joint, Bolted joint under various types of eccentric loadings, Eccentric load on circular base ; Various types of welded joints, Design of welded joints under various types of eccentric loadings ;
Various types of helical springs, Terminology of Helical Spring, Materials of helical spring, Styles of End, Stress and deflection equation.; Design of a helical spring by trial-and-error method; Various types of Leaf Spring, Nipping of a Leaf Springs.

Design of transmission shaft, keys and flanges

An overview on transmission shafts, Design of shaft on strength basis and torsional rigidity basis; Design of hollow shaft on strength basis and torsional rigidity basis, Design of shaft using ASME Code; Different types of Keys, Design of square flat key and Kennedy key; Various types of flanges, Design of rigid flange.

Module III [10L]

Design of Rolling and Sliding contact Bearings

Bearing types, nature of load; Static and dynamic load capacity, Stribeck equation ; Dynamic load carrying capacity, Equivalent bearing load, Load life relationship, Selection of bearing from manufacturers catalogue, Design under cyclic loading, Measurement of reliability of a deep groove ball bearing ,
Various types of sliding contact bearings, Viscosity and its measurements, Petroff's equation and Mckee's investigation, Design of a hydrostatic step bearing and Hydrodynamic Journal bearing.

Design of Transmission elements

Types of gears, Nomenclature of a gear tooth of various gears, Relation among the gear parameters, Various profiles of gear teeth and their comparative discussion, Concept of pressure angle and interference ; Force analysis of spur gear, helical gear, bevel gear and worm gear; Design of a spur gear ; Design of a helical gear ; Design of a bevel gear.

Module IV: [9L]

Design of Transmission elements

An overview about various types of belt drives, Design of a belt drive; Brief discussion on chain drives, Design of a Chain Drive

Vibrations in machine elements and various case studies

Degree of freedom of a vibration, Natural frequency and critical damping; Forced vibration and resonance; Torsional vibration and critical speed of a rotating shaft.

Case studies on automobile suspensions, Automatic transmission, material conveyor systems and construction machinery.

Text Books

1. Design of Machine Elements- V. B. Bhandari, TMH.
2. Shigley, J.E. and Mischke, C.R., "Mechanical Engineering Design," McGraw-Hill, 1989
3. Sadhu Singh, "Machine Design", Khanna Book Publishing, 2021.
4. Sadhu Singh, "Machine Design Data Book", Khanna Book Publishing, 2022.

Reference Books

1. Deutschman, D., & Wilson, C.E., "Machine Design Theory & Practice", Macmillan, 1992
2. Spottes, M.F., "Design of Machine elements", Prentice-Hall India, 1994.
3. R. L. Norton, "Mechanical Design – An Integrated Approach", Prentice Hall, 2009.

Course Title: Heat Transfer					
Course Code: MEC3102					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	0	0	4	4

Course Outcomes:

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

MEC3102.1: Identify the basic laws of heat transfer, and implement the concepts in thermal analyses of engineering systems.

MEC3102.2: Judge the steady heat transfer by conduction in simple geometries.

MEC3102.3: Examine heat transfer rates in extended surfaces; in transient conduction; and appraise radiation heat transfer between black bodies, as well as between gray bodies

MEC3102.4: Describe and analyze forced and free convection phenomena

MEC3102.5: Explain boiling heat transfer phenomenon and describe laminar film condensation.

MEC3102.6: Examine heat exchanger performance by using the methods of LMTD and ε-NTU.

Module I: [13L]

Fundamentals: Modes of heat transfer: Physical origins and rate equations; Relationship to Thermodynamics; Analysis of heat transfer problems-methodology; Relevance of heat transfer.

Introduction to Conduction: The conduction rate equation (Fourier's law); Thermal conductivity, isotropic, homogeneous medium, effect of temperature on thermal conductivity of solids, liquids and gases; Thermal diffusivity.

The heat diffusion equation: in Cartesian, Cylindrical and Spherical coordinates and its reduction to specific cases.

One-dimensional, steady-state conduction without heat generation: Plane Wall — temperature distribution, thermal resistance, electrical analogy, composite wall, thermal contact resistance; Radial Systems— the Cylinder and the Sphere, critical thickness of insulation; Overall heat transfer coefficient.

One-dimensional, steady-state conduction with heat generation: Plane wall and radial systems.

Module II: [13L]

Heat Transfer from Extended Surfaces: General conduction-convection analysis, types of fin, heat flow analysis through fin of uniform cross section (infinitely long, insulated tip, fixed tip temperature), efficiency and effectiveness of fin.

Transient Conduction: Lumped capacitance method, thermal time constant, validity of lumped parameter approach, Biot number, Fourier number.

Radiation: Physical mechanism of thermal radiation, spectral radiation intensity, spectral emissive power and total emissive power; Blackbody radiation: definition of black body, radiation laws, emissivity, absorptivity, reflectivity, transmissivity, Kirchoff's identity; Gray body.

Radiation exchange between black bodies, radiation shape factors and various relationships; Heatexchange between non-black bodies, concept of opaque, gray and diffuse surface, irradiation, radiosity, radiation heat exchange among surfaces forming enclosure.

Module III: [13L]

Forced Convection: Principles of convection; Newton's law of cooling and significance of heat transfer coefficient.

Dimensional analysis applied to forced convection; Dimensionless numbers and their physical significance; Empirical correlations.

Derivation of continuity, momentum and energy equations in 2-D.

The velocity and thermal boundary layer and its significance; Local and average convection coefficients; Momentum and energy equations of laminar boundary layer on a flat plate; Similarity methods.

General solution of von Kármán integral momentum and energy equation of boundary layer; Relation between fluid friction and heat transfer; Introduction to turbulent boundary layer heat transfer.

Forced Convection (Continued): Heat transfer in laminar tube flow; Bulk temperature; Empirical relations for pipe and tube flow.

Module IV: [13L]

Natural Convection: Mechanism of free convection; Velocity and thermal boundary layers. Free convection heat transfer on a vertical flat plate; Empirical relations for free convection.

Introduction to Boiling Heat Transfer: General aspects, Boiling regimes, Bubble shape, size, growth and collapse, Critical diameter; Factors affecting nucleate boiling.

Condensation Heat Transfer: General aspects; laminar film condensation.

Heat Exchangers: Uses and types of heat exchangers; Parallel and counter-flow types.

Introduction to LMTD method; correction factors; Fouling factor.

ϵ-NTU method for heat exchangers

Text Books

1. Introduction to Heat Transfer- S.K. Som, PHI, 2e
2. Heat & Mass Transfer, P.K. Nag, TMH, 3e

Reference Books

1. Fundamentals of Heat and Mass Transfer-Incropera, DeWitt, Bergmam, & Lavine, Wiley India
2. Heat and Mass Transfer: A Practical Approach- Yunus A. Cengel, McGraw-Hill, 2007
3. Heat Transfer-J P Holman & Souvik Bhattacharyya, TMH
4. NPTEL lecture series on heat transfer

Course Title: Mechatronics, Robotics & Control					
Course Code: MEC3103					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

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

MEC3103.1: Discuss the application of mechatronics system.

MEC3103.2: Identify different components of industrial robots and classify based on different criterion.

MEC3103.3: Explain different types of drive system and their application.

MEC3103.4: Discuss the working principle and application of different sensors.

MEC3103.5: Analyze and apply robot kinematics.

MEC3103.6: Explain, analyze and evaluate different control system.

Module I: [10L]

Introduction: Elements of mechatronics system

Definition of robot; Main components of robot, Robot geometry; Classification of robot; Robot specifications.

Robot end effector: Grippers; mechanical grippers, vacuum cups, magnetic grippers, adhesive grippers; Robot Tools: Spot welding gun, pneumatic wrench, welding torch, grinder, spray painting gun.

Module II: [10L]

Mechanical Drives: Introduction, Different mechanisms, transmission system, recirculating ball screws, Linear motion bearings, harmonic drives.

Pneumatic and Hydraulic Drives & actuators: Elements of pneumatic and hydraulic drives comparison between them, pneumatic and hydraulic circuits, symbolic representations of such circuits indicating different valves, actuators, etc.

Electrical Drives & actuators: Servo motors, Brushless DC motors, Induction motor and Variable Frequency Drive, Stepper motor

Special actuators: Magnetostrictive, Shape memory alloy, Elastomeric.

Module III: [9L]

Sensors and transducers: Displacement-linear & angular, velocity, acceleration, pressure, force, temperature, proximity, tactile sensors.

Robot Vision System: definition, use, functions, components, classification; Application of robot vision system.

Module IV: [10L]

System modeling in Mechatronics system

Definition of Robot kinematics, Tool frame and base frame. World – coordinate system, Direct kinematics, Inverse kinematics, Position and orientation of objects, Homogeneous transformation, Denavit-Hartenberg (D-H) representation.

Types of control system, transfer function, time domain analysis, frequency domain analysis, Stability, Close loop controllers.

Text Books

1. Mechatronics- W. Bolton, Pearson Education
2. Industrial Robotics- MP Groover- TMH Education Pvt. Ltd.
3. Mechatronics- Tilak Thakur, Oxford University Press
4. Mechatronics- N.P. Mahalik, Tata McGraw Hill Publication

Reference Books

1. The 8051 microcontroller and embedded systems using assembly and C - Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinlay, Pearson Education
2. Microcontrollers: principles and applications- Ajit Pal, PHI
3. Mechatronics- HMT Ltd., Tata McGraw Hill Publication.
4. Mechatronics- M.D. Singh and J.G. Joshi, Prentice Hall of India Pvt. Ltd.

Course Title: Refrigeration & HVA					
Course Code: MEC3131					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

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

MEC3131.1: Describe the term in the refrigeration system and various refrigerants used in the refrigeration system and its impact on the environment.

MEC3131.2: Analyze standard vapour compression cycle working principle and calculate COP of different systems.

MEC3131.3: Explain Air Refrigeration system, its advantages and limitations, and its applications, Aircraft refrigeration system.

MEC3131.4: Judge the different parts of vapour absorption refrigeration cycle, its advantages and disadvantages over VCRS.

MEC3131.5: Recognize the use of different components in refrigeration systems.

MEC3131.6: Calculate various properties of moist air, evaluate the various psychrometric processes.

Module I: [10L] Introduction and Vapour compression cycle (VCRS)

Concepts of Refrigeration and Air-conditioning, Unit of refrigeration, Refrigerants Desirable Properties, Nomenclature.

Vapour compression cycle (VCRS) on p−*h* and T−s diagrams, Cycles with sub-cooling, superheating and their effects; Effect of changes in evaporator pressure and condenser pressure on the performance of a simple VCRS.

Multi-stage and multiple evaporator system, Cascade system, COP comparison.

Module II: [9L] Air Refrigeration System and Vapour Absorption Refrigeration System

Air Refrigeration System (ARS)

Bell-Coleman refrigerator. COP determination, actual air refrigeration cycle, Air craft Refrigeration system, Boot – strap air cooling system.

Vapour Absorption Refrigeration System (VARS)

Advantages of VARS over VCRS, Working principle of simple VARS, practical VARS, Refrigerant-absorbent combinations, Lithium bromide-water System, Aqua-ammonia systems. Limitations of VARS, Maximum COP of VARS, Three fluid absorption System.

Module III: [9L] Equipment and Control

Major Refrigeration Equipment - Compressors: rotary & centrifugal. Condensers: types used in refrigeration systems; Evaporators: expansion devices: capillary tubes and thermostatic expansion valves.

Module IV: [11L] Different Psychrometric Process

Basic definitions and principles related to Psychrometry; Psychrometric Charts & Their Uses;

Heating, Cooling, Heating & Humidification and Cooling & Dehumidification processes. Different Air conditioning system under winter/summer, Adiabatic Saturation, Cooling Coils, By-pass Factor. Sensible Heat Factors. Heat Load estimation: Simple cases of Cooling and Dehumidification.

Ventilation: Definition & Requirements, Natural & Mechanical Ventilation, Ventilation Load Calculation, Air Handling unit. Duct Sizing & Duct Design.

Text Books

1. Refrigeration and Air Conditioning- C.P. Arora, TMH, 3e.
2. Refrigeration and Air Conditioning- S.C. Arora and S. Domkundwar, Dhanpat Rai Publication

Reference Books

1. Refrigeration and Air Conditioning- R.C. Arora, PHI.
2. Basic Refrigeration and Air Conditioning- P.N. Ananthanarayanan, TMH, 3e.
3. Refrigeration and Air Conditioning- W.F. Stoecker & J.W. Jones, McGraw Hill.

Course Name: Electrical Machines					
Course Code: MEC3132					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes

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

MEC3132.1: Explain the constructional details and operating principle of the DC generator and analyze the performance under various operating.

MEC3132.2: Acquire knowledge about the constructional details, principle of operation, excitation types and analyze the performance of DC motors.

MEC3132.3: Acquire knowledge regarding the structural aspects, operational principles, evaluation of performance, and examination techniques concerning single-phase transformers.

MEC3132.4: Analyse the operation of three phase induction motors and understand various methods of speed control.

MEC3132.5: Apply the knowledge of synchronous generator to identify and analyze the problems related to performance analysis.

MEC3132.6: Acquire an understanding of synchronous motor and analyse its performance.

Module-I: [10L]

Construction of DC machine. Different methods of excitation of DC machine.

DC Generators: EMF equation, Concept of armature reaction. Voltage build-up of shunt Generator. Characteristics of DC Generator.

D.C. Motors: Principle of operation. Back EMF. Torque equation. Characteristics of DC motors. Speed control of DC motor. Starting of DC shunt motor. Different methods of braking.

Losses and Efficiency of D.C Machine, Application of D.C Machine

Module-II: [10L]

Single phase Transformers: Construction, Operating principle, Emf Equation, Equivalent circuit and phasor diagram of ideal and practical transformer, Losses and efficiency, Open & short circuit tests, Voltage regulation, Parallel operation.

Autotransformer: Comparison between autotransformer and two winding transformer.

Module-III: [8L]

Three phase Induction Motor: Construction, Production of rotating magnetic field, Working principle, Concept of slip, relation between frequency of rotor induced emf and supply frequency, Equivalent circuit and phasor diagram, Torque equation, Condition of maximum torque, Torque-slip characteristic, Methods of improving the starting torque, Introduction to speed control and braking of induction motor, Application of three phase Induction Motor.

Module-IV: [8L]

Alternator: Construction, Excitation Systems, E.M.F equation, Pitch factor and Distribution factor, Armature reaction- Lagging, Leading, Unity p.f load, Equivalent circuit and phasor diagrams.

Synchronous Motor: Principle of operation, Phasor diagram, Effect of varying field current- V curve, starting of synchronous motor. Hunting. Application of synchronous motor.

Text Books:

1. Electrical Machinery, P.S. Bimbhra, 6th Edition, Khanna Publishers.
2. Electrical Machines, Ashfaq Hussain, Dhanpat Rai and Co.
3. Theory and Performance of Electrical Machines, J. B. Gupta, Katson Publication
4. A Textbook of Electrical Technology - Volume II, B. L. Theraja, A. K. Theraja, S. Chand and Co. Ltd.

References:

1. Electrical Machines, P.K. Mukherjee & S. Chakrabarty, Dhanpat Rai Publication.
2. Electric machines, D.P. Kothari & I.J Nagrath, 3rd Edition, Tata Mc Graw-Hill Publishing Company Limited.

Course Title: Data Structure and RDBMS					
Course Code: MEC3133					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

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

MEC3133.1: Ability to choose appropriate data structures to represent data items in real world.

MEC3133.2: Ability to design programs using a variety of data structures such as stacks, queues, linked lists, hash tables, binary trees, search trees.

MEC3133.3: Implement the application of algorithms for sorting and searching.

MEC3133.4: Identify the fundamental elements of relational database management systems.

MEC3133.5: Design and explain the basic concepts of relational data model, entity-relationship model, and relational database design**.**

MEC3133.6: Identify the use of normalization and functional dependency in database design.

Module I: [11L]

Linear Data structures: Singly Linked List- Insertion at beginning, at end and any position of the List. Deletion by value, by position: beginning, end and any position of the List Stack and Queue: Both array and Linked Representation, Circular queue using array only. Application of stack: Infix to postfix conversion, Evaluation of postfix expression.

Module II: [8L]

Non-Linear Data Structures:

Trees: Binary Trees: Array and Linked representation, Binary tree Traversal Techniques, reconstruction of binary tree using traversal sequence. Binary Search Trees - Insertion and Deletion algorithms.

Sorting Algorithms: Bubble sort, Insertion sort, Selection sort, Quick sort and their comparison.
Searching Algorithms: Linear search, Binary search and their comparison.

Module III: [10L]

Database Concept

Introduction to Database Concepts, File Processing System and Database Management System, DBMS Architecture and Data Independence. Data Model: Basic Concepts, Entity-Relationship

Diagram, Keys, Cardinality, Weak Entity Set. Introduction to SQL: Operators like select, project, rename, Cartesian product, join, union, intersect, minus, DDL, DML.

Module IV: [10L]

Relational Database Design: Functional Dependencies, Normalization: Different anomalies in database designing 1NF, 2NF, 3NF and BCNF. Introduction to Transaction Processing Concepts: ACID properties, Serializability.

Text Books:

1. Data Structures. Author: Seymour Lipschutz. Publication: Tata McGraw-Hill (India)
2. Data Structures and Program Design in C. Author: Kruse Robert L., Robert Kruse, Cl Tondo. Publication: Pearson Education India.
3. Fundamentals of Database Systems Author: Elmasri Ramez and Navathe Shamkant Publication: Pearson.
4. Database System Concepts Author: A. Silberschatz, H.F Korth, S.Sudarshan Publication: McGraw Hill Education (India) Private Limited

Reference Books:

1. Data Structures using C. Author: Tanenbaum A. S, Langsam Y., Augenstein M. J. Publication: Pearson.
2. The Art of Computer Programming Author: Donald E. Knuth Publication: Addison-Wesley Professional
3. Introduction to Database Management Vol. I, II, III, Author: Date C. J. Publication: Addison Wesley.
4. Principles of Database Systems Author: Ullman JD. Publication: Galgottia Publication Subject Name: RAILWAY & AIRPORT ENGINEERING

Course Title: Programming for Engineering Applications					
Course Code: MEC3134					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

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

MEC3134.1: Do basic math operations and perform operations related to linear algebra

MEC3134.2: Solve differential equations analytically and numerically

MEC3134.3: Numerical solution of nonlinear equations

MEC3134.4: Perform different data analysis techniques

MEC3134.5: Represent data in with suitable plots

MEC3134.6: Solve engineering problems

Module I: [9L] Introduction and Matrix operations

Introduction, basic math operation: addition, substraction, multiplication, division, remainder, exponent, Matrices and vectors – indexing, matrix manipulation, creating vectors, arithmetic operations, relational operations, logical operations, elementary math functions, matrix functions.

Module II: [10L] Graphics

Files and File Management – Import/Export.

2D plot – labels, legend, text, axis control, modify.

3D plots – mesh and surface plot, vector field, volumetric plot.

Graphic handling – object handle, object property, modify, layout.

Saving and printing graphs.

Module III: [10L] Mathematical Computing

Linear Algebra - solving linear system, Gaussian elimination, Eigenvalues, Eigen vectors, matrix factorisation. Curve fitting and Interpolation – polynomial curve fitting, least square curve fitting, general nonlinear curve fitting. Differentiation, Integration, Differential equations - Basic Symbolic, 1st order ODE, 2nd order ODE.

Nonlinear algebraic equations.

Numerical Techniques and Transforms.

Module IV: [10L] Engineering Applications

Mechanics- Projectile, force and potentials.

Static analysis- Deflection of bar, beam and shaft.

Dynamic analysis- Vibration, stability of 1 degree of freedom system.

Heat transfer- 1D problems.

Fluid kinematics and dynamics- 1D problems.

Text Books

1. Introduction to Programming Using Python, Y. Daniel Liang. Pearson, 2017.
2. Numerical Python: Scientific Computing and Data Science Applications with Numpy, SciPy and Matplotlib-Johansson. R. Apress, 2018.
3. Getting Started With MATLAB, Pratap R., Oxford University Press, Indian Edition, 2010.
4. Numerical Methods Using MATLAB, Mathews J.H., Fink K. D., Prentice Hall of India, 2007.

Reference Books

1. Engineering Mechanis-Statics, Meriam J.L., Kraige L. G., Indian Edition, 2017
2. Engineering Mechanis-Dynamics, Meriam J.L., Kraige L. G., Indian Edition, 2018
3. Strength of Materials-Part 1, Timoshenko S., CBS Publishers and Distributors Pvt. Ltd., 3rd edition, 2021
4. Kinematics and Dynamics of Machinery – R. L. Norton, McGraw Hill Education, 1e, 2009.
5. Introduction to Fluid Mechanics and Fluid Machines, Som S. K., Biswas G., Chakraborty S., McGraw Hill Education India Pvt. Ltd, 2011
6. Introduction to Heat Transfer, Incropera F. P., DeWitt. D. P., Bergman, T. L., Lavine A S., John Wiley & Sons, 2017.

Course Title: Mechanical Vibration					
Course Code: MEC3141					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

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

MEC3141.1: Determine natural frequency of free vibration for single degree freedom systems.

MEC3141.2: Determine natural frequency of forced vibration for single degree freedom systems.

MEC3141.3: Determine natural frequencies of multi degree freedom systems.

MEC3141.4: Apply numerical methods to determine natural frequencies of multi degree freedom systems.

MEC3141.5: Analysis of whirling of and determination of critical speed of shaft

MEC3141.6: Describe vibration measurement system and analyze experimentally obtained data.

Module I: [10L] Free Vibration with Single degree of freedom

Vibration: Definition, Terminologies
Un-damped: Equation of motion and natural frequency – longitudinal, torsional and transverse vibration.
Damped: Equation of motion and natural frequency – longitudinal, torsional and transverse vibration; viscous damping - underdamping, critical damping, over damping; equivalent damping coefficient; logarithmic decrement; Coulomb damping.

Module II: [10L] Forced Vibration with Single degree of freedom

Equation of motion and solution function for forced vibration. Steady state forced vibration, sources of excitation, impressed harmonic force, resonance, impressed force due to rotating unbalance, base excitation, transmissibility and isolation, performance of different types of isolators, power absorbed by viscous damping.

Module III: [12L] Multi-degree Vibration

Multi degree of freedom system: Natural vibration, Forced harmonic vibration.

Lagrangian method for formulation of equation of motion Rayleigh's method, Dunkerley's method, Rayleigh-Ritz method, Method of matrix iteration.

Critical speeds of shafts: Critical speed of a light shaft having a single disc - without damping and with damping. Critical speed of a shaft having multiple discs - secondary critical speed.

Module IV: [7L] Vibration measurement and control systems

Vibration absorber; piezoelectric transducers and linear variable differential transformer transducer; Vibration pickups: Vibrometer, Accelerometer, Vibration exciters - Mechanical exciters, impact hammer and electrodynamic shaker.

Text Books

1. Theory of Vibrations with Applications – William Thomson, Pearson, 2008.
2. Theory of Machines – S S Rattan, Tata McGraw Hill, 4e, 2014.

Reference Books

1. Mechanical Vibrations - G. K. Groover, 8th Edition, Nem Chand & Bros, 2009.
2. Mechanical Vibrations , Singiresu S. Rao, 6th Edition, Pearson Education, 2018
3. Mechanical Vibrations, S. Graham Kelly, 1st Edition, Tata McGraw Hill, 1996

Course Title: Turbo Machinery					
Course Code: MEC3142					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

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

MEC3142.1: Understand and compare the features and working of various turbomachines.

MEC3142.2: Explain the basic working principle of different types of turbomachines.

MEC3142.3: Apply the concepts of energy transformation in turbomachines.

MEC3142.4: Solve problems using basic concepts of turbomachines.

MEC3142.5: Analyze the hydrodynamic forces and the performance of different turbomachines.

MEC3142.6: Select an appropriate class of turbo machine for a particular application.

Module I: [10L] Introduction:

Definition, classification and application of turbo machines. Comparison of turbo machines with positive displacement machines; Non- dimensional parameter sand their significance; Unit and specific quantities; Similarity and model study in turbo machines and its numerical; Effect of Reynolds number, specific speed. Installation losses of turbomachines.

Steam Turbines and Gas Turbines**:** Classification, application and comparison.

Module II: [10L] Hydraulic Turbines:

Classification and applications; Main components and their functions; degree of reaction; design aspects of Pelton wheel, Francis and Kaplan turbines; Run away speed of turbine.

Selection of turbine: Models and their testing, similarity considerations, relation between the characteristic data of a turbine and that of its model; Comparison between hydraulic turbine and steam turbine.

Governing of water turbine; water conveyance system and surge tank.

Module III: [9L] Pump:

Overview of pump Classification and applications, Main components and their function and power transmission system in pump; Velocity diagram; Multi stage of pump; Submersible pump, slip

factor; Minimum speed of pump to deliver liquid; overall design considerations of pump; similarity relations and specific speed.

Selection of pump; cavitation and NPSH.

Module IV: [10L] Compressible flow machines:

Introduction: comparison among fans, Blowers & compressors; classification and applications; set up and operating characteristics of fans, blowers & compressors.

Centrifugal Compressor: Introduction, elements of centrifugal compressor, Work done and pressure rise, inlet duct impeller, pre-whirl vanes, Diffuser design, Choking, Overall pressure ratio developed; losses in centrifugal compressor.

Axial flow compressor: Axial compressor characteristics, compressor staging, flow through stages, velocity triangles, pressure ratio developed per stage– work-done factor.

Text Books

1. Introduction to Fluid Mechanics and Fluid Machines–Som, Biswas and Chakraborty, TMH, 4e.
2. Hydraulic Machines–Dr. Jagdish Lal, Metropolitan Book Co. Pvt. Ltd, Reprint2011.
3. Mechanics of Fluids–B Messy, Taylor & Francis, 8e.
4. Turbines, Compressors & Fans–S.M.Yahya, Mc Graw Hill, 4e.

Reference Books

1. Fluid Mechanics and Machinery–C. S. P. Ojha, R. Berndtsson, P. N. Chandramouli, OUP,1e.
2. Turbomachinery: Designed and theory–Gorla, Taylor & Francis (Yes Dee Publishing Pvt. Ltd), 1st Indian reprint 2011.
3. Incompressible Flow Turbomachines–Rowal, Elsevier (Yes Dee Publishing Pvt. Ltd), 1st Indian reprint 2011.
4. Principle of Turbomachinery– Turton R. K, Springer (Yes Dee Publishing Pvt. Ltd), 1st Indian reprint 2011.
5. Turbomachines–B.U.Pai; WILEY, 1e, 2013.

Course Title: Aerodynamics					
Course Code: MEC3143					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

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

MEC3143.1: Describe the fundamental laws of aerodynamics**.**

MEC3143.2: Relate the fundamental laws to solve problems in aerodynamic applications.

MEC3143.3: Solve problems for vortex motion, lift, etc.

MEC3143.4: Analyze the effect of drag and lift forces on various geometries and aerofoils.

MEC3143.5: Estimate the nature of compressible flow.

MEC3143.6: Explain various duct flow and shocks behaviour.

Module I: [10L] Fundamental laws of aerodynamics and application

Introduction: definition, historical development, classification & practical objectives, some fundamental aerodynamic variables, Aerodynamic forces & moments, centre of pressure, dimensional analysis and flow similarity.

Application of the knowledge of aerodynamics in the design of vehicles, buildings, structures and turbo-machines, etc.

Module II: [10L] Vortex motion

Circulation and vorticity; Vortex flow: forced and free vortex flow, equation of motion for vortex flow.

Vortex tube, vortex sheet, Biot-Savart law, Kelvin's theorem, vortex theorems of Helmboltz, Combination of basic flow patterns: lift on a rotating cylinder, Magnus effect, Joukowski's transformation.

Module III: [9L] Lift and Drag

Lift on an aerofoil: aerodynamic forces on a lifting surface; nomenclature and shape of aerofoils; lift and drag coefficients of aerofoils; finite span effects; lift induced drag.

Drag on an aerofoil: effect of viscosity, skin friction and form drag; flow separation and stalling; boundary layer control and its effect.

Module IV: [10L] Compressible flow

Compressible Flow: speed of propagation of a small disturbance through a compressible fluid, sonic velocity, Mach number, Mach cone and Mach wave; isentropic flow, stagnation properties of a compressible flow, isentropic pressure, temperature and density ratios; mass flow rate through a duct, maximum mass flow rate through a duct, critical condition and choking; flow through convergent-divergent nozzle.

Normal and oblique shock waves attached and detached shocks on aerospace structures.

Text Books:

1. Fundamentals of Aerodynamics, John D. Anderson, Jr., Mc-Graw Hill, 3e.
2. Foundations of Aerodynamics: Bases of Aerodynamics Design, Arnold M. Kuethe and Chuen-Yen Chow, Wiley India Pvt. Ltd.

Reference books:

1. Theoretical Aerodynamics, L. M. Milne-Thomson, Dover Pub.

Course Title: Power Plant Engineering					
Course Code: MEC3144					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

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

MEC3144.1: Analyze and evaluate different types of thermodynamic cycles used in thermal power plants and list their thermodynamic advantages and disadvantages.

MEC3144.2: Understand the fundamentals of boiler operation (which includes evaluation of boiler performance and calculation of chimney height) and combustion.

MEC3144.3: Differentiate and Evaluate the impulse and reaction turbine and nozzle performance.

MEC3144.4: Analyze the operations of surface condensers and cooling towers.

MEC3144.5: Understand power plant economics and its utility in optimizing power generation process.

MEC3144.6: Understand the working principle of nuclear and hydel power plant.

Module I: [10L] Review of fundamentals;

Power plant cycles – Carnot, Rankine, Reheat, regenerative cycles and Co-generation cycle;

Binary vapour cycle working principle, Coupled cycles;

Combined cycle plants: Gas turbine – Stream turbine plant – Series and Parallel;

Module II: [10L]

Introduction to Boilers: Fire tube and water tube boilers, mountings and accessories, Super-critical boilers;

Draft in boilers- natural, induced, forced and balanced; Chimney height, power requirement of forced draft and induced draft fans;

Performance of boilers - equivalent evaporation, boiler efficiency, losses in boilers and heat balance;

Coal combustion- properties of coal, ultimate analysis, proximate analysis, combustion calculations, Coal and ash handling system;

Module III: [10L]

Steam turbines- parts and classification, nozzle types, flow through nozzles, condition for maximum flow rate, nozzle efficiency.

Impulse turbine- velocity diagram, work done and blade efficiency. Condition for maximum blading efficiency.

Pressure compounding or Rateau Turbine and velocity compounding or Curtis Turbine of steam turbine.

Impulse, reaction turbine- velocity diagram, degree of reaction. Parsons turbine: condition for maximum blading efficiency. Governing in steam turbines.

Module IV: [9L]

Condensing systems- basic ideas. Classification of steam condensers. Leakage in condensers, condensing efficiency, Cooling Tower –Dry cooling tower and Wet cooling tower; cooling tower calculations.

Power plant economics: load curve and various factors.

Introduction to nuclear power plant and hydel power plant.

Text Books

1. Power Plant Engineering - 4e, Nag, P. K. – TMH.
2. Thermal Engineering- 8e, R. K. Rajput, Laxmi Publication (P) Ltd

Reference Books

1. Thermal Engineering- 24e, B. L. Ballaney, Khanna Publishers
2. Power Plant Engineering -8e, Domkundwar- Arora- Domkundwar, Dhanpat Rai & Co.
3. Power plant Technology, M. M. El-Wakil, Tata McGraw-Hill Education
4. Power Station Engineering and Economy, William A. Vopat, Tata McGraw-Hill Education

Course Title: Design for Manufacturing & Assembly					
Course Code: MEC3145					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

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

MEC3145.1: Understand the quality aspects of design for manufacture and assembly.

MEC3145.2: Apply the concept of designs for casting, welding, forming and assembly.

MEC3145.3: Know the manufacturing issues that must be considered in the mechanical engineering design process.

MEC3145.4: Identify the design factors and processes along customer desires for manufacturing.

MEC3145.5: Be familiar with tools and methods to facilitate development of manufacture mechanical designs.

MEC3145.6: Know the principles of assembly to minimize the assembly time.

Module I: [9L] Introduction to Manufacturing & Assembly

Manufacturing processes and classification of manufacturing processes.

Mechanical properties of materials and selection of materials.

General design rules for machining –limit, fit, dimensional tolerance and surface roughness.

Need identification and problem definition, concept generation and evaluation for developing a product.

Module II: [10L] Form design of castings, welding, forging and sheet metal components

Form design of castings: Sprue design, riser design, and core print design.

Design for welding: Factors in design of weldments, general design guidelines.

Design features of forging dies.

Design of rolling wheels.

Design for sheet metal forming processes.

Module III: [10L] Design for machining considerations

General design rules for machining.

Machinability: Definition, assessment, improvement and evaluation of optimum cutting velocity and tool life.

Control of speed and feed of machine tools: Need of wide ranges of speeds and feeds, design of speed structure and ray diagrams.

Grinding: Selection of grinding wheels and application.

Module IV: [10L] Design for reliability and assembly

Design for reliability: Failure mode and effect analysis and quality, design for quality.

Design for assembly: Design guidelines for manual assembly, large assemblies, analysis of an assembly, rules for product design for automation, design for robot assembly, design for manufacture and computer aided design.

Text Books

1. Product Design for Manufacture and Assembly, G. Boothroyd, P. Dewhurst, W. A. Knight, CRC Press.
2. Product Design and Manufacturing, A K Chitale and R C Gupta, Prentice Hall of India, New Delhi, 2003.
3. Materials and Design - the art and science of material selection in product design, M F Ashby and K Johnson, Butterworth-Heinemann, 2003.

Reference Books

1. Engineering Design - A material processing approach, George E. Dieter 5/e, McGraw Hill International, 2003.
2. Product Design for Manufacturing and Assembly, Geoffrey Boothroyd, Peter Dewhurst &Winston Ansthony Knight, CRC Press, 2010.

Course Title: Additive Manufacturing					
Course Code: MEC3121					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

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

MEC3121.1: Understand the fundamentals of additive manufacturing processes and various applications.

MEC3121.2: Interpret the use of CAD interfaces for 3D modeling and slicing in additive manufacturing processes.

MEC3121.3: Illustrate the working principles and characteristics of various solid state-based additive manufacturing processes.

MEC3121.4: Compare the working principles and characteristics of various liquid state-based additive manufacturing processes.

MEC3121.5: Examine the working principles and characteristics of various powder based additive manufacturing processes.

MEC3121.6: Implement suitable post-processing techniques for various additive manufacturing processes.

Module I: [11L] Introduction and Application of Additive Manufacturing (AM)

Introduction: Evolution of AM/3D printing; Comparison with subtractive and forming processes; Advantages and Disadvantages of AM; Classification of AM processes; Significance of CAD interfaces and slicing operation;

Applications of AM: Product development – Proof of Concept, Prototyping, visualization aids, replacement parts, jigs and fixtures, moulds and casting;

Application sectors – aerospace, automobile, medical, jewelry, sports, electronics, food, architecture, construction and others.

Module II: [9L] Solid State-based AM Processes

Fused Deposition Modeling – working principle, process parameters, materials; Equipment and specifications; materials characterization; Laminated object manufacturing – working principle, process parameters, materials; Equipment and specifications; Applications, advantages,

disadvantages, examples; Other solid-state processes – Ultrasonic consolidation, Thermal bonding, etc., and Post processing.

Module III: [9L] Liquid State-based AM Processes

Stereolithography (SLA) – working principle, process parameters, materials; Photopolymers; Photo polymerization, layering technology, Laser and Laser scanning; Equipment and specifications; Applications, advantages, disadvantages, examples; Solid ground curing: working principle, process parameters, materials; Equipment and specifications; Applications, advantages, disadvantages, examples, and Post processing.

Module IV: [10L] Powder Based AM Processes

Powder Bed Fusion (PBF) Processes – working principle, process parameters, materials; Powder fusion mechanism and powder handling; Various PBF processes (principle, materials, applications and examples) – Selective Laser Sintering (SLS), Electron Beam Melting (EBM), Laser Engineered Net Shaping, Binder Jetting; Comparison between PBF processes; Materials-process-structure-property relationships; relative advantages and limitations, and Post processing.

Text Books

1. Sabrie Soloman, 3D Printing & Design, Khanna Book Publishing Company, New Delhi, 1st edition.
2. C.P Paul, A.N Junoop, "Additive Manufacturing: Principles, Technologies and Applications," McGrawHill, 1st edition.
3. Chua Chee Kai, Leong Kah Fai, "3D Printing and Additive Manufacturing: Principles & Applications," World Scientific, 5th edition.

Reference Book

1. Ian Gibson, David W Rosen, Brent Stucker, "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping and Direct Digital Manufacturing", Springer, 2nd edition.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_me115/preview
2. https://onlinecourses.nptel.ac.in/noc20_mg70/preview

Course Title: Computational Methods In Engineering					
Course Code: MEC3122					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

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

MEC3122.1: Apply different mathematical models to obtain numerical solutions and classify different types of error.

MEC3122.2: Analyze and solve a system of linear algebraic equations by different methods and find out the roots.

MEC3122.3: Implement the regression and interpolation methods for curve fitting and apply different types of optimization techniques to solution of problems.

MEC3122.4: Use different numerical integration methods for practical problems.

MEC3122.5: Classify Initial-value and Boundary-value problems in order to formulate their solutions, implement different methods for their solutions, and solve Eigenvalue problems applied to physical systems.

MEC3122.6: Classify linear, second-order partial differential equations (PDEs) as elliptic, parabolic, or hyperbolic, and apply the Finite Difference Method to formulate the solutions of different classes of PDEs.

Module I: [10L]

Simple Mathematical model of engineering problem,

Approximations– Significant figures, Accuracy, Precision & Error; definition and formulations. Round-off and truncation errors, error propagation, total numerical error.

Formulation and solution of linear algebraic equations, Gauss elimination, LU decomposition. Solution of linear algebraic equations through iteration methods

Roots of Equation: Newton Raphson method, Secant Method, roots of polynomial: Muller's method, Bairstow's method.

Module II: [10L]

Linear and polynomial regression, multiple linear regression, general linear least squares.

Interpolation methods: Newton's divided difference interpolation of polynomials, Lagrange interpolation of polynomials.

Optimization: one dimensional unconstrained problem, Golden-section search, multi dimension unconstrained problem, Gradient method.

Module III: [9L]

Numerical Integration: The Trapezoidal rule, Simpson's rule, Gauss quadrature two points and three points.

Boundary Value Problems in Ordinary Differential Equations, Initial and Boundary Value Problems in Partial Differential Equations.

Eigen value problems applied to a physical system.

Module IV: [10L]

Basics of Finite Difference Method-Forward Differences, Backward Differences, Central Differences, Symbolic Relations and Separation of Symbols.

Numerical Solution of Ordinary Differential Equations-Solution by Taylor's series, Picard's Method, Euler's Method, Second-order and Fourth-order Runge-Kutta Methods

Adams-Bashforth-Moulton Predictor-Corrector Method, Cubic Spline Method, Finite Difference solution of Boundary-value Problems.

Numerical Solution of Partial Differential Equations-Classification of PDEs, Elliptic equations (Laplace equation), Parabolic equations (Transient Diffusion equation), Hyperbolic equations (Wave equation).

Numerical Solution of Two-dimensional Laplace equation-Nodal network in two dimensions, Finite Difference form, Solution procedure for Finite Difference equations.

Text Books

1. Numerical Methods for engineers, Steven C Chapra & Raymond P. Canale, McGraw- Hill
2. Numerical Analysis, P Sivaramakrishna Das and C Vijaykumari, Pearson Education
3. Computational Methods in Engineering, S.P. Venkateshan and Prasanna Swaminathan, Academic Press

Reference Books

1. Numerical Methods for engineers, Steven C Chapra & Raymond P. Canale, McGraw-Hill
2. Numerical Analysis, P Sivaramakrishna Das and C Vijaykumari, Pearson Education

Course Name: Industrial Safety and Hazards					
Course Code: CHE3122					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

After completion of the course students will be able to:

CHE3122.1: Use important technical fundamentals of chemical process safety and to impart basic knowledge that allows the students to evaluate occupational safety and health hazards in the workplace.

CHE3122.2: Analyze the effects of work place exposures, injuries and illnesses, fatalities.

CHE3122.3: Use safety programs to prevent or mitigate damage or losses and to develop preventative measure to avoid accident.

CHE3122.4: Use logic based quantitative risk analysis.

CHE3122.5: Carry out HAZOP analyses.

CHE3122.6: Use knowledge of safety and hazards in chemical plant layout.

Module I [10L]

Fundamental Concepts: Introduction to Process Safety:

Definition of safety, Concepts of Hazard and Risk, Safety program, Engineering ethics,

Inherent Safety:

Safety regulations, OSHA, FAR, Process safety management,

Introduction to Hazards:

Hazards due to fire, explosions and toxic chemicals,

Fire and Explosion:

Distinction between fire and explosion, Upper Flammability limit and Lower Flammability Limit, Fire Triangle, BLEVE, Runaway reaction.

Module II [10L]

Tools for Hazards Identification and Analysis:

Concepts of HAZOP, HAZOP Analysis

Logic Tree in Safety Analysis:
Concepts of Fault Tree and its analysis, Concepts of Event Tree and its analysis, Combination of frequencies, Duration of coincidence of events, Advantage of ETA, Comparison of FTA and ETA, Bath Tub Curve

Failure Mode and Effect Analysis:
Methodology of FMEA, Dow Fire and Explosion Index, Mond Index. Fire and Explosion Index

Module III [10L]

Risk Analysis Concept and Methodology:
Risk concept and measure of risk,

Risk Acceptance Criteria:
Quantitative risk analysis, Probit number. Fractional dead time

Module IV [10L]

Control of Chemical Plant Hazards:
Intensification and attenuation of hazardous materials, Industrial plant layout,

Industrial Ventilation:
Reasons for ventilation, Positive pressure ventilation, Dilution ventilation, TLV, TWA

Personal Protection:
Fire prevention, Personnel protection devices, Laboratory safety, Emergency safety, Safety systems.

Disaster Management:
Definition, Types of disaster, Complex Emergencies, Pandemic Emergencies, Preparedness, Disaster Response, Disaster Recovery

Case Studies:
Flixborough (England), Bhopal (India), Seveso (Italy), Pasadona (Texas)

Text Book:

1. Crowl D.A. and .Louvar J.F. Chemical Process Safety: Fundamentals with Applications: Prentice Hall, 1990.

Reference Books:

1. Kharbanda O.P. and Stall worthy E. Safety in Chemical Process Industries: Heinmann. Professional Publishing LTD.1988.
2. Wentz C.A. Hazardous Waste management: Mc-Graw Hill,
3. Cutter S.L. Environmental Risks & Hazards, Prentice Hall, 1994.
4. Trevor A. Kletz, What went wrong? Case Histories of Process Plant Disasters and How They Could Have Been Avoided, 5th, Edition, Butterworth-Heinemann/IChemE

Course Name :Total Quality Management					
Course Code: MEC3123					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

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

MEC3123.1: Explain the concepts of Total Quality Management and Total Quality Education, Report Quality Cost measure, Customer Satisfaction Index.

MEC3123.2: Identify the problems in Quality Improvement Process, Use various QC tools, appreciate the benefits of implementing 5-S Techniques.

MEC3123.3: Apply various Quality Function Deployment (QFD) Techniques.

MEC3123.4: Analyze Statistical Process Control (SPC) data to improve processes, Design experiments for arriving at optimal solutions.

MEC3123.5: Appreciate the incorporation of ISO System standard and its benefits, Address isues relating to closure of NCR'S.

MEC3123.6: Propose how business leaders might plan and execute quality management in an organization, struggles to gain and sustain competitive e advantage in today's global business arena.

Module I: [9L] Introduction

Definition of quality; Quality control vs. Quality Assurance; TQM- Components of TQM; TQM vs. TPM; Quality Gurus ; Quality Planning and Quality costs; Collection and reporting of quality cost information; Leadership role in TQM; Role of senior management in TQM; Implementation and Barriers to TQM; Customer Satisfaction- Customer perception of quality-customer complaints- customer feedback- customer retention; Employee involvement.

Module II: [11L]

QMS (ISO 9000):

Evolution of QMS- ISO 9000 series of standards- Quality manual – ISO 9001 requirements; Different clauses of ISO 9001 system and their applicability in various business processes; Registration of ISO 9001 : 2000 ; ISO 9001: 2000 Certification ; Steps involved in ISO 9001: 2000 Certification; benefits/limitations of ISO 9001 : 2000; Internal Audits and Implementation of ISO 9001:2000.

EMS (ISO 14000):

Concepts of ISO 14001; Requirements of ISO 14001; Benefits of ISO 14001

Module III: [9L] Continuous Improvement in Quality

PLAN-DO-CHECK-ACT (PDCA); 7 QC tools and their use for quality improvement; Quality Function Deployment; QFD team ; Benefits of QFD; QFD Process KAIZEN; 5 – S Principle; Concept of quality circles.

Module IV: [10L] Statistical Process Control

Basic statistical concepts; control charts for variables; Group control charts ; Control charts for attributes; Acceptance Sampling - OC Curve ; Process capability; Sampling Plans ; Six Sigma and its applications; Design of experiments and Taguchi Methodology

Text Books

1. Total Quality Management– J.D.Juran, MHE.
2. Total Quality Management-Besterfield, Pearson Education.

Reference Books

1. Statistical Quality Control–M. Mahajan, Dhanpat Rai & Co. (Pvt.) Ltd.

Course Title: Industrial Engineering					
Course Code: MEC3124					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

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

MEC3124.1: Identify different concepts of IE functions.

MEC3124.2: Execute product development and design-manufacturing decisions with IE tools.

MEC3124.3: Classify and implement plant layout/location decisions.

MEC3124.4: Explain different types of production systems and their characteristics.

MEC3124.5: Judge the production planning and inventory management with a mechanism of proper control.

MEC3124.6: Recognize and select appropriate tools of work-study for improvement in productivity.

Module I: [7L] Introduction to Industrial Engineering

Evolution of modern concepts in IE-Functions of IE, Field of application of IE, Product Development and Research-Design Functions-Objectives of Design-Manufacturing vs. Purchase-Economic aspects-CVP Analysis-Simple Problems, Development of designs- prototype, production and testing-Human factors in design-Value Engineering,

Module II: [10L] Location Selection and Plant Layout

Nature of Location Decision, Importance of Plant Location, Dynamic Nature of Plant Location, Choice of site for selection, Comparison of Location, Principles of Plant Layout and Types, Factors affecting Layout, methods, Factors governing flow pattern, travel chart, analytical tool of plant layout, layout of manufacturing shop floor, repair shop, service sectors and process plant, Quantitative methods of Plant Layout: CRAFT and CORELAP, Relationship Diagrams.

Module III: [10L] Production Planning & Control

Importance of Planning, Types of Production Systems and their Characteristics, Functions & Objectives of Production Planning & Control-Routing, Scheduling, Dispatching and Expediting-Gantt Charts, Inventory Control, Inventory models-determination of EOQ and reorder levels-

simple problems- selective Inventory control techniques, introduction to line of balance, assembly line balancing ,and progress control.

Module IV: [12L] Productivity and Work Study

Definition of Productivity, application and advantages of Productivity improvement tools, reasons for increase and decreases in Productivity, Areas of application of work study in Industry, Method Study: objectives and procedure for methods analysis, recording techniques, operations process chart, man-machine chart, multiple activity chart, travel chart, and two handed process chart, string diagram, Therbligs, micro-motion study: principles of motion economy, Work measurement : objectives, work measurement techniques-time study, work sampling, pre-determined motion time standards(PMTS) Determination of time standards, observed time, basic time, normal rating, rating factors, allowances, and standard time. Ergonomics-wages and incentives, primary wage system, wage incentive plans.

Text Books

1. Modern Production/Operations Management (Wiley Series in Production)/Operations Management by Elwood S. Buffaand Rakesh K. Sarin|2 September1987.
2. Production System, Planning, Analysis and Control by J L Riggs, 3rd Edition Wiley.

Reference Books

1. Production and Operation Management by R Panneerselvam, PHI publishers
2. Industrial Engineering and Production Management by Martland Telsang, S Chand and Company.

Course Title : Indian Constitution and Civil Society					
Course Code : INC3016					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	2	0	0	2	0

Course Outcomes:

After completion of the course, students will be able to

INC3016.1: analyse the historical, political and philosophical context behind the Indian Constitution-making process.

INC3016.2: appreciate the important principles characterizing the Indian Constitution and institute comparisons with other constitutions.

INC3016.3: understand the contemporaneity and application of the Indian Constitution in present times.

INC3016.4: critique the contexts for constitutional amendments in consonance with changing times and society.

INC3016.5: establish the relationship between the Indian Constitution and civil society at the collective as well as the individual levels.

INC3016.6: consciously exercise the rights and the duties emanating from the Indian Constitution to one's own life and work.

Module I: [6L]

Introduction to the Constitution of India- Historical Background
Making of Indian Constitution -the process of framing the constitution, the constituent assembly.

Module II: [6L]

Salient Features of the Indian constitution
Comparison with the constitutions of other countries

Module III: [6L]

Relevance of the Constitution of India
Constitution and Governance
Constitution and Judiciary
Constitution and Parliament- Constitutional amendments.

Module IV: [6L]

Constitution and Society-democracy, secularism, justice

Constitution and the individual citizen- Fundamental Rights, Directive Principles of state policy and Fundamental Duties

Reference Books

1. C. M. Elliot, (ed.), Civil Society and Democracy, OUP, Oxford, 20012
2. David Held et.al (ed),The Idea of the Modern State, Open Univ. Press, Bristol, 1993
3. Neera Chandoke, State and Civil Society, Sage, Delhi, 19953

Course Title: Thermodynamics and Heat Transfer Lab					
Course Code: MEC3152					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

Course Outcomes:

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

MEC3152.1: Describe a combined separating and throttling calorimeter and examine the dryness fraction of a steam sample by its use.

MEC3152.2: Determine the calorific value of a fuel and understand the basic operating principles of a four stroke and two stroke I C engines.

MEC3152.3: Judge the thermal conductivity of (i) a cylindrical metallic rod and (ii) insulating powder using appropriate principles.

MEC3152.4: Explain a shell and tube heat exchanger and appraise log-mean temperature difference as well as effectiveness of the heat exchanger.

MEC3152.5: Examine the convective heat transfer coefficient for forced convection over a cylindrical fin and natural convective heat transfer coefficient in a heated vertical cylinder.

MEC3152.6: Recognize the basic terminologies related to thermal radiation and weigh the emissivity of a gray body.

List of Experiments:

1. Determination of dryness fraction of steam by a combined separating and throttling calorimeter.
2. Study of cut models of two stroke and four stroke I C engines
2. Study of valve timing diagram of a four stroke S I engine
3. Determination of calorific value by a bomb calorimeter
4. Determination of thermal conductivity of a metal rod.
5. Determination of thermal conductivity of an insulating powder.
6. Study of a shell and tube heat exchanger for determination of LMTD and calculation of effectiveness.
7. Determination of local heat transfer coefficient (h) for forced convection over a cylindrical fin and temperature plotting.
8. Determination of emissivity of a gray body.
9. Determination of the Natural Heat Transfer Coefficient in a heated vertical cylinder.

Text Books

1. Engineering Thermodynamics- 5e, Nag, P.K. – TMH
2. Introduction to Heat Transfer- S.K. Som, PHI, 2e
3. Heat & Mass Transfer, P.K. Nag, TMH, 3e

Course Title: Mechatronics, Robotics & Control Lab					
Course Code: MEC3153					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

Course Outcomes:

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

MEC3153.1: Explain the working principle of different sensors and transducers and their application.

MEC3153.2: Measure and analyze different process parameters.

MEC3153.3: Control the motion of various drive system having servo and stepper motor.

MEC3153.4: Control the speed of Induction motor using Variable Frequency Drive.

MEC3153.5: Design and control pneumatic and hydraulic systems.

MEC3153.6: Programming different controllers to perform different operations.

List of Experiments:

1. Measurement of load by using strain gauge load cells.
2. Load measurement using Pressure dependent resistor/ force sensing resistor
3. Measurement of linear displacement using LVDT.
4. Characteristics of Light dependent resistor
5. Distance measurement using ultrasonic sensor
6. Use of Inductive sensor as proximity sensor
7. Use of IR sensor as proximity sensor.
8. Angular position control by using D.C. servo motor
9. Torque - speed characteristics of D.C. servo motor
10. Speed control of Induction motor using variable frequency drive
11. Programming AT 89C51 / 52 microcontroller with Assembly language program (or Hex Code)
12. Motion control in hydraulic system
13. Motion control in pneumatic system
14. Control of conveyor belt unit using Programmable Logic Controller

Course Title: Kinematics & Dynamics of Machines Lab					
Course Code: MEC3155					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

Course Outcomes:

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

MEC3155.1: Design and develop a mechanism for a given application.

MEC3155.2: Apply the knowledge of vibration to determine experimentally the natural frequency, radius of gyration, moment of inertia, and modulus of rigidity.

MEC3155.3: Determine the performance characteristics of a governor.

MEC3155.4: Measure gyroscopic effect on rotating component undergoing precession.

MEC3155.5: Determine and eliminate unbalancing forces in a system under static and dynamic state.

MEC3155.6: Calculate follower displacement program for a given cam follower pair to determine its jump speed.

List of Experiments:

1. Synthesis and fabrication of Mechanism: Four Bar Mechanism, Slider Crank Mechanism, Crank and Slotted Lever Mechanism, Whitworth Quick Return Mechanism, Hooks joint-single and double, Steering gear mechanisms - Ackerman, Davis.
2. Measurement of time period and the use of a simple pendulum.
3. Measurement of time period and the use of a compound pendulum.
4. Undamped torsional vibration of a single rotor shaft system.
5. To determine the radius of gyration of a given bar by using bifilar suspension.
6. Experiments on working of gyroscope, operation and analysis.
7. Performance characteristics of Watt and Porter Governors.
8. Performance characteristics of Proell and Hartnell Governor.
9. Analysis of motion of different cam and follower pairs.
10. Balancing of a shaft having rotating mass.
11. Experiment on Free Damped Torsional oscillation.
12. Experiment on Forced Damped Vibration.

Text Books

1. Theory of Machines – S S Rattan, Tata McGraw Hill, 4e, 2014.
2. Theory of Vibrations with Applications – William Thomson, Pearson, 2008.

Reference Books

1. Theory of Machines and Mechanisms – Uicker, Pennock and Shigley, Oxford University Press, 3e, 2009.
2. Kinematics and Dynamics of Machinery – R. L. Norton, McGraw Hill Education, 1e, 2009.
3. Mechanism and Machine Theory – Ashok G. Ambekar, PHI Learning, 1e, 2007.
4. Theory of Mechanisms & Machines (3rd edition) – Ghosh and Mallik; East West Press, 3e, 2006.

Course Title: Refrigeration & HVA Lab					
Course Code: MEC3161					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

Course Outcomes:

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

MEC3161.1: Demonstrate the VCRS and compare the theoretical and experimental COP.
MEC3161.2: Demonstrate the VARS and calculate the COP.

MEC3161.3: Analyze the window type Air Conditioner by calculating the COP using psychometric chart.

MEC3161.4: Calculate the heat rejection rate of window type Air Conditioner \

MEC3161.5: Perform the experiment on an air condition test rig and calculate the theoretical and experimental COP for cooling-dehumidification and heating-humidification process.

MEC3161.6: Demonstrate the thermoelectric cooling and heating process and calculate the COP.

List of Experiments:

1. Study of a cut model of VCRS and determination of COP of a VCR system.
2. Study of a cut model of VARS and determination of COP of a VAR system.
3. Study of a room (window type) Air Conditioner and determination of COP.
2. Determine the heat rejection rate by the condenser of window air conditioner.
3. Performance test of an Air Conditioning Unit: Determination of COP and plotting of the cooling – dehumidification process on a psychometric chart.
4. Performance test of an Air Conditioning Unit: Determination of COP and plotting of the heating – humidification process on a psychometric chart.
5. Performance test of thermoelectric refrigeration system used as cooler.
6. Performance test of thermoelectric system used as Heater. Concepts of Refrigeration and Air-conditioning, Unit of refrigeration, Refrigerants Desirable Properties, Nomenclature.

Course Title: Electrical Machines Lab					
Course Code: MEC3162					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

Course Outcomes:

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

MEC3162.1: Analyze different characteristics of various electrical machines to understand the performance of different machines.

MEC3162.2: Determine the equivalent circuit parameters and phasor diagram and efficiency by performing the open circuit & short circuit test to analyze the performance of a single phase transformer.

MEC3162.3: Understand different speed control methods of the DC shunt motor.

MEC3162.4: Analyze the performance of 3 phase induction motor through the speed-torque characteristics of 3 phase induction motor.

List of Experiments:

1. To study the open circuit and short circuit tests of a single phase transformer.
2. To study the speed control of a D.C Shunt Motor.
3. To study the saturation characteristics of a D.C Shunt Generator.
4. Speed control of D.C shunt Motor by Ward-Leonard method.
5. To study the Speed-Torque characteristics of a Slip-ring Induction Motor.
6. To study the external load characteristics of a D.C Shunt Generator.

Course Title: RDBMS LABORATORY					
Course Code: MEC3163					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

Course Outcomes:

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

MEC3163.1: To give a good formal foundation on the relational model of data.

MEC3163.2: To present SQL and procedural interfaces to SQL comprehensively.

MEC3163.3: To give an introduction to systematic database design approaches covering conceptual design, logical design and an overview of physical design.

MEC3163.4: To present the concepts and techniques relating to query processing by SQL engines.

MEC3163.5: To present the concepts and techniques relating to ODBC and its implementations.

MEC3163.6: To introduce the concepts of transactions and transaction processing.

Experiments on Database on RDBMS Platform (Oracle):

DDL Commands: Creating Tables along with constraints like: Primary Key, Foreign Key, unique, Not Null, Check. Altering Table Structure like adding and modifying constraints, adding and modifying column data types, etc.

DML: Inserting rows, Updating rows, Deleting rows.

SQL Query: Cartesian Product, All types of Join, Union, Intersect, Minus, Single Row functions, multiple row functions using GROUP BY clause, ORDER BY Clause, Nested Sub-Queries

Reference Books

1. SQL, PL/SQL: The Programming Language Of Oracle (With CD-ROM) (English) 4th Revised Edition by Ivan Bayross, BPB Publications

Course Title: Programming for Engineering Applications Lab					
Course Code: MEC3164					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
		0	2	2	1

Course Outcomes:

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

MEC3164.1: Perform basic operations in Linear algebra.

MEC3164.2: Differentiate and integrate in symbolic form.

MEC3164.3: Create and use user defined functions.

MEC3164.4: Plot data graphically.

MEC3164.5: Solve differential equations numerically.

MEC3164.6: Apply programming knowledge to solve engineering problems.

List of Experiments:

1. Introduction to programming language, IDE, Libraries and Modules; Basic math operations: Addition, subtraction, multiplication, division.
2. Basic matrix operations for 1D, 2D and 3D matrices
3. Determination of Eigenvalues and Eigenvectors of a matrix and its interpretations
4. Differentiation and integration using symbolic form.
5. Conditional statements
6. Iteration using Loop: While and For loop
7. User defined functions
8. Representation of data using 2D and 3D plots
9. Numerical solution of ODE differential equation
10. Numerical solution of PDE differential equation
11. Motion analysis of a moving object
12. Calculation of stress generated and deflection due static load on a body
13. Calculation of natural frequency of vibration
14. 1 D flow analysis
15. 1 D heat transfer analysis

APPENDIX – A

Point Description for Mandatory Additional Requirement (MAR)

OFFICE OF THE CONTROLLER OF EXAMINATIONS

HERITAGE INSTITUTE OF TECHNOLOGY, KOLKATA

MANDATORY ADDITIONAL REQUIREMENTS (MAR)

Activity List w.e.f. 2023-2024 Academic Year

	Activity	Points per Activity	Permissible Points (max)
1.	***MOOCS (SWAYAM / NPTEL / SPOKEN TUTORIAL / ANY TECHNICAL, NON-TECHNICAL COURSE) (PER COURSE)***		
a)	For 12 weeks duration/40 Hours	20	40
b)	For 8 weeks duration/30 Hours	15	
c)	For 4 weeks duration/20 Hours	10	
d)	For 2 weeks duration/10 Hours	5	
2.	***TECH FEST / FEST / TEACHERS DAY / FRESHER'S WELCOME***		
a)	Organizer	5	10
b)	Participant	3	6
3.	***RURAL REPORTING***	5	10
4.	***TREE PLANTATION AND UP-KEEPING (PER TREE)***	1	10
5.	***RELIEF / CHARITABLE ACTIVITIES***		
a)	Collection of fund / materials for the Relief Camp or Charitable Trusts	5	40
b)	To be a part of the Relief Work Team	20	
6.	***PARTICIPATION IN DEBATE / GROUP DISCUSSION / WORKSHOP / TECH QUIZ / MUSIC / DANCE / DRAMA / ELOCUTION / QUIZ / SEMINAR / PAINTING / ANY PERFORMING ARTS / PHOTOGRAPHY / FILM MAKING / LIFE SKILLS***	10	20
7.	***PUBLICATION IN NEWS PAPER, MAGAZINE, WALL MAGAZINE & BLOGS***	10	20
8.	***RESEARCH PUBLICATION (PER PUBLICATION)***	15	30
9.	***INNOVATIVE PROJECTS (OTHER THAN COURSE CURRICULUM)***	30	60
10.	***BLOOD DONATION***		
a)	Individual Blood donation	8	16
b)	Blood Donation Camp Organization	10	20
11.	***SPORTS / GAMES / ADVENTURE SPORTS / TREKKING / YOGA CAMP***		
a)	Personal Level	10	20
b)	College level	5	10
c)	University Level	10	20
c)	District Level	12	24
e)	State Level	15	30
f)	National / International Level	20	20
12.	***ACTIVITIES IN A PROFESSIONAL SOCIETY / STUDENT CHAPTER***	10	20
13.	***RELEVANT INDUSTRY VISIT & REPORT / HOTEL-EVENT MANAGEMENT TRAINING & REPORT (MINIMUM 3 DAYS WITH SUBMITTED REPORT)***	10	20
14.	***COMMUNITY SERVICE & ALLIED ACTIVITIES LIKE: CARING FOR THE SENIOR CITIZENS, UNDER-PRIVILEGED / STREET CHILDREN / ANIMAL CARE ETC. / TRAINING TO DIFFERENTLY ABLE***	10	20
15.	***SELF-ENTREPRENEURSHIP PROGRAMME***		
a)	To organise entrepreneurship programmes and workshops	10	20
b)	To take part in entrepreneurship workshop and get certificate	5	10
c)	Video film making on entrepreneurship	10	20
d)	Submit business plan on any project	10	20
e)	To work for start-up/as entrepreneur	20	40

Format for Report Submission

Name :

Department :

Year/Semester :

Title of the Activity :

Date :

Name of the organization :

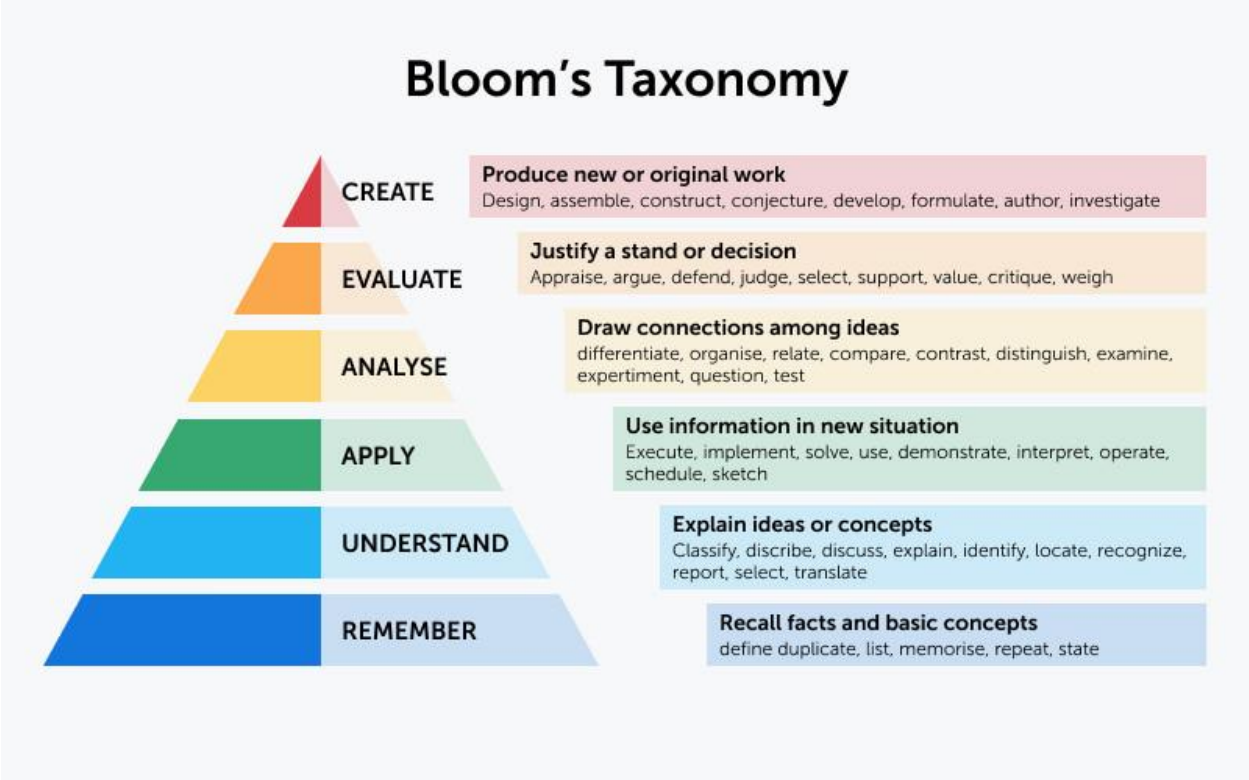
Report :

Signature
(Coordinator / Competent Authority)

Points earned:

Signature of the Mentor

APPENDIX – B


Bloom's Taxonomy
CREATE
Produce new or original work
Design, assemble, construct, conjecture, develop, formulate, author, investigate
EVALUATE
Justify a stand or decision
Appraise, argue, defend, judge, select, support, value, critique, weigh
ANALYSE
Draw connections among ideas
differentiate, organise, relate, compare, contrast, distinguish, examine, expertiment, question, test
APPLY
Use information in new situation
Execute, implement, solve, use, demonstrate, interpret, operate, schedule, sketch
UNDERSTAND
Explain ideas or concepts
Classify, discribe, discuss, explain, identify, locate, recognize, report, select, translate
REMEMBER
Recall facts and basic concepts
define duplicate, list, memorise, repeat, state