Go, Change the world®

RV Educational Institutions ®
RV College of Engineering ®

Autonomous Institution Affiliated to Visvesvaraya Technological University, Belagavi

Approved by AICTE, New Delhi

Scheme and Syllabus of I – IV semester

(Autonomous System of 2022 Scheme)

Master of Technology (M. Tech.)

in

MACHINE DESIGN (MMD)

DEPARTMENT OF MECHANICAL ENGINEERING

Academic Year 2022-23

Estd.1963

Go, change the world

RV COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to VTU, Belagavi)
RV Vidyaniketan Post, 8th Mile, Mysuru Road, Bengaluru - 560 059.

2022 Ranked 89th in Engineering Category

One of the most preferred Technical Institutions

Accredited by NBA

PROGRAMS OFFERED

B.E. Programs : AI, AS, BT, CH, CS, CV, CD, CY, EC, EE, EI, ET, IM, IS, ME.
M. Tech (13) MCA, M.Sc. (Engg.)
Ph.D. Programs : All Departments are recognized as Research Centres by VTU Except AI & AS

Five RVCE Alumni cleared Civil Services Exam in 2020-21

Ranked in top 10 Pvt. College in the Country by various magazines

Ranked 3rd in Sports & Cultural Activities under VTU (2019-20)

Use of ICT in Teaching Learning Process

e-Journals e-books | QEE 48 Courses | SWAYAM | NPTEL 9,300+ Enrolled 68th place in the country (Jul-Oct-2019) | Wikispace | MOOCS | MODULE

Conference Publications 1325
Journal Publicatons 1020
Patents Filed 55
Patents Publised 48
Patents Granted 16

Holistic development of students through NCC, NSS Cultural activities, Community service & Sports.

16 Centres of Excellences
07 Centres of Competence

MoUs: 90+with Industries / Academic Institutions in India & abroad

Executed more than Rs. 40 crores worth sponsored research projects & consultancy works sicnce 3 years

UPSC Results (2020): RVCE-Alumni

Name : Kushal Jain
Rank : 40
ISE-2016 Pass out

Name : Naveen Kumar
Rank : 62
ME - Pass out

Name : Deepak R. Shet
Rank : 311
ECE – 2013 Pass out

Human Resource

Faculty with Industrial experience 104
Visiting Adjunct Faculty 05
Total Number of Faculty 347
Faculty with Ph.D. Qualification 240
Faculty Pursuing Ph.D. 87
Technical & Admin Staff 221

RVCE - Greaves Cotton Ltd Centre of excellence in e-mobility

RV-Mercedes Benz Centre for Automotive Mechatronics

THE World University Rankings 2023

World University Rankings	1501+
Subject Ranking - Engineering	1001+
Subject Ranking - Computer Science	801+

Glossary of Abbreviations

1.	AS	Aerospace Engineering
2.	BS	Basic Sciences
3.	BT	Biotechnology
4.	CH	Chemical Engineering
5.	CHY	Chemistry
6.	CIE	Continuous Internal Evaluation
7.	CS	Computer Science & Engineering
8.	CV	Civil Engineering
9.	EC	Electronics & Communication Engineering
10.	EE	Electrical & Electronics Engineering
11.	EI	Electronics & Instrumentation Engineering
12.	ET	Electronics & Telecommunication Engineering
13.	GE	Global Elective
14.	HSS	Humanities and Social Sciences
15.	IM	Industrial Engineering & Management
16.	IS	Information Science & Engineering
17.	L	Laboratory
18.	MA	Mathematics
19.	MBT	M. Tech in Biotechnology
20.	MCE	M. Tech. in Computer Science & Engineering
21.	MCN	M. Tech. in Computer Network Engineering
22.	MCS	M. Tech. in Communication Systems
23.	MDC	M. Tech. in Digital Communication
24.	ME	Mechanical Engineering
25.	MHT	M. Tech. in Highway Technology
26.	MIT	M. Tech. in Information Technology
27.	MMD	M. Tech. in Machine Design
28.	MPD	M. Tech in Product Design & Manufacturing
29.	MPE	M. Tech. in Power Electronics
30.	MSE	M. Tech. in Software Engineering
31.	MST	M. Tech. in Structural Engineering
32.	MVE	M. Tech. in VLSI Design & Embedded Systems
33.	N	Internship
34.	P	Projects (Minor / Major)
35.	PHY	Physics
36.	SDA	Skill Development Activity
37.	SEE	Semester End Examination
38.	T	Theory
39.	TL	Theory Integrated with Laboratory
40.	VTU	Visvesvaraya Technological University

POSTGRADUATE PROGRAMS

Sl. No	Core Department	Program	Code
1.	BT	M. Tech in Biotechnology	MBT
2.	CS	M. Tech in Computer Science & Engineering	MCE
3.	CS	M. Tech in Computer Network Engineering	MCN
4.	CV	M. Tech in Structural Engineering	MST
5.	CV	M. Tech in Highway Technology	MHT
6.	EC	M. Tech in VLSI Design & Embedded Systems	MVE
7.	EC	M. Tech in Communication Systems	MCS
8.	EE	M. Tech in Power Electronics	MPE
9.	ET	M. Tech in Digital Communication	MDC
10.	IS	M. Tech in Software Engineering	MSE
11.	IS	M. Tech in Information Technology	MIT
12.	ME	M. Tech in Product Design & Manufacturing	MPD
13.	ME	M. Tech in Machine Design	MMD

DEPARTMENT OF MECHANICAL ENGINEERING

VISION

Quality education in Design, Materials, Thermal and Manufacturing with emphasis on research, sustainable technologies and entrepreneurship for societal symbiosis.

MISSION

1. Imparting knowledge in basic and applied areas of Mechanical Engineering.
2. Providing state-of-the-art laboratories and infrastructure for academics and research in the areas of design, materials, thermal engineering, and manufacturing.
3. Facilitating faculty development through continuous improvement programs.
4. Promoting research, education and training in materials, design, manufacturing, Thermal Engineering, and other multidisciplinary areas.
5. Strengthening collaboration with industries, research organizations and institutes for internship, joint research and consultancy.
6. Imbibing social and ethical values in students, staff and faculty through personality development programs.

PROGRAMME OUTCOMES (PO)

M. Tech in **Machine Design** graduates will be able to:

PO1: An ability to independently carry out research / investigation and development work to solve practical problems related to machine design.

PO2: An ability to write and present a substantial technical report / document.

PO3: An ability to demonstrate a degree of mastery over the areas of machine design. The mastery should be at a level higher than the requirements in the BE Mechanical Engineering and allied programs.

PO4: An ability to use modern tools for the design and analysis of static and dynamic systems and mechanisms.

PO5: An ability to adapt technical, safety, ethical and environmental factors in the design of system and mechanism.

PO6: An ability to perform in multidisciplinary teams with sound interpersonal and management skills with a commitment to lifelong learning.

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M.Tech in Machine Design: MMD

I SEMESTER M.Tech

Sl. No.	Course Code	Course Title	Credit Allocation L	T/ SDA	P	Total	BoS	Category	CIE Duration (H)	Max Marks CIE	SEE Duration (H)	Max Marks SEE
1	22MAT11AT	Computational Mathematics	3	1	0	**4**	MA	Theory	1.5	100	3	100
2	22MMD12TL	Advanced Mechanisms Design	3	0	1	**4**	ME	Theory+Lab	1.5	100	3	100
3	22MMD13TL	Composite Materials	3	0	1	**4**	ME	Theory+Lab	1.5	100	3	100
4	22MMD14L	Machine Learning Lab	1	0	1	**2**	ME	Lab	1.5	50	3	50
5	22XXX1AXT	Elective A (Professional Elective)	3	0	0	**3**	ME	Theory	1.5	100	3	100
6	22XXX1BXT	Elective B (Professional Elective)	3	0	0	**3**	IM	Theory	1.5	100	3	100

Note: For the course code 22HSS42, Students need to select one ONLINE MOOC course as recommended by HSS BoS. This course can be selected anytime between I to III semester and it will be evaluated during IV semester.

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Code	Elective A (Professional Elective)	Code	Elective B (Professional Elective)
22MPD1A1T	Machine Learning for Mechanical Engineers	22MMD1B1T	Finite Element Modeling and Analysis
22MMD1A2T	Advanced Solid Mechanics	22IM1B2T	Financial Management
22MMD1A3T	Sustainable and Smart Design	22MPD1B3T	Robotics and Automation

II SEMESTER M.Tech

Sl. No.	Course Code	Course Title	Credit Allocation L	T/ SDA	P	Total	BoS	Category	CIE Duration (H)	Max Marks CIE	SEE Duration (H)	Max Marks SEE
1	22IM21T	Research Methodology	3	0	0	**3**	IM	Theory	1.5	100	3	100
2	22MMD22TL	Vibrations and Acoustics	3	0	1	**4**	ME	Theory+Lab	1.5	100	3	100
3	22MMD23T	Advanced Machine Design	3	0	0	**3**	ME	Theory	1.5	100	3	100
4	22MMD2CXT	Elective C (Professional Elective)	3	0	0	**3**	ME	Theory	1.5	100	3	100
5	22XXX2DXXT	Elective D (Global Elective)	3	0	0	**3**	Res. BoS	Theory	1.5	100	3	100
6	22MMD24L	Automation and IoT Lab	1	0	1	**2**	ME	Lab	1.5	50	3	50
7	22HSS25T	Professional Skills Development-I	2	0	0	**2**	HSS	Theory*	1.5	50	2	50

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Code	Elective C (Professional Elective)
22MMD2C1T	Design for Tribology
22MMD2C2T	Theory of Plates and Shells
22MMD2C3T	Design of Pressure Vessels

Elective D (Global Elective)			
22BT2D01T	Bioinspired Engineering	22ET2D08T	Tracking and Navigation Systems
22BT2D02T	Health Informatics	22IM2D09T	Project Management
22CS2D03T	Business Analytics	22IS2D10T	Database and Information Systems
22CV2D04T	Industrial and Occupational Health and Safety	22IS2D11T	Management Information Systems
22CV2D05T	Intelligent Transportation Systems	22MAT2D12T	Statistical and Optimization Methods
22EC2D06T	Electronic System Design	22ME2D13T	Industry 4.0
22EC2D07T	Evolution of Wireless Technologies		

III SEMESTER M.Tech

Sl. No.	Course Code	Course Title	Credit Allocation L	T/ SDA	P	Total	BoS	Category	CIE Duration (H)	Max Marks CIE	SEE Duration (H)	Max Marks SEE
1	22MPD31TL	Industrial IoT	3	0	1	**4**	ME	Theory+Lab	1.5	100	3	100
2	22XXX3EXT	Elective E (Professional Elective)	3	1	0	**4**	ME	Theory	1.5	100	3	100
3	22MMD32N	Internship	0	0	6	**6**	ME	Internship	1.5	50	3	50
4	22MMD33P	Minor Project	0	0	6	**6**	ME	Project	1.5	50	3	50
						20						

Code	Elective E (Professional Elective)
22MMD3E1T	Fracture Mechanics
22MPD3E2T	Reliability Engineering
22MMD3E3T	Advanced Finite Element Analysis

IV SEMESTER M.Tech

Sl. No.	Course Code	Course Title	Credit Allocation L	T/ SDA	P	Total	BoS	Category	CIE Duration (H)	Max Marks CIE	SEE Duration (H)	Max Marks SEE
1	22MMD41P	Major Project	0	0	18	**18**	ME	Project	1.5	100	3	100
2	22HSS42	Professional Skills Development-II	2	0	0	**2**	HSS	NPTEL	--	50	ONLINE	50
Student need to submit the certificate for the evaluation of Course code 22HSS42												
						20						

SEMESTER: I						
Course Code	:	22MAT11AT	**COMPUTATIONAL MATHEMATICS**	CIE Marks	:	100
Credits L-T-P	:	3 - 1 - 0		SEE Marks	:	100
Hours	:	42L+28T	*Common Course (MPD, MMD, MPE, MBT, MST, MHT)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. A Sujatha			

UNIT - I **09 Hrs**

Vector Spaces and Orthogonality: Vector spaces and subspaces, linear independence, basis and dimension, four fundamental subspaces, change of basis. Inner product, orthogonal vectors, orthogonal projections, orthogonal bases. Eigen subspaces, Gram-Schmidt orthogonalization process, QR factorization and singular value decomposition.

UNIT - II **09 Hrs**

Multiple Random variables: Joint probability mass functions and probability density functions, marginal density function, conditioning of random variables, statistical independence, correlation and covariance functions, covariance and correlation matrices, transformation of random variables, Markov and Chebyshev inequalities, Gaussian distribution-Multivariate normal density and its properties.

UNIT - III **08 Hrs**

Principal component analysis and Factor analysis:
Overview of principal component analysis and factor analysis, eigen structure of covariance or correlation matrix. Principal component-standardized variables, covariance matrices. Factor model-principal component method, maximum likelihood method, factor scores, factor rotation.

UNIT - IV **08 Hrs**

Engineering optimization: Engineering applications of optimization, statement of an optimization problem-design vector, design constraints, constraint surface, objective function and objective function surface. Multivariable optimization with inequality constraints-Kuhn-Tucker conditions, constraint qualification.

UNIT - V **08 Hrs**

Numerical solution of differential equations:
Boundary value problems–finite difference method for linear and nonlinear problems, shooting method and Galerkin method. Finite difference methods for parabolic, elliptic and hyperbolic partial differential equations.

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Illustrate the fundamental concepts of distributions, linear algebra, differential equations and optimization arising in various fields engineering.
CO2	:	Derive the solution by applying the acquired knowledge and skills of statistical/numerical/optimization techniques to solve problems of probability distributions, linear algebra and differential equations.
CO3	:	Evaluate the solution of the problems using appropriate statistical numerical and optimization techniques to the real world problems arising in many practical situations.
CO4	:	Compile the overall knowledge of probability distributions, linear algebra and optimization methods gained to engage in life – long learning.

Reference Books

1. Richard A Johnson and Dean W Wichern, “Applied Multivariate Statistical Analysis”, Pearson Prentice Hall, 6th Edition, 2007, , ISBN-13: 978-0-13-187715-3, ISBN-10: 0-13-187715-1.

2. Gilbert Strang, “Linear Algebra and its Applications”, Cengage Learning, 4th Edition, 2006, ISBN 97809802327.

3. Edgar G. Goodaire “Linear Algebra: Pure & Applied Kindle Edition”, World Scientific, 1st Edition, 2013, ISBN-13: 978-9814508360.

4. M K Jain, S. R. K. Iyengar, R. K. Jain; Numerical methods for scientific and engineering computation; New Age International Publishers; 6th edition; 2012; ISBN-13: 978-81-224-2001-2.

5. Singiresu S. Rao, Engineering Optimization Theory and Practice, New Age International (P)Ltd., 3rd edition, 2009, ISBN: 81-224-1149-5.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: I						
Course Code	:	22MMD12TL	**ADVANCED MECHANISMS DESIGN**	CIE Marks	:	100
Credits L-T-P	:	3-0-1	*(Theory & Practice)*	SEE Marks	:	100
Hours	:	42L + 28P	*(Professional Core - 1)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Krishna M			

UNIT - I	**8 Hrs**
Classical Dynamics: Mechanical System, Generalized Coordinates, Constraints, Virtual work, Generalized force energy and momentum. Derivation of Lagrange's equation, problems on simple pendulum, Double pendulum, particle in whirling tube, particle with machinary support.	
UNIT - II	**8 Hrs**
Hamilton principle, Derivation of Hamilton's equation, The form of the Hamilton functions, problems. Hamilton-Jacobi Theorem, Hamilton's principle function, The Hamilton-Jacobi equation, Mobi Thoerem.	
UNIT - III	**9 Hrs**
Synthesis of Mechanisms- Analytical Method: Type, Number and Dimensional Synthesis, Function Generation, path Generation and Body Guidance, Design of a slider-crank mechanism, Four-bar crack rocker mechanism, Crank-Rocker mechanism with optimum Transmission Angle, Precision points for Function Generation, Structural Error, Chebychev Spacing, Frudenstein's Equation for both four bar and slider-crank mechanism, Bloch's Method of Synthesis Analytic Complex Number Modeling in Kinematic Synthesis, The Dyad or Standard Form, Problems.	
UNIT - IV	**9 Hrs**
Synthesis of Mechanisms-Graphical Method: Dead Center problems (Slider-crank and Crack-Rocker mechanisms), Synthesis of a Quick-Return Mechanisms, Crank-Rocker Mechanisms with optimum Trnasmission Angle, Three-position Synthesis, Four-Position Synthesis (Point-Position Reduction) The Overlay Method, Motion Generation Mechanism coupler as the output (two positions, Three position), Coupler-Curve Synthesis (two position, Four positions, Five position), Rober-Chevschev synthesis, Pole, Relative pole, Synthesis of Four bar and slider crank mechanism (Two position and Three position), Problems.	
UNIT - V	**8 Hrs**
Synthesis of Spatial Mechanism : Introduction, Exceptions in the Mobility of Mechanisms, The position-Analysis Problem, The Eulerian Angles, introduction to Robotics, Topology arrangements of roboticarms, Forward Kinematics, Invrse Position Analysis, Inverse Velocity and Acceleration Analyses.	
LABORATORY	**28 Hrs**
Modeling and functional simulation of: 1. Freely falling body - To Simulate and plot a freefalling body (point mass) of certain mass and inertial properties in the y-axis with simulation time of 2secs. 2: Inclined Plane – Simulation of rate at which the object slides down the surface is depending upon how tilted the surface is; the greater the tilt of the surface, the faster the rate at which the object will slide down it. 3: Lift Mechanism – Geometry - implementation of general multibody system dynamics on Scissor lift Mechanism (i.e., four bar parallel mechanism) within a bond graph modeling framework. 4: Lift Mechanism – Simulation with geometry design and functional parameters. 5: One-degree-of-freedom Pendulum – Motion study of the center of mass and to get the natural frequency of the pendulum and along with angle measurement. 6: Projectile - Explore projectile motion by changing the initial conditions and watching the resulting changes in the projectile's motion. 7: Spring Damper - Part 1 - This simulation shows a single mass on a spring, which is connected to a wall. This is an example of a simple linear oscillator. Change mass, spring stiffness, and friction (damping). 8: Spring Damper - Part 2 – The simulation for the spring damper considering single mass will be repeated considering different conditions. 9: Suspension System 1 – Simulation of suspension model with variable stiffness mechanism and study its displacement characteristics with geometrical and boundary conditions 1. 10: Suspension System 2 - Simulation of suspension model with variable stiffness mechanism and study its displacement characteristics with geometrical and boundary conditions 2. 11: Four Bar Mechanism - A planar four-bar linkage consists of four rigid rods in the plane connected by pin joints. 12: Cam-Follower - A cam and follower mechanism is a profiled shape mounted on a shaft that causes a lever or follower to move. 13: Crank Slider - Simple demonstration of the SLIDER-CRANK mechanism with 1 Degree of Freedom 14: Controls Toolkit in ADAMS/View – Demonstration of functions of control toolkit in ADAMS	

Course Outcomes:

After going through this course the student will be able to:

CO1	:	Understand the classical dynamics of Lagrangian, Hamilton-Jacobi, and Mobi principles
CO2	:	Synthesize mechanisms for their dimensions by analytical method
CO3	:	Estimate the dimensions of mechanisms by graphical method
CO4	:	Illustrate the process for the development of spatial and robotic mechanisms

Reference Books

1. George N Sandoor / Arthur G. Erdman, Advanced Mechansim Design Analysis and Synthesis (Vol.2), (2010) ISBN 0-13-011437-5

2. John J Uicker Jr. Gordon R. Pennock, Joseph E. Shigley, Theory of Machines and Mechanisms, Third Edition, Oxford University Press. (2003)

3. Kinematics and Dynamics of Machines, R.L.Nortron, Mc Graw Hill, 2017, Edition, ISBN:9789351340201

4. N.G.Sandorand, G.A.Erdman, Advanced Mechanism Design,Vol.2, Prentice Hall, 1984, 3rdEdition,ISBN-13: 978-0130408723ISBN-10: 0130408727

Scheme of Continuous Internal Evaluation (CIE): 10 + 30 + 30 + 30 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The average of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks will be reduced to 30 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (10), Video based seminar /presentation /demonstration (20) adding upto 30 marks.

Laboratory: Conduction of laboratory exercises, Lab report & observation & analysis (30 Marks), Lab Test (10 Marks) & Innovative Experiment/Concept Design & Implementation (10 Marks) adding up to 50 Marks. The final marks will be reduced to 30 Marks.

Scheme of Semester End Examination (SEE) for 100 marks: Each unit consists of TWO Questions of 16 Marks each. Answer FIVE full questions selecting one from each unit (from 1 to 5). Question No. 11 is compulsory (Laboratory component) for 20 Marks.

Rubric for CIE & SEE for Integrated Theory courses with Laboratory

RUBRIC of CIE			***RUBRIC of SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	10	Each unit consists of TWO questions of 16 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5). Question No. 11 is compulsory (Laboratory component) for 20 Marks.		
2	Tests - T1 & T2	30			
3	Experiential Learning - EL1 & EL2	30	1 & 2	Unit-1: Question 1 or 2	16
4	Laboratory	30	3 & 4	Unit-2: Question 3 or 4	16
	Total Marks	100	5 & 6	Unit-3: Question 5 or 6	16
NO SEE for Laboratory			7 & 8	Unit-4: Question 7 or 8	16
			9 & 10	Unit-5: Question 9 or 10	16
			11	Laboratory Component (Compulsory)	20
				Total Marks	100

SEMESTER: I						
Course Code	:	22MMD13TL	**COMPOSITE MATERIALS**	CIE Marks	:	100
Credits L-T-P	:	3- 0 - 1	*(Theory & Practice)*	SEE Marks	:	100
Hours	:	42L + 28P	*(Professional Core - 2)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Ramesh S Sharma			

UNIT - I	**9 Hrs**
Introduction to Composite Materials: Definition, Classification: Polymer Matrix Composites, Metal Matrix Composites, Ceramic Matrix Composites, Natural composites, and applications. Fibres- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosets, Sandwich composites. Advantages and Limitations of composite materials. Properties of composites in comparison with standard materials.	
UNIT - II	**8 Hrs**
Elastic behavior of Composite Lamina: Introduction, Strength of Materials Approach, Semi- Empirical Models, Elasticity Approach, Rule of Mixtures, Volume and Mass Fractions, Density, and Void Content, Evaluation of the Four Elastic Moduli, Ultimate Strengths of a Unidirectional Lamina Mechanical & Dynamic Properties - Stiffness and Strength, Mechanical Testing: ASTM Standards - Determination of stiffness and strengths of unidirectional composites; tension, compression, flexure and shear. Modal anlaysis of composite structures.	
UNIT - III	**8 Hrs**
Failure, Design of Lamina and laminates: Basic assumptions, laminate code, Strength Failure Theories of an Angle Lamina: Maximum Stress Failure Theory, Strength Ratio, Failure Envelopes, Maximum Strain Failure Theory, Tsai–Hill Failure, Theory, Tsai–Wu Theory. Laminate: Special Cases of Laminates, and Failure Criterion for a Laminate, and Design of a Laminated Composite.	
UNIT - IV	**8 Hrs**
Manufacturing methods: Hand and spray lay - up, vacuum bagging, injection molding, resin injection, filament winding, pultrusion, centrifugal casting and prepregs. Joining Methods: Joining –Advantages and disadvantages of adhesive and mechanically fastened joints. Typical bond strengths and test procedures.	
UNIT - V	**9 Hrs**
Nanocomposites: General introduction to nanocomposites; Materials, particulate, clay, and carbon nanotube, graphene nanocomposites, synthesis, characterization, properties, and applications. Neural network learning in composites design: Background, Digital signal characterization, Failure mechanism in composites, Neural Networks, Backpropagation Neural Networks, Algorithm, Numerical Examples.	
LABORATORY	**28 Hrs**
Lab Component 1. Preparation of glass/epoxy, carbon/epoxy laminates using hand lay-up technique – Using Handlay up process different composite materials are prepared. 2. Tensile testing of laminates as per ASTM standards – Using standard testing procedures the yield strength and ultimate strength of composite laminates are analyzed under tension. 3. Compression testing of composite laminates as per ASTM standards - Using standard testing procedures the yield strength and ultimate strength of composite laminates are analyzed under compression. . 4. Flexural testing of composite laminates as per ASTM standards - Using standard testing procedures the yield strength and ultimate strength of composite laminates are analyzed under bending load. 5. Drop weight Impact testing of composite laminates - Using standard testing procedures the impact strength of composite laminates is analyzed under suddenly applied loads . 6. Modal testing of composite laminates under different boundary conditions – Using different boundary conditions the natural frequency and mode shapes of different composite laminates is analyzed. 7. Hardness testing of laminates - Using standard testing procedures the hardness of composite laminates is analyzed. 8. Flexural testing of Sandwich composite as per ASTM standards – Using standard testing procedures the yield strength and ultimate strength of sandwich composite panels are analyzed under bending load. 9. Bonding strength of adhesively joined composites with different resin systems. 10. Izod and Charpy testing of laminates – Study of impact characteristics of composite laminates	

Course Outcomes:

After going through this course the student will be able to:

CO1	:	Comprehend the definition, classification and applications of composites in comparison with standard materials
CO2	:	Analyze elastic behavior and dynamic properties of composite materials applying basic laws in mechanics to the composite materials.
CO3	:	Develop skills in understanding the different manufacturing & Joining methods available for composite materials.
CO4	:	To understand the basics of nanomaterials and their synthesis, characterization and applications. Apply neural networks for composite design.

Reference Books

1. Mechanics of Composite Materials, (Second Edition), by Autar K. Kaw, CRC Press, 2010. ISBN 0–8493–1342-0

2. Composite Materials Handbook, Mein Schwartz, McGraw Hill Ed.,1992, ISBN 0-007557438

3. Smart Composites Mechanics and Design by Rani Elhajjar, Valeria La Saponara, Anastasia Muliana, 1st ed, 2014 ISBN 9781138075511, Published by CRC Press

4. Polymer nanocomposites: synthesis, characterization, and modeling by Ramanan Krishnamoorti, Washington, D.C.: American Chemical Society: Distributed by Oxford University Press (2002), ISBN 9491358265321

Scheme of Continuous Internal Evaluation (CIE): 10 + 30 + 30 + 30 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The average of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks will be reduced to 30 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (10), Video based seminar /presentation /demonstration (20) adding upto 30 marks.

Laboratory: Conduction of laboratory exercises, Lab report & observation & analysis (30 Marks), Lab Test (10 Marks) & Innovative Experiment/Concept Design & Implementation (10 Marks) adding up to 50 Marks. The final marks will be reduced to 30 Marks.

Scheme of Semester End Examination (SEE) for 100 marks: Each unit consists of TWO Questions of 16 Marks each. Answer FIVE full questions selecting one from each unit (from 1 to 5). Question No. 11 is compulsory (Laboratory component) for 20 Marks.

Rubric for CIE & SEE for Integrated Theory courses with Laboratory

RUBRIC of CIE			***RUBRIC of SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	10	Each unit consists of TWO questions of 16 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5). Question No. 11 is compulsory (Laboratory component) for 20 Marks.		
2	Tests - T1 & T2	30			
3	Experiential Learning - EL1 & EL2	30	1 & 2	Unit-1: Question 1 or 2	16
4	Laboratory	30	3 & 4	Unit-2: Question 3 or 4	16
	Total Marks	100	5 & 6	Unit-3: Question 5 or 6	16
NO SEE for Laboratory			7 & 8	Unit-4: Question 7 or 8	16
			9 & 10	Unit-5: Question 9 or 10	16
			11	Laboratory Component (Compulsory)	20
				Total Marks	100

SEMESTER: I						
Course Code	:	22MMD14L	**MACHINE LEARNING LAB**	CIE Marks	:	50
Credits L-T-P	:	1 - 0 - 1		SEE Marks	:	50
Hours	:	14L + 28P	*(Coding / Skill Laboratory)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Krishna M			

Content	**28 Hrs**
Lab Component: Introduction to Python: Unique features of Python, Install Python and Environment Setup (jupyter), First Python Program, Python Identifiers, Keywords and Indentation Comments and document interlude in Python Command line arguments Getting User Input Python Data Types, variables, Python Core objects and Functions, Number and Mathematical functions, Control flow (if-elif-else), loop (foor, while) List, Ranges & amp; Tuples in Python, Introduction Lists in Python, More About Lists, Generators , Comprehensions and Lambda Expressions, Introduction Generators and Yield, Next and Ranges, Python Dictionaries and Sets Introduction to the section, Python Dictionaries, More on Dictionaries, Sets, Python Sets Examples, Input and Output in Python, Reading and writing text files, writing Text Files, Appending to Files, Strings, regular expressions, pandas, Numpy, Scipy, matplot functions. Introduction to Plotting and visualization, Solving Dynamic Equations, Curve Fitting And Regression, Understanding Iterative Solvers, Data Analysis, Programs on simple equation of Mechanics, Mechanical vibration, thermal, heat transfer and fluid mechanics	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Understand python Programming in Mechanical Engineering
CO2	:	Use Python for Data Analysis
CO3	:	Solve Mechanical Engineering problems
CO4	:	Simulate Mechanical problems using Python

Reference Books

1. Alex Kenan, Python for Mechanical and Aerospace Engineering, Publisher : Alexander Kenan, ISBN-13.-978-1736060629, Publication Date, 13 December 2020

2. Ashok Namdev Kamthane , Amit Ashok Kamthane, Programming and Problem Solving with Python, Publisher, McGraw Hill, ISBN-13:978-9390113026, Publication Date, 5 August 2020

3. Alasdair Gilchrist “Industry 4.0 The Industrial Internet of Things” A press Publisher, ISBN-13 (pbk): 978-1-4842-2046-7 (2016).

4. Alp Ustundag • Emre Cevikcan “Industry 4.0: Managing The Digital Transformation”, Springer, 2018 ISBN 978-3-319-57869-9

Scheme of Continuous Internal Evaluation (CIE- Laboratory) : Only LAB Course 30 + 10 + 10 = 50. The Laboratory session is held every week as per the timetable and the performance of the student is evaluated in every session. The average of marks over number of experiments conducted over the weeks is considered for 30 Marks i.e (Lab Report, Observation & Analysis). The students are encouraged to implement additional innovative experiments in the lab (10 marks). At the end of the semester a test is conducted for 10 Marks (Lab Test). This adds to 50 Marks.

Scheme of Semester End Examination (SEE- Laboratory) : Only LAB Course 40 + 10 =50. Students will be evaluated for Write-up, Experimental Setup, Experiment Conduction with Results, Analysis & Discussions for 40 Marks and Viva will be conducted for 10 Marks adding to 50 Marks.

Only LAB Courses with 50 Marks

	RUBRIC FOR CIE			RUBRIC FOR SEE	
	Sl.No	Content	Marks	Content	Marks
	1	Write Up, Setup, Conduction Results, Analysis & Discussions	30	1. Write Up, Setup, Conduction 2. Results, Analysis & Discussions	40
	2	Innovative Experiment/Concept Design & Implementation	10		
	3	Laboratory Internal	10	Viva Voce	10
		Total Marks	50	Total Marks	50

SEMESTER: I						
Course Code	:	22MPD1A1T	**MACHINE LEARNING FOR MECHANICAL ENGINEERS**	CIE Marks	:	100
Credits L-T-P	:	3- 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective A (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Krishna M			

UNIT - I	**9 Hrs**
Introduction to Machine Learning, history of machine learning, artificial intelligence vs machine learning, data science vs machine learning, decision tree, Naive Bayes approach	
UNIT - II	**8 Hrs**
Learning Models , Types of Learning: Supervised, Unsupervised, Reinforcement, Perspectives and Issues, Version Spaces, PAC Learning, VC Dimension	
UNIT - III	**8 Hrs**
Regression: Linear Regression, Multiple Linear Regression, Bayesian Regression, Neural Networks: Introduction, Perception, Multilayer Perception, Support Vector Machines: Linear and Non-Linear, Kernel Functions, K nearest Neighbours. Introduction to clustering, K-means clustering, K-Mode Clustering.	
UNIT - IV	**8 Hrs**
Genetic Algorithms: Hypotheses, Genetic Operator, Fitness Function and Selection, an Illustrative Example, Hypothesis Space Search, Genetic Programming, Parallelizing Genetic Algorithms.	
UNIT - V	**9 Hrs**
Smart machining: application of neural networks, genetic algorithm for turning, milling, drilling and robotic applications, sensing, monitoring, data analysis, parameters, interpretation of responses.	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Understand the basics of probability distributions and components of learning.
CO2	:	Develop the regression models and algorithms for mechanical applications.
CO3	:	Assess the solution using advanced optimisation techniques.
CO4	:	Predict the responses from neural network and genetic algorithms for smart machining applications.

Reference Books

1.Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Prentice Hall of India, 3rd Edition2014.
2.Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar " Foundations of Machine Learning", MIT Press,2012
3.Tom Mitchell, "Machine Learning", McGraw Hill, 3rdEdition, 1997.
4.MACHINE LEARNING - An Algorithmic Perspective, Second Edition, Stephen Marsland, 2015.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			RUBRIC for SEE		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes – Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests – T1 & T2	40			
3	Experiential Learning – EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: I							
Course Code	:	22MMD1A2T	**ADVANCED SOLID MECHANICS**	CIE Marks	:	100
Credits L-T-P	:	3- 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective A (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. V L Jagannatha Guptha			

UNIT - I	**9 Hrs**
Analysis of Stress: Introduction, Body Force, Surface Force and Stress Vector, The State of Stress at a Point, Normal and Shear Stress Components, Rectangular Stress Components, Stress Components on an Arbitrary Plane, Equality of Cross Shears, General Theorem Principal Stresses, Stress Invariants, Mohr's Circles for the Three-Dimensional State of Stress, Planes of Maximum Shear, Octahedral Stresses, The State of Pure Shear, Decomposition into Hydrostatic and Pure Shear States, Cauchy's Stress, The Plane State of Stress, Differential Equations of Equilibrium, Equilibrium Equations for Plane Stress State.	
UNIT - II	**8 Hrs**
Analysis of Strain: Introduction, Deformation in the Neighborhood of a Point, Change in Length of a Linear Element, Change in Length of a Linear Element — Linear Components, Rectangular Strain Components, The State of Strain at a Point, Cubical Dilatation, Principal Axes of Strain and Principal Strains, Plane State of Strain, Plane Strains in Polar Coordinates, Compatibility Conditions, Strain Deviator and its Invariants. Stress–Strain Relations for Linearly Elastic Solids: Introduction, Generalized Statement of Hooke's Law, Stress – Strain Relations for Isotropic Materials, Relations between the Elastic Constants.	
UNIT - III	**8 Hrs**
Theories of Failure or Yield Criteria and Introduction to Ideally Plastic Solid: Introduction, Theories of Failure, Significance of the Theories of Failure, Use of Factor of Safety in Design, A Note on the use of Factor of Safety, Mohr's Theory of Failure, Ideally Plastic Solid, Stress Space and Strain Space, General Nature of the Yield Locus, Yield Surfaces of Tresca and Von Mises, Stress–Strain Relations (Plastic Flow), Prandtl–Reuss Equations, Saint Venant–Von Mises Equations.	
UNIT - IV	**8 Hrs**
Energy Methods: Introduction, Hooke's Law and the Principle of Superposition, Work Done by Forces and Elastic Strain Energy Stored, Reciprocal Relation, Maxwell–Betti–Rayleigh Reciprocal Theorem, Generalised Forces and Displacements, Begg's Deformeter, First Theorem of Castigliano, Expressions for Strain Energy, Fictitious Load Method, Superposition of Elastic Energies, Statically Indeterminate Structures, Theorem of Virtual Work, Kirchhoff 's Theorem, Second Theorem of Castigliano or Menabrea's Theorem, Generalisation of Castigliano's Theorem or Engesser's Theorem, Maxwell–Mohr Integrals.	
UNIT - V	**9 Hrs**
Bending of Beams: Introduction, Straight Beams and Asymmetrical Bending, Regarding Euler–Bernoulli Hypothesis, Shear Centre or Centre of Flexure, Shear Stresses in Thin-Walled Open Sections: Shear Centre Shear Centres for a Few Other Sections, Bending of Curved Beams (Winkler-Bach Formula), Deflections of Thick Curved Bars. Torsion: Introduction, Torsion of General Prismatic Bars–Solid Sections, Alternative Approach Torsion of Circular and Elliptical Bars, Torsion of Equilateral Triangular Bar, Torsion of Rectangular Bars, Membrane Analogy, Torsion of Thin-Walled Tubes, Torsion of Thin-Walled Multiple-Cell Closed Sections, Torsion of Bars with Thin Rectangular Sections, Multiply Connected Sections, Centre of Twist and Flexural Centre.	

Course Outcomes:

After going through this course the student will be able to:

CO1	:	Identify the stress-strain relations in elastic and plastic conditions
CO2	:	Examine bodies subjected to three dimensional stresses for the onset of failure based on failure criteria.
CO3	:	Analyze deflections in beams subjected to different types of loads for elastic, elastoplastic and plastic conditions.
CO4	:	Evaluate stresses in bars subjected to torsion for elastic, elastoplastic and plastic conditions.

Reference Books

1. L. S. Srinath, Advanced Mechanics of solids, 2000, Tata Mc. Graw Hill, ISBN-13: 978-0070702608,2009
2. S. P. Timoshenko, Theory of Elasticity, 1972, Mc. Graw Hill, 3rd edition, ISBN 978-0-13-223319-3
3. S. M. A. Kazimi, Solid Mechanics, Tata McGraw-Hill, 2001, 0074517155, 9780074517154
4. T.G. Sitharam, Applied Elasticity, Interline Publications, 2004

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE

Sl.No	Content	Marks
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	100

RUBRIC for SEE

Q. No	Contents	Marks
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
1 & 2	Unit-1: Question 1 or 2	20
3 & 4	Unit-2: Question 3 or 4	20
5 & 6	Unit-3: Question 5 or 6	20
7 & 8	Unit-4: Question 7 or 8	20
9 & 10	Unit-5: Question 9 or 10	20
	Total Marks	100

SEMESTER: I							
Course Code	:	22MMD1A3T	**SUSTAINABLE AND SMART DESIGN**	CIE Marks	:	100
Credits L-T-P	:	3- 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective A (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Krishna M			

UNIT - I	**9 Hrs**
Addressing Sustainability by Design – The sustainability challenge, Responses from design- The beginnings, From green design to design for sustainability transitions, Green Design and Product Eco design- addressing the individual qualities of products to adopting a life cycle perspective, Design practice, Ecodesign principles, strategies and guidelines, Benefits and limitations, Future research directions, examples for Green design, Ecodesign.	
UNIT - II	**8 Hrs**
Emotionally Durable Design - Designing the emotional bond between the product and the user, Four main determinants, Design practice, Benefits and limitations, Future research directions , EDD examples. Design for sustainable behaviour - Triggering and supporting changes in human behaviour, Three main models, comprehensive action determination model (CADM), Design practice, framework of four phases, The decision support framework for promoting sustainable behaviour, combining a set of existing DfSB approaches, methods and tools, Benefits and limitations, Future research directions. Examples of DsSB.	
UNIT - III	**8 Hrs**
Biomimicry Design - inspiration from nature, Design practice – methodology, methods and tools, Benefits and limitations, Future research directions. Examples of BM. Product- Service System for sustainability - From designing individual products to integrated sets of products and services, classification, design stages, methods and tools, Benefits and limitations, Future research directions. PSS examples. Design for social innovation - place- based innovations, Design practice, tools and methods, interrelated principles of collaborative realisation, Benefits and limitations, Future research directions. DfSI examples.	
UNIT - IV	**8 Hrs**
Smart Design – Smart Materials - Actuators to Architecture: Actuators, Piezoelectric Ceramics, Functionally Graded Materials, Actuators and Sensors, Smart Materials for Active Structures. Hybrid Composites, Magnetorheological Fluids, Shape Memory Alloys, Types and Functionalities. Rotary wing aircraft - Trailing Edge Flaps, Servoflap, Smart Structures for Flight in Nature, The Range of Active Structures and Materials Applications in Aeronautics, Aircraft Structures. SMA for Ship Health Monitoring, Sound Control with Smart Skins.	
UNIT - V	**9 Hrs**
Smart Design – Smart Manufacturing - Implementing/Adopting Smart Manufacturing across an Industrial Organization, Industrie 4.0 and International Perspective, Cyber infrastructure for the Democratization of Smart Manufacturing, Hardware and Software for Smart Manufacturing, Measuring, Managing and Transforming Data for Operational Insights, The Role of Advanced Process Modeling in Smart Manufacturing, Industrial AI and Predictive Analytics for Smart Manufacturing Systems	

Course Outcomes:

After going through this course the student will be able to:

CO1	:	Analyzing the fundamental tools and concepts of sustainable engineering to analyze engineering projects.
CO2	:	Design and develop a product focused on sustainability
CO3	:	Describe the smart materials for their features and applications.
CO4	:	Describe the innovation processes for sustainable products, from product definition to sustainable manufacturing.

Reference Books

1. Design for sustainability – A multilevel framework from product to socio-technical systems by Fabrizio Ceschin and idil Gaziulusoy, Routledge, Taylor and Francis Group, 2020, ISBN: 978- 1- 138- 31516- 7 (hbk).

2. C. Vezzoli et al., Designing Sustainable Energy for All, Green Energy and Technology, https://doi.org/10.1007/978-3-319-70223-0_5, 2018

3. Encyclopedia of Smart materials Volume 1 and volume 2 Mel Schwartz, A Wiley-Interscience Publication, John Wiley & Sons, Inc. 2002, ISBN 0-471-17780-6

4. Smart Manufacturing - Concepts and Methods, Masoud Soroush, McKetta Michael Baldea, Thomas Edgar, 1st Edition - August 4, 2020 , Elsevier, Paperback ISBN: 9780128200278, eBook ISBN: 9780128203804

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: I							
Course Code	:	22MMD1B1T	**FINITE ELEMENT MODELING AND ANALYSIS**	CIE Marks	:	100
Credits L-T-P	:	3- 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective B (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Bharatisha A			

UNIT - I	**9 Hrs**
Introduction to Finite Element Analysis: Basic Concepts of Finite Element Analysis, shape function of the linear bar element, quadratic bar element, 2-D Constant strain triangular element, 2-D linear triangular element, 4 noded quadrilateral element, 9-noded, quadrilateral element and scrindipidy elements. Stiffness, traction and body force vectors for 2 noded element, truss element, CST element and 4 noded quadrilateral elements and related problems	
UNIT - II	**8 Hrs**
Axisymmetric Solids: Structures of Revolution, Derivation of stiffness matrix, shape functions of axisymmetric triangular element, strain displacement relations, numericals, numerical integration	
UNIT - III	**8 Hrs**
General Solids: Solid Elements: Overview. Four noded Tetrahedron, eight noded hexhedron element, shape functions, strain matrix, stiffenss and mass matrices, application of morphing	
UNIT - IV	**8 Hrs**
Dynamic Analysis: Introduction – simple harmonic oscillator, multi degrees of freedom systems, equation of motion, longitudinal vibration of bars – transverse vibration of beams – consistent mass matrices, eigen values and eigen vectors, modeling of damping, solution methods: polynomial iteration, matrix iteration and cholesky method.	
UNIT - V	**9 Hrs**
Heat Tranfer and Fluid flow Analysis: : One dimensional heat transfer element, composite structures, applications, fins in 2-Dimensions, Axisymmetric heat transfer, stream function in two dimeional flow, velocity potential function, boundary conditions	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Understand the basic elements, shape functions and domains of FEA
CO2	:	Develop the stiffness matrices, stress and strain relations of various elements
CO3	:	Assess the solution obtained for structural problems
CO4	:	Formulate the finite element model for industry oriented projects

Reference Books

1. Fundamentals of FEM, Hutton, Tata McGraw Hill education Pvt. Ltd, 2005, ISBN: 070601224
2. First Course in Finite element methods, Daryl L Logan, 5 th Edition, Thomson Brooks, 2011, ISBN : 10:0495668257
3. Introduction to FE in engineering, T R Chandrupatla, A D Belegondu, 3 rd Edition, Prentice Hall, 2004, ISBN - 978-0130615916
4. Finite Element method in machining processes, Angelos.P.Markopoulos, Srpinger series, 2013, ISBN: 978-1-4471-4330-7

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100
QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.
TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks will be reduced to 40 Marks.
EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: I							
Course Code	:	22IM1B2T	**FINANCIAL MANAGEMENT**	CIE Marks	:	100
Credits L-T-P	:	3- 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective B (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Rajeshwara Rao K V S			

UNIT - I	**9 Hrs**
Financial Management - An overview: Financial Decisions in a firm, Goals of a firm, Fundamental principle of finance, Organization of finance function and its relation to other functions, Regulatory framework. The financial System: Functions, Assets, Markets, Market returns, Intermediaries, regulatory framework, Growth and trends in Indian financial system. Financial statements, Taxes and cash flow: Balance sheet, statement of profit and loss, items in annual report, manipulation of bottom line, Profits vs Cash flows, Taxes. (Conceptual treatment only)	
UNIT - II	**8 Hrs**
Time Value of Money: Future value of a single amount, future value of an annuity, present value of a single amount, present value of an annuity. Valuation of securities: Basic valuation model, bond valuation, equity valuation-dividend capitalization approach and other approaches. Risk and Return: Risk and Return of single assets and portfolios, measurement of market risk, relationship between risk and return, implications (Conceptual and Numerical treatment)	
UNIT - III	**8 Hrs**
Techniques of Capital Budgeting: Capital budgeting process, project classification, investment criteria, Net present value, Benefit-Cost ratio, Internal Rate of return, Pay back period, Accounting rate of return. Cost of Capital: Preliminaries Cost of debt and preference, cost of retained earnings, cost of external equity, determining the proportions, weighted average cost of capital, weighted marginal cost of capital schedule. Capital structure and cost of capital: Assumptions and concepts, net income approach, net operating income approach, traditional position, Modigliani and Miller Position, Taxation and Capital structure, Other imperfections and Capital structure (Conceptual and Numerical treatment)	
UNIT - IV	**9 Hrs**
Long term finance: Sources- Equity capital, Internal accruals, preference capital, term loans, debentures. Raising long term finance- Venture capital, Initial Public Offer, Follow on Public Offer, Rights Issue, Private Placement, Term Loans, Investment Banking Securities Market: Primary market vs Secondary market, Trading and Settlements, Stock market quotations and Indices, Govt. securities market, Corporate debt market. Working Capital – Policy and Financing: Factors influencing working capital requirements, Current assets financing policy, operating cycle and cash cycle. Accruals, trade credit, banks, public deposits, inter-corporate deposits, short term loans, right debentures, commercial paper, Factoring (Conceptual treatment only)	
UNIT - V	**8 Hrs**
Contemporary topics in Finance: Reasons and Mechanics of a merger, Takeovers, Divestures, Demergers, World monetary system, Foreign exchange markets, raising foreign currency finance, International capital budgeting, Options market, Futures market, Warrants, Venture capital financing framework, Indian venture capital scenario. (Conceptual treatment only)	

Course Outcomes:

After going through this course the student will be able to:

CO1	:	Explain the features of financial system and basic principles of financial management.
CO2	:	Describe the processes and techniques of capital budgeting and theories of capital structure.
CO3	:	Demonstrate an understanding of various sources of long term and working capital financing by organizations.
CO4	:	Analyze the trends in global financial scenarios.

Reference Books

1. Fundamentals of Financial Management , Prasanna Chandra, 6th Edition, 2018, McGraw Hill Education (India) Pvt. Ltd, ISBN: 978-93-392-0313-9, 93-392-0313-5

2.Financial Management-Text, Problems and Cases, Khan M Y & Jain P K, 8th Edition, 2018, McGraw Hill Education (India) Pvt. Ltd, ISBN: 9353162181 , 9789353162184

3. Financial Management, I M Pandey, 11th Edition, 2015, Vikas Publishing House, ISBN: 9789325982291

4. Fundamentals of Financial Management, James C. Van Horne, 13th Edition, 2008, Prentice Hall, ISBN: 978-0273713630

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: I							
Course Code	:	22MPD1B3T	**ROBOTICS AND AUTOMATION**	CIE Marks	:	100
Credits L-T-P	:	3- 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective B (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. S K Harisha			

UNIT - I	**9 Hrs**
Configuration Space: Degrees of Freedom of a Rigid Body, Degrees of Freedom of a Robot, Topology and Representation, Configuration and Velocity Constraints, Task Space and Workspace. Multiple robots, machine interface, robots in manufacturing and non-manufacturing applications, robot cell design, selection robot. Rigid-Body Motions: Rigid-Body Motions in the Plane, Rotations and Angular Velocities, Rigid-Body Motions and Twists: Homogeneous Transformation Matrices, Exponential Coordinate Representation of Rigid-Body Motions.	
UNIT - II	**8 Hrs**
Forward Kinematics: Denavit-Hartenberg Parameters, Euler Angles, Roll-Pitch-Yaw Angles, Unit Quaternions, Analytic Forward Kinematics First Formulation: Axes Expressed in Base Frame, Planar robot and Spatial robot. Inverse Kinematics: Analytic Inverse Kinematics, Numerical Inverse Kinematics, Inverse Velocity Kinematics, Closed loop system.	
UNIT - III	**8 Hrs**
Velocity Kinematics and Statics: Manipulator Jacobian, Statics of Open Chains, Singularity Analysis, Manipulability. Trajectory Generation: Joint space, Cartesian space, Point to point, Continuous trajectory planning, Polynomial Via Point Trajectories, Time-Optimal Time Scaling.	
UNIT - IV	**8 Hrs**
Dynamics of Open Chains: Lagrangian Formulation, Dynamics of a Single Rigid Body, Newton-Euler Inverse Dynamics, Dynamic Equations in Closed Form, Forward Dynamics of Open Chains, Dynamics in Task Space Coordinates, Constrained Dynamics, Actuation, Gearing, and Friction.	
UNIT - V	**9 Hrs**
Wheeled Mobile Robots: Types of Wheeled Mobile Robots, Omnidirectional Wheeled Mobile Robots, Nonholonomic Wheeled Mobile Robots, Odometry, Mobile Manipulation. Motion Planning: Overview of Motion Planning, Foundations, Complete Path Planners, Grid Methods, Sampling Methods, Virtual Potential Fields, Nonlinear Optimization.	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Analyze the manipulator design including actuator, drive and sensor issues.
CO2	:	Calculate the forward kinematics, inverse kinematics and Jacobian industrial robots.
CO3	:	Solve trajectory and dynamic related robotic problems.
CO4	:	Evaluate the different configurations, stability and motion concept of autonomous robots.

Reference Books

1. F. C. Park and K. M. Lynch, Modern Robotics - Mechanics, planning, and control, Cambridge University Press-2017, SBN 978110715630.

2. Mohsen Shahinpoor, A Robot Engineering Textbook, Harper & Row publishers, New York. ISBN:006045931X. (1987)

3. Fu, Lee and Gonzalez, Robotics: Control, Sensing, Vision and Intelligence, 1986, McGraw Hill International. ISBN:0070226253.

4. John J. Craig, Introduction to Robotics: Mechanics and Control, 2004 Addison Wesley Publishing, ISBN:0201543613.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	**22IM21T**	**RESEARCH METHODOLOGY**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Common Course to all M.Tech Programs*	SEE Durations	:	3 Hrs
Faculty Coordinator:		Dr. Rajeswara Rao K V S				

UNIT - I	8 Hrs
Research Problem: Problem Solving – General Problem Solving, Logical Approach, Soft System Approach, Creative Approach, Group Problem Solving Techniques for Idea Generation. Formulation of Research Problems – Approaches to Research Problem, Exploration for Problem Identification, Hypothesis Generation and Formulation of the problem.	
UNIT - II	9 Hrs
Research Design: Experimental Design – Principles of Experiment, Laboratory Experiment, Experimental Design, Quasi Experimental Design, Action. Research, Validity and Reliability of Experiment and Quasi Experiments. Ex Post Facto Research – Exploratory Research, Historical Research, Descriptive Research, Field Studies, Survey Research, Qualitative Research Methods.	
UNIT - III	8 Hrs
Research Design for Data Acquisition: Measurement Design – Primary types of Measurement scales, Validity and Reliability Measurement, Sample Design – Non-Probability Sampling, Probability Sampling. Data Collection Procedures – Sources of secondary data, Primary data collection methods, Validity and Reliability of data collection procedures.	
UNIT - IV	9 Hrs
Data Analysis: Exploratory Data Analysis, Statistical Estimation, Hypothesis Testing, Parametric Tests, Non-Parametric Tests, Multiple Regression, Factor Analysis, Cluster Analysis	
UNIT - V	8 Hrs
Research Proposal: Purpose, Types, Development of Proposal, Evaluation of Research Proposal. Report Writing: Pre-writing consideration, Format of Reporting, Briefing, Best practices for Journal writing.	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Recognize the principles and concepts of research types, data types and analysis procedures.
CO2	:	Apply appropriate method for data collection and analyze the data using statistical principles.
CO3	:	Express research output in a structured report as per the technical and ethical standards.
CO4	:	Develop a research design for the given engineering and management problem context.

Reference Books:

1. Krishnaswami, K.N., Sivakumar, A. I. and Mathirajan, M., Management Research Methodology, Integration of Principles, Methods and Techniques, 17th Impression, Pearson India Education Services Pvt. Ltd, 2018. ISBN: 978-81-7758-563-6

2. William M. K. Trochim, James P. Donnelly, The Research Methods Knowledge Base, 3rd Edition, Atomic Dog Publishing, 2006, ISBN: 978-1592602919

3. Kothari C.R., Research Methodology Methods and Techniques, 4th Edition, New Age International Publishers, 2019, ISBN: 978-93-86649-22-5.

4. Levin, R.I. and Rubin, D.S., Statistics for Management, 8th Edition, Pearson Education: New Delhi, 2017, ISBN-13- 978-8184957495.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			*RUBRIC for SEE*		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	22MMD22TL	**VIBRATIONS AND ACOUSTICS**	CIE Marks	:	100
Credits L-T-P	:	3-0-1	*(Theory & Practice)*	SEE Marks	:	100
Hours	:	42L+28P	*(Professional Core - 3)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Ramesh S Sharma			

UNIT - I **9 Hrs**

Fundamentals of vibration – Basic concept of vibration, Importance of the study of vibration, Classification of vibration, Vibration analysis procedure, Simple Harmonic Motion, Addition of two harmonics (analytical and graphical method), Design case study (forging hammer), Examples using MATLAB

Free Vibration of Single Degree Freedom Systems – Free vibration of undamped systems, Equation of motion, Springs in series & parallel, Effect of mass of spring, Numericals & Examples using MATLAB

UNIT - II **8 Hrs**

Damped Free Vibration – Types of damping, over, critical and under damped systems, Logarithmic decrement, vibration energy and logarithmic decrement.

Harmonically excited Vibration – Introduction, Equation of motion, Response of an underdamped system under harmonic force, Response of a damped system under harmonic force, Forced vibration with coulomb damping, hysteresis damping, and other types of damping.

UNIT - III **8 Hrs**

Vibration Control – Introduction, Vibration severity, ISO recommendations, Reduction of vibration at the source, Whirling of rotating shafts, vibration isolation, vibration absorbers.

Vibration Measuring Instruments – Introduction, Transducers, Vibration pickups, Frequency measuring instruments, Frahm's Reed Tachometer, Fullerton tachometers, Vibration exciters.

UNIT - IV **8 Hrs**

Finite Element Dynamic Analysis – Introduction, Eigen value Analysis, Axial vibrations of bar element, Transverse vibrations of beams, Numerical examples

Determination of Natural Frequencies, Damping & Mode Shapes – Influence coefficient, Rayleigh's Method & Dunkerley's method, Experimental Modal testing of structures, Examples using MATLAB

UNIT - V **9 Hrs**

Acoustics – Basics of Acoustics, Human perception of sound, sound pressure and sound pressure level, Sound wave propagation in 1D, Acoustic quantities and relations, Additive effects of sound.

Acoustic Transducers – Introduction, Technical considerations, Technical specifications, Environmental considerations, various types of microphones. Human vibration - Hand Arm Vibration, Whole Body Vibration – basic concept & modelling.

LABORATORY **28 Hrs**

1. Whirling of shafts with different shaft diameters – Analyze the speed at which a rotating shaft will tend to vibrate violently in the transverse direction if the shaft rotates in horizontal direction.
2. Longitudinal vibration of spring mass system (with & without damping) - The study of the dynamical behavior of longitudinally vibrating rods with and without damping.
3. Torsional vibration of spring mass system (with & without damping) - The study of the dynamical behavior of torsional vibrating discs with & without damping
4. Estimation of damping in a cantilever beam using FRF Curve – Accurate evaluation of flexural vibration damping of cantilever beam using Frequency Response Function (FRF).
5. Determination of natural frequency & damping of SDOF system using MAT LAB code - Analyze the damping ratio, natural frequency, and time constant of the poles of the linear SDOF system.
6. Modal testing of cantilever beam using FFT Analyzer - Analyze the natural frequency and modal shapes of cantilever beam using FFT analyzer.
7. Modal testing of plate under free-free condition using FFT Analyzer - Analyze the natural frequency and modal shapes of plate under free-free condition using FFT analyzer.
8. Modal testing of a composite plate using FFT Analyzer - Analyze the natural frequency and modal shapes of composite plate using FFT analyzer.
9. Measurement of Frequency Response Function (FRF) using modally tuned shaker
10. Noise Level Measurement at different locations using Noise Meter

Course Outcomes:

After going through this course the student will be able to:

CO1	:	Understand the fundamentals of vibration applying Newton's law of motion

CO2	:	Model the undamped and damped mechanical systems & structures
CO3	:	Apply concepts of vibration control and instrumentation
CO4	:	Select numerical methods to estimate modal parameters and comprehend the basics of acoustics

Reference Books

1. S S Rao, 'Mechanical Vibrations', Pearson Publisher, 6th Edition, ISBN 978-0-13-212819-3, 2016
2. C Sujatha, 'Vibration and Acoustics ',McGraw Hill Education, ISBN 978-007014878, 2017
3. Jyoti Kumar Sinha, 'Vibration Analysis, Instruments, and Signal Processing', CRC Press, Taylor & Francis Group, New York, ISBN 78-1-4822-3145-8, 2015
4. Rao V Dukkipati, 'Solving Vibration Analysis Problems using MATLAB', New Age International Publishers, ISBN 978-81-224-2427-0, 2007

Scheme of Continuous Internal Evaluation (CIE): 10 + 30 + 30 + 30 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The average of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks will be reduced to 30 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (10), Video based seminar /presentation /demonstration (20) adding upto 30 marks.

Laboratory: Conduction of laboratory exercises, Lab report & observation & analysis (30 Marks), Lab Test (10 Marks) & Innovative Experiment/Concept Design & Implementation (10 Marks) adding up to 50 Marks. The final marks will be reduced to 30 Marks.

Scheme of Semester End Examination (SEE) for 100 marks: Each unit consists of TWO Questions of 16 Marks each. Answer FIVE full questions selecting one from each unit (from 1 to 5). Question No. 11 is compulsory (Laboratory component) for 20 Marks.

Rubric for CIE & SEE for Integrated Theory courses with Laboratory

RUBRIC of CIE			***RUBRIC of SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	10	Each unit consists of TWO questions of 16 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5). Question No. 11 is compulsory (Laboratory component) for 20 Marks.		
2	Tests - T1 & T2	30			
3	Experiential Learning - EL1 & EL2	30	1 & 2	Unit-1: Question 1 or 2	16
4	Laboratory	30	3 & 4	Unit-2: Question 3 or 4	16
	Total Marks	100	5 & 6	Unit-3: Question 5 or 6	16
NO SEE for Laboratory			7 & 8	Unit-4: Question 7 or 8	16
			9 & 10	Unit-5: Question 9 or 10	16
			11	Laboratory Component (Compulsory)	20
				Total Marks	100

SEMESTER: II							
Course Code	:	22MMD23T	**ADVANCED MACHINE DESIGN**	CIE Marks	:	100
Credits L-T-P	:	3- 0 - 0		SEE Marks	:	100
Hours	:	42L	*(Professional Core - 4)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. L J Kirthan			

UNIT - I	**9 Hrs**
Introduction: Role of failure prevention analysis in mechanical design, Modes of mechanical failure, Review of failure theories for ductile and brittle materials including Mohr's theory and modified Mohr's theory, Numerical examples. Fatigue of Materials: Introductory concepts, High cycle and low cycle fatigue, Fatigue design models, Fatigue design methods, Fatigue design criteria, Fatigue testing, Test methods and standard test specimens, Fatigue fracture surfaces and macroscopic features, Fatigue mechanisms and microscopic features.	
UNIT - II	**8 Hrs**
tress-Life (S-N) Approach: S-N curves, the statistical nature of fatigue test data, General S N behaviour, Mean stress effects, Different factors influencing S-N behaviour, S-N curve representation and approximations, Constant life diagrams, Fatigue life estimation using SN approach. Strain-Life(ε-N)approach: Monotonic stress-strain behaviour ,Strain controlled test methods, Cyclic stress-strain behaviour, Strain based approach to life estimation, Determination of strain life fatigue properties, Mean stress effects, Effect of surface finish, Life estimation by ε-N approach.	
UNIT - III	**8 Hrs**
LEFM Approach: LEFM concepts, Crack tip plastic zone, Fracture toughness, Fatigue crack growth, Mean stress effects, Crack growth life estimation. Notches and their effects: Concentrations and gradients in stress and strain, S-N approach for notched membranes, mean 30 stress effects and Haigh diagrams, Notch strain analysis and the strain – life approach, Neuber's rule, Glinka's rule, and applications of fracture mechanics to crack growth at notches.	
UNIT - IV	**9 Hrs**
Fatigue from Variable Amplitude Loading: Spectrum loads and cumulative damage, Damage quantification and the concepts of damage fraction and accumulation, Cumulative damage theories, Load interaction and sequence effects, Cycle counting methods, Life estimation using stress life approach.	
UNIT - V	**8 Hrs**
Surface Failure: Introduction, Surface geometry, Mating surface, Friction, Adhesive wear, Abrasive wear, Corrosive wear, Surface fatigue spherical contact, Cylindrical contact, General contact, Dynamic contact stresses, Surface fatigue strength.	

Course Outcomes:

After going through this course the student will be able to:

CO1	:	Identify and explain the types of fractures of engineered materials and their characteristic features.
CO2	:	Develop a detailed understanding of S-N curves, S-N approach & behaviour.
CO3	:	Understand the differences in the classification of fracture mechanics (LEFM and EPFM) and how their corresponding parameters can be utilized to determine conditions under which engineering materials will be liable to fail catastrophically in service.
CO4	:	Appreciate the theoretical basis of the experimental techniques utilized for surface failure analysis

Reference Books

1. Ralph I. Stephens, Ali Fatemi, Robert, Henry o. Fuchs, Metal Fatigue in engineering, , 2001, John wiley, Newyork, Second edition.. ISBN: 978-1-933489-67-4

2. Jack. A. Collins, Failure of Materials in Mechanical Design, John Wiley, 1992, Newyork. ISBN: 988-3-955783-62-2

3. Machine Design, Robert L. Norton, Pearson Education India, 2000, ISBN 0-06-008493-3

4. S.Suresh, Fatigue of Materials, Cambridge University Press, -1998

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	22MMD2C1T	**Design for Tribology**	CIE Marks	:	100
Credits L-T-P	:	3- 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective C (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:		Dr. Bharatisha A				

UNIT - I	**9 Hrs**
Friction: Physico-Chemical Characteristics of Surface Layers, Analysis of Surface Roughness, Measurement of Surface Roughness, Contact Between Solid Surfaces, Friction: Basic Mechanisms of Sliding Friction, Friction Transitions During Sliding, Stick-Slip, Rolling Friction,Friction of Metals and Alloys, ceramics, polymers and solid lubricants	
UNIT - II	**8 Hrs**
Wear: Types of Wear Mechanism, Adhesive Wear, abrasive wear, fatigue Wear, impact Wear, Chemical, Fretting and Fretting Corrosion, wear debris, wear of creamics, metals and polymers	
UNIT - III	**8 Hrs**
Fluid Film Lubrication: Hydrostatic Lubrication, hydrodynamic lubrication, Reynolds equation, thrust bearings, jorunal bearings, Elastohydrodynamic Lubrication, forms of contact	
UNIT - IV	**9 Hrs**
Tribological Components and Applications: Sliding-Contact Bearings, rolling bearings, gears, seals, Cams and Tappets, Piston Rings, Electrical Brushes, MEMS, NEMS, material processing and industrial applications	
UNIT - V	**8 Hrs**
Nanotribology: SFA Studies, AFM/FFM Studies, Atomic-Scale Computer Simulations, Friction and Wear Screening Test Methods: Sliding Friction and Wear Tests, Abrasion Tests, Rolling-Contact Fatigue Tests, Solid-Particle Erosion Test, Corrosion Tests.	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Demonstrate fundamentals of tribology,friction, wear and lubrication
CO2	:	Analyze bearings for load carrying capacity, frictional force and power loss
CO3	:	Simulate and illustrate the testing methods in nanotribology
CO4	:	Design the various tribological componenents for minimum wear and friction

Reference Books

1. Introduction to tribology, second edition, Bharat Bhushan, John Wiley & Sons, Ltd, 2013, ISBN 978-1-119-94453-9
2. Tribology in machine design, T A Stolarski, Buttworth Heinemann, ISBN: 978-1-119-94453-9
3. Engineering Tribology, G W Stachowiak, A W Batchelor, Elsevier publication, ISBN:9780080875880, 1993
4. Lubrication of Bearings - Theoretical principles and design, Radzimovsky, Oxford press Company, 2000

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100
QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.
TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks will be reduced to 40 Marks.
EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			*RUBRIC for SEE*		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	22MMD2C2T	**THEORY OF PLATES AND SHELLS**	CIE Marks	:	100
Credits L-T-P	:	3- 0- 0		SEE Marks	:	100
Hours	:	42L	*Elective C (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. H N Narasimha Murthy			

UNIT - I	**8 Hrs**
General Introduction: Review of equations of elasticity- kinematics, compatibility equations, stress measures- equations of motions- constitutive relations- transformation of stresses, strains and stiffness-energy principles and variational methods in elasticity- virtual work-external and internal virtual work variational operator- functionals- Euler Lagrange equations- energy principles- Hamilton's principle- principle of minimum total potential- applications.	
UNIT - II	**9 Hrs**
Classical Theory Of Plates: Plates as structural elements- stress and moment resultants- assumptions made in the classical theory- displacement fields and strains- equations of equilibrium in Cartesian coordinates and in polar coordinates- boundary conditions – bending of rectangular plates with various boundary conditions and loading- symmetrical and asymmetrical bending of circular plates-limitations of classical theory- finite element analysis	
UNIT - III	**8 Hrs**
Buckling Analysis of Rectangular Plates: Buckling of simply supported plates under compressive forces- governing equations- the Navier solution- biaxial compression of a plate- uniaxial compression of a plate- buckling of plates simply supported on two opposite edges- Levy's solution- buckling of plates with various boundary conditions- general formulation- finite element analysis	
UNIT - IV	**8 Hrs**
Vibration of Plates: Governing equations for natural flexural vibrations of rectangular plates- natural vibrations of plates simply supported on all edges- vibration of plates with two parallel sides simply supported Levy's solution- vibration of plates with different boundary conditions- Rayleigh-Ritz method Natural vibration of plates with general boundary conditions- transient analysis of rectangular plates- finite element analysis.	
UNIT - V	**9 Hrs**
Analysis of Thin Elastic Shells of Revolution: Classification of shell surfaces- geometric properties of shells of revolution- general strain displacement relations for shells of revolution- stress resultants- equations of motion of thin shells, analytical solution for thin cylindrical shells- membrane theory- flexure under axisymmetric loads, shells with double curvature- geometric considerations- equations of equilibrium- bending of spherical shells- vibration of cylindrical shells- finite element analysis.	

Course Outcomes:

After going through this course the student will be able to:

CO1	:	Apply the structural mechanics approximations of membrane, plates and shells.
CO2	:	Develop simple modifications to the membrane plate and shell theories
CO3	:	Describe the static, dynamic, and non-linear motion of membrane, plate and shell structures.
CO4	:	Analyze numerical problems in shells of revolution

Reference Books

1. Theory and Analysis of Elastic Plates & Shells, Reddy,J.N., C.R.C. Press, NY, USA, 2nd Edition, eISBN-9780429127601, 2006

2. Theory and Analysis of Plates, Szilard, R., Prentice Hall Inc., 1999,ISBN 0-12-9353336-2

3. Theory of Plates and Shells, Timoshenko, S. and Krieger S.W, McGraw Hill Book Company, New York 1990, ISBN 0-13-913426-3

4. Stresses in shells, Wilhelm Flügge, Springer –Verlag, ISBN 978-3-662-01030-3 ISBN 978-3-662-01028-0 (eBook) DOI 10.1007/978-3-662-01028-0, 1960

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	22MMD2C3T	**DESIGN OF PRESSURE VESSELS**	CIE Marks	:	100
Credits L-T-P	:	3- 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective C (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. H N Narasimha Murthy			

UNIT - I **8 Hrs**

Introduction, stresses in cylindrical, spherical and conical shells, dilation of pressure vessels, intersecting spheres, general theory of membrane stresses in vessels under internal pressure, torus under internal pressure, theory of thick cylinders and spheres, shrink fit stresses in built up cylinders, autofrettage of thick cylinders, thermal stresses in pressure vessels.

UNIT - II **9 Hrs**

Stresses in flat plates: bending of rectangular plates with different edge conditions, bending of circular plates, plates with simply supported and clamped ends subjected to various loads, shell connections, heads and closures of various shapes.

UNIT - III **8 Hrs**

Discontinuity stresses in pressure vessels: beam on an elastic foundation, infinitely long beam, semiinfinite beam, cylindrical vessel under axially symmetrical loading, slope and deflectionconsiderations, discontinuity stresses in vessels, deformation and stresses in flanges.

UNIT - IV **8 Hrs**

Design and construction features: localized stresses and their significance, stress concentration at a variable thickness transition section in a cylindrical vessel, stress concentration about a circular hole in a plate subject to tension, elliptical openings, theory of reinforced openings, nozzle reinforcement, placement and shape, fatigue stress concentration, welded connections, bolted joints and gaskets.

UNIT - V **9 Hrs**

Design of vessels under external pressure, design of tall vessels, design of supports, design of thickwalled high pressure vessels.
Piping design: piping stress analysis, flexibility factor and stress intensification factor, design of piping system as per standard piping codes.

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Determine stresses in pressure vessels
CO2	:	Design pressure vessels using ASME codes
CO3	:	Analyse the boundary conditions for stresses in pressure vessels
CO4	:	Apply design methods like strength and stiffnes condition for pressure vessels and fluid piping

Reference Books

1. J. F. Harvey, Theory and Design of Pressure Vessels. CBS Publishers and Distributors, ISBN: 9788123910413
2001
2. B. C. Bhattacharyya, Introduction to Chemical Equipment Design: Mechanical Aspects.CBS Publishers and Distributors, ISBN: 13-978-8123909455, 2011
3. H. H. Bednar, Pressure Vessel Design Hand Book. Van Nostrand Reinhold, 1986, ISBN -978-0442213855
4. L. E. Brownell and E. D. Young, Process Equipment Design.Wiley, 2009. ISBN - 9780471113195

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100
QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.
TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks will be reduced to 40 Marks.
EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II

Course Code	:	22BT2D01T	**BIOINSPIRED ENGINEERING**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hr
Faculty Coordinator:		Dr Nagashree Rao and Dr Ashwani Sharma				

UNIT - I **8 Hrs**

Introduction to Bio-inspired Engineering: Macromolecules, Stem cells; types and applications. Synthetic Biology; Bottom-up' and 'top-down' engineering approaches. Synthetic/ artificial life. Biological Clock, Genetic Algorithms.

UNIT - II **9 Hrs**

Principles of bioinspired materials: Biological and synthetic materials, Self-assembly, hierarchy and evolution. Biopolymers, Bio-steel, Bio-composites, multi-functional biological materials. Thermal Properties. Antireflection and photo-thermal biomaterials, Microfluidics in biology, Invasive and non-invasive thermal detection inspired by skin

UNIT - III **9 Hrs**

Lessons from Nature:Bioinspired Materials and mechanism: Firefly-Bioluminescence, Cockleburs –Velcro, Lotus leaf - Self-cleaning materials, Gecko - Gecko tape, Whale fins - Turbine blades, Box Fish / Bone - Bionic car, Shark skin - Friction reducing swim suits, Kingfisher beak - Bullet train, Coral - Calera cement, Forest floor / Ecosystem functioning - Flooring tiles, Morpho butterfly- Structural color, Namib beetle- Water collecting, Termite mound passive cooling, Birds/Insects-flights/ aerodynamics, Mosquito inspired micro needle.

UNIT - IV **8 Hrs**

Biomedical Inspiration-Concept and applications: Organ system- Circulatory- artificial blood, artificial heart, pacemaker. Respiratory- artificial lungs. Excretory- Artificial kidney and skin. Artificial Support and replacement of human organs: artificial liver and pancreas. Total joint replacements- artificial limbs. Visual prosthesis -artificial eye/ bionic eye.

UNIT - V **8 Hrs**

Biomimetics: Inventions in nature for Human Innovation: Photosynthesis and Photovoltaic cells, Bionic/Artificial leaf. Bio-ink and 3D-Bioprinting. Cellular automata. Biosensors: Artificial tongue and nose. Biomimetic echolation. Insect foot adaptations for adhesion. Thermal insulation and storage materials. Bees and Honeycomb Structure. Artificial Intelligence, Neural Networking and bio-robotics.

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Elucidate the concepts and phenomenon of natural processes
CO2	:	Apply the basic principles for design and development of bioinspired structures
CO3	:	Analyse and append the concept of bio-mimetics for diverse applications
CO4	:	Designing technical solutions by utilization of bio-inspiration modules.

Reference Books:

1. D. Floreano and C. Mattiussi, Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, 1st edition, MIT Press, 2008, ISBN: 9780262062718

2. Guang Yang, Lin Xiao, and Lallepak Lamboni. Bioinspired Materials Science and Engineering. 1st edition, John Wiley, 2018, ISBN: 978-1-119-3903362

3. M.A. Meyers and P.Y. Chen. Biological Materials, Bioinspired Materials, and Biomaterials, 1st edition, Cambridge University Press, 2014, ISBN 978-1-107-01045.

4. Tao Deng. Bioinspired Engineering of Thermal Materials, 1st edtion, Wiley-VCH Press, 2018. ISBN: 978-3-527-33834-4.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II							
Course Code	:	22BT2D02T	**HEALTH INFORMATICS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:		Dr A H Manjunatha Reddy				

UNIT - I	**8 Hrs**
Introduction, Healthcare data, information and knowledge: Data types, data conversion, clinical data warehouse, data analytics, challenges, role of informatics in analytics, future trends	
UNIT - II	**8 Hrs**
Electronic health records: Introduction, scope for the e health records, challenges, examples, logical steps to selecting and implementing EHR	
UNIT - III	**8 Hrs**
Data standards and medical coding: Introduction, medical content standards, termonology standards, transport standards, medical coding and reimbursement, future trends,	
UNIT - IV	**9 Hrs**
Healthcare Enterprise: Overview of Health Informatics: Introduction, Key players in HI, organizations involved, barriers, programs, organizations and career, HI Resoruces	
UNIT - V	**9 Hrs**
Health Information privacy and security: Introduction, basic security principles, authentication and identity management, data security in the cloud and client/server management	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Understand the basic principles of Health informatics
CO2	:	Data capture to data transformation and to analysis
CO3	:	Creation of E health records, identify the challenges
CO4	:	Improvise the significant factors as per the spatio-temporal requirements

Reference Books:

1. Robert E. Hoyt Ann K. Yoshihashi, Health Informatics, Practical guide for Healthcare and Information Technology Professionals, 6th edition, Informatics Education, 2014, ISBN: 978-0-9887529-2-4
2. Kathryn J. Hannah Marion J. Ball, Health Informatics, Springer Series edition, Springer, 2005, ISBN: 1-85233-826-1
3. William R Hersh, Health Informatics, a Practical guide, 8th edition. 2022, ISBN 978-1-387-85475-2
4. Pentti Nieminen. Medical informatics and data analysis 1st edition, MDPI AG, 2021, ISBN-13 : 978-3036500980

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	22CS2D03T	**BUSINESS ANALYTICS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:		Dr. Azra Nasreen and Dr. Badarinath K				

UNIT - I	**9 Hrs**
Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling.	
UNIT - II	**9 Hrs**
Trendiness and Regression Analysis Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.	
UNIT - III	**8 Hrs**
Organization Structures of Business analytics Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, Predictive Analytics, Predicative Modelling, Predictive analytics analysis.	
UNIT - IV	**8 Hrs**
Forecasting Techniques Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.	
UNIT - V	**8 Hrs**
Decision Analysis Formulating Decision Problems, Decision Strategies with and without Outcome, Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Apply the concepts and methods of business analytics to solve business problems
CO2	:	Analyse, model and solve decision problems in different settings
CO3	:	Interpret results/solutions and identify appropriate courses of action for a given business scenario
CO4	:	Demonstrate skills like investigation, effective communication, working in team/Individual and following ethical practices by implementing solutions to decision making problems

Reference Books:

1. Business analytics Principles, Concepts, and Applications FT Press Analytics, Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, 1st Edition, 2014, ISBN-13: 978-0133989403, ISBN-10: 0133989402
2. The Value of Business Analytics: Identifying the Path to Profitability, Evan Stubs , John Wiley & Sons, |DOI:10.1002/9781118983881,1st Edition 2014, ISBN:978111898388
3. Business Analytics, James Evans, Pearsons Education 2nd Edition, ISBN-13: 978-0321997821 ISBN-10: 0321997824
4. Predictive Business Analytics Forward Looking Capabilities to Improve Business, Gary Cokins and Lawrence Maisel, Wiley; 1st Edition, 2013, ISBN: 978-1-118-17556-9 .

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100
QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.
TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 marks. Final test marks will be reduced to 40 Marks.
EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II

Course Code	:	22CV2D04T	**INDUSTRIAL AND OCCUPATIONAL HEALTH AND SAFETY**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:		Dr.V.AnanthaRam				

UNIT - I **08Hrs**

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and fire fighting, equipment and methods.

UNIT - II **09Hrs**

Occupational health and safety: Introduction, Health, Occupational health: definition, Interaction between work and health, Health hazards, workplace, economy and sustainable development, Work as a factor in health promotion. Health protection and promotion Activities in the workplace: National governments, Management, Workers, Workers' representatives and unions, Communities, Occupational health professionals. Potential health hazards: Air contaminants, Chemical hazards, Biological hazards, Physical hazards, Ergonomic hazards, Psychosocial factors, Evaluation of health hazards: Exposure measurement techniques, Interpretation of findings recommended exposure limits. Controlling hazards: Engineering controls, Work practice controls, Administrative controls. Occupational diseases: Definition, Characteristics of occupational diseases, Prevention of occupational diseases.

UNIT - III **09Hrs**

Hazardous Materials characteristics and effects on health: Introduction, Chemical Agents, Organic Liquids, Gases, Metals and Metallic Compounds, Particulates and Fibers, Alkalies and Oxidizers, General Manufacturing Materials, Chemical Substitutes, Allergens, Carcinogens, Mutagens, Reproductive Hazards, Sensitizers and Teratogens, Recommended Chemical Exposure Limits. Physical Agents, Noise and Vibration, Temperature and Pressure, Carcinogenicity, Mutagenicity and Teratogenicity. Ergonomic Stresses: Stress-Related Health Incidents, Eyestrain, Repetitive Motion, Lower Back Pain, Video Display Terminals.

UNIT - IV **08 Hrs**

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT - V **08 Hrs**

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, over hauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Explain the Industrial and Occupational health and safety and its importance.
CO2	:	Demonstrate the exposure of different materials, occupational environment to which the employee can expose in the industries.
CO3	:	Characterize the different type materials, with respect to safety and health hazards of it.
CO4	:	Analyze the different processes with regards to safety and health and the maintenance required in the industries to avoid accidents.

Reference Books:

1.Maintenance Engineering Handbook, Higgins & Morrow, SBN 10: 0070432015 / ISBN 13: 9780070432017, Published by McGraw-Hill Education. Da Information Services.

2. H. P. Garg, Maintenance Engineering Principles, Practices & Management, 2009,S. Chand and Company, New Delhi, ISBN:9788121926447

3.Fundamental Principles of Occupational Health and Safety, Benjamin O. ALLI, Second edition,2008 International Labour Office – Geneva: ILO, ISBN 978-92-2-120454-1

4.Foundation Engineering Handbook, 2008, Winterkorn, Hans, Chapman & Hall London. ISBN:8788111925428.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	22CV2D05T	**INTELLIGENT TRANSPORTATION SYSTEMS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr.Sunil S			

UNIT - I	**8 Hrs**
Introduction: –Historical Background, Definition, Future prospectus, ITS training and educational needs. Fundamentals of Traffic Flow and Control- Traffic flow elements, Traffic flow models, Shock waves in Traffic streams, Traffic signalization and control principles, Ramp metering, Traffic simulation	
UNIT - II	**9 Hrs**
ITS User services-User services bundles, Travel and Traffic management, Public Transportation Operations, Electronic Payment, Commercial Vehicles Operations, Emergency Management, Advanced Vehicle Control and safety systems, Information Management, Maintenance and construction Management. ITS Architecture-Regional and Project ITS Architecture, Need of ITS architecture, concept of Operations, National ITS Architecture, Architecture development tool	
UNIT - III	**9 Hrs**
Technology Building Blocks for ITS-Introduction, Data acquisition, Communication Tools, Data Analysis, and Traveller Information. Various detection, identification and collection methods for ITS. ITS Applications and their benefits-Freeway and incident management systems, Advanced arterial traffic control systems, Advanced Public Transportation Systems, Multimodal Traveller Information systems	
UNIT - IV	**8 Hrs**
ITS Planning-Transportation planning and ITS, Planning and the National ITS Architecture, Planning for ITS, Integrating ITS into Transportation Planning, relevant case studies. ITS Standards-Standard development process, National ITS architecture and standards, ITS standards application areas, National Transportation Communications for ITS Protocol, Standards testing	
UNIT - V	**8 Hrs**
ITS Evaluation – Project selection at the planning level, Deployment Tracking, Impact Assessment, Benefits by ITS components, Evaluation Guidelines, Challenges and Opportunities. ITS for Law Enforcement: Introduction, Enhance and support the enforcement traffic rules and regulations, ITS Funding options and ITS case studies	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Identify and apply ITS applications at different levels
CO2	:	Illustrate ITS architecture for planning process
CO3	:	Examine the significance of ITS for various levels
CO4	:	Compose the importance of ITS in implimentions

Reference Books:

1. Pradip Kumar Sarkar and Amit Kumar Jain, “Intelligent Transport Systems”, PHI Learning Private Limited, Delhi,2018, ISBN-9789387472068
2. Choudury M A and Sadek A, “Fundamentals of Intelligent Transportation Systems Planning” Artech House publishers (31 March 2003); ISBN-10: 1580531601
3. Bob Williams, “Intelligent transportation systems standards”, Artech House, London, 2008. ISBN-13: 978-1-59693-291-3
4. Asier Perallos, Unai Hernandez-Jayo, Enrique Onieva, Ignacio Julio Garcia Zuazola “Intelligent Transport Systems: Technologies and Applications” Wiley Publishing ©2015, ISBN:1118894782 9781118894781

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100
QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.
TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom’s Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 marks. Final test marks will be reduced to 40 Marks.
EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	22EC2D06T	**ELECTRONIC SYSTEM DESIGN**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:		Prof. Ravishankar Holla				

UNIT - I	**9 Hrs**
Design Process & its Fundamentals: Life Cycle of Electronic Products, Design and Development Process, Guidance for Product Planning, Design and Development, Technical Drawings, Circuit Diagrams, Computer-Aided Design (CAD)	
UNIT - II	**9 Hrs**
System Architecture and Protection Requirements: Introduction - Terminology, Functions and Structures, Systems Design Architecture, Electronic System Levels, System Protection Experiential Learning: (4 quizzes on the below mentioned topics other than CIE) Reliability Analysis: Introduction, Calculation Principles, Exponential Distribution, Failure of Electronic, Components, Failure of Electronic Systems, Reliability Analysis of Electronic Systems, Recommendations for Improving Reliability of Electronic Systems	
UNIT - III	**8 Hrs**
Thermal Management and Cooling: Introduction - Terminology, Temperatures and Power Dissipation, Calculation Principles, Heat Transfer, Methods to Increase Heat Transfer, Application Examples in Electronic Systems, Recommendations for Thermal Management of Electronic Systems, Cooling systems, liquid, air and non cooling systems.	
UNIT - IV	**8 Hrs**
Electromagnetic Compatibility (EMC): Introduction, Coupling Between System Components, Grounding Electronic Systems, Shielding from Fields, Electrostatic Discharge (ESD), Recommendations for EMC-compliant Systems Design	
UNIT - V	**8 Hrs**
Recycling Requirements and Design for Environmental Compliance: Introduction - Motivation and the Circular Economy, Manufacture, Use, and Disposal of Electronic Systems in the Circular Economy, Product Recycling in the Disposal Process, Material Recycling in the Disposal Process, Design and Development for Disassembly, Material Suitability in Design and Development, Recommendations for Environmentally Compliant Systems	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Realize the fundamentals of Design, Architecture, thermal management, EMC and Recycling requirements of Electronic System Design
CO2	:	Analyze the various application wise design requirements in Electronic systems along with the related concepts of implementations, standards and Compliances.
CO3	:	Use modern open source tools to realize the various concepts of Electronic system design
CO4	:	Engage in self-study through assignments, simulations, case studies and projects

Reference Books:

1. Fundamentals of Electronic Systems Design, Jens Lienig, Hans Brümmer 2017, Springer International Publishing, ISBN 978-3-319-55839-4, DOI:10.1007/978-3-319-55840-0
2. “Embedded System Design”, Marwedel, Peter, Springer Nature, 10.1007/978-3-030-60910-8
3. “Electromagnetic Compatibility Engineering”, Henry W. Ott, WILEY Publication, ISBN: 978-0-470-18930-6
4. "Handbook of Electronic Systems Design" by Charles A. Harper, McGraw-Hill Inc.,US , 0070266832, 978-0070266834

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100
QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.
TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom’s Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 marks. Final test marks will be reduced to 40 Marks.
EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II

Course Code	:	22EC2D07T	**EVOLUTION OF WIRELESS TECHNOLOGIES**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:		Dr. Mahesh A				

UNIT - I — **9 Hrs**

Introduction to cellular systems: Overview of Cellular Systems and evolution 2G/3G/4G/5G, Cellular Concepts – Frequency reuse, Co
channel and Adjacent channel Interference, C/I, Handoff, Blocking, Erlang Capacity, Bluetooth, WiFi, WWAN and PAN.

UNIT - II — **9 Hrs**

Fundamentals of wireless communication: Wireless Channel, Wireless propagation, Link budget, Free-space path loss, Noise figure of receiver, Multipath fading, Shadowing, Fading margin, Shadowing margin, Wireless Channel Capacity, OFDM and LTE, Large Scale Propagation effects and Channel Models

UNIT - III — **8 Hrs**

Fundamentals of 5G architecture: Difference between 4G and 5G, 5G Architecture, Planning of 5G Network, Quality of Service, Radio
Network, Requirements, Security, SIM in 5G Era, Specifications, Standardization, Terminal States

UNIT - IV — **8 Hrs**

mmWave and Visible Light Communications: Back ground and concept of mmWave Communications, Frequency bands, propagation characteristics, channel models, applications and challenges in 5G

UNIT - V — **8 Hrs**

Future Generations: Future Generations(where is the 6G?), Health Considerations, Identifiers, Interfaces, ,Key Derivation, Location Based Services, Massive Internet of Things, Measurements, Network Functions Virtualization,
Network Slicing, Open Source, , User Equipment, Vehicle-to-Vehicle communications (V2V),Virtual Reality (VR/AR/XR). Case study- Bharath Stack

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Demonstrate their understanding on functioning of wireless communication system and evolution of different wireless communication systems and standards
CO2	:	Compare different technologies used for wireless communication systems.
CO3	:	Demonstrate an ability explain recent techniques for Wireless Communication systems
CO4	:	Update the latest trends in wireless communications

Reference Books:

1. Theodore S. Rappaport, “Wireless Communications: Principles and Practice”, Pearson, 2nd Edition.
2. Aditya K Jagannatham, “Principles of Modern Wireless Communications”, McGraw Hill, 2017
3. Robin Chataut, Robert Akl, “Massive MIMO Systems for 5G and beyond Networks—Overview, Recent Trends, Challenges, and Future Research Direction” Sensors, May 2020
4. A. N. Uwaechia and N. M. Mahyuddin, A Comprehensive Survey on Millimeter Wave, Communications for Fifth-Generation Wireless Networks: Feasibility and Challenges, in IEEE, Access, vol. 8, pp. 62367-62414, 2020

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EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

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2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	22ET2D08T	**TRACKING AND NAVIGATION SYSTEMS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Prof. Shambulinga .M, Dr. B. Roja Reddy			

UNIT - I	**9 Hrs**
An Introduction to Radar: Basic Radar, The simple form of the Radar Equation, Radar Block Diagram, Radar Frequencies, Application of radar, Types of Radars. Detection of signals in Noise, Receiver Noise and the Signal-to Noise Ratio, Probability of Detection and False alarm, Introduction to Doppler, MTI, UWB Radars	
UNIT - II	**8 Hrs**
Terrestrial Network based positioning and navigation: General Issues of wireless positions location, Fundamentals, positioning in cellular networks, positioning in WLANs, Positioning in Wireless sensor networks.	
UNIT - III	**8 Hrs**
Satellite-based navigation systems: Global Navigation satellite systems (GNSS), GNSS receivers.	
UNIT - IV	**9 Hrs**
LiDAR: Introduction to LiDAR, context and conceptual discussion of LiDAR, Types of LiDARS, LiDARS Detection modes, Flash LiDAR versus Scanning LiDAR, Monostatic versus Bistatic LiDAR, Major Devices in a LiDAR, LiDAR remote sensing, Basic components and physical principles of LiDAR, LiDAR accuracy and data formats.	
UNIT - V	**8 Hrs**
SONAR: Underwater acoustics, applications, comparison with radar, submarine detection and warfare, overcoming the effects of the ocean, sonar and information processing.Transmission of the acoustic signal: Introduction, detection contrast and detection index, transmission equation, equation of passive and active sonar.	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Understand the concepts of Radar, LiDAR, Sonar, terrestrial and satellite based navigation system
CO2	:	Apply the concepts of radars, LiDAR, Sonar, cellular networks, WLAN, sensor networks and satellites in determining the user position and navigation.
CO3	:	Analyze the different parameters of satellite and terrestrial networks for navigation systems.
CO4	:	Evaluate the Radar, LiDAR, Sonar systems and satellite and terrestrial network based navigation and tracking systems

Reference Books:

1. M. L Skolnik,Introduction to RADAR Systems,3rd edition, 2017,TATA Mcgraw-Hill, ISBN: 978-0070445338
2. Mark A Richards, James A Scheer, William A Holam,Principles of Modern Radar Basic Principles, 2010, 1st edition,SciTech Publishing Inc, ISBN:978-1891121524 .
3. Davide dardari, Emanuela Falletti, Marco Luise, Satellite and Terrestrial Radio Positioning techniques- A signal processing perspective, 1st Edition, 2012, Elsevier Academic Press, ISBN: 978-0-12-382084-6.
4. Paul McManamon,LiDAR Technologies and Systems, SPIE press, 2019.
5. Pinliang Dong and Qi Chen,LiDAR Remote Sensing and Applications, CRC Press, 2018, ISBN: 978-1-4822-4301-7
6. Jean-Paul Marage, Yvon Mori, Sonar and Underwater Acoustics, Wiley, 2013, ISBN: 9781118600658

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100
QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.
TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 marks. Final test marks will be reduced to 40 Marks.
EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.
Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	22IM2D09T	**PROJECT MANAGEMENT**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:		Dr. Vikram N Bahadurdesai				

UNIT - I	**8 Hrs**
Introduction: Project Planning, Need of Project Planning, Project Life Cycle, Roles, Responsibility and Team Work, Project Planning Process, Work Breakdown Structure (WBS), Introduction to Agile Methodology.	
UNIT - II	**8 Hrs**
Capital Budgeting: Capital Investments: Importance and Difficulties, phases of capital budgeting, levels of decision making, facets of project analysis, feasibility study – a schematic diagram, objectives of capital budgeting	
UNIT - III	**9 Hrs**
Project Costing: Cost of Project, Means of Finance, Cost of Production, Working Capital Requirement and its Financing, Profitability Projections, Projected Cash Flow Statement, Projected Balance Sheet, Multi-year Projections, Financial Modeling, Social Cost Benefit Analysis	
UNIT - IV	**8 Hrs**
Tools & Techniques of Project Management: Bar (GANTT) chart, bar chart for combined activities, logic diagrams and networks, Project evaluation and review Techniques (PERT) Critical Path Method (CPM), Computerized project management	
UNIT - V	**9 Hrs**
Project Management and Certification: An introduction to SEI, CMMI and project management institute USA – importance of the same for the industry and practitioners. PMBOK 6 - Introduction to Agile Methodology, hemes / Epics / Stories, Implementing Agile. Domain Specific Case Studies on Project Management: Case studies covering project planning, scheduling, use of tools & techniques, performance measurement.	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Explain project planning activities that accurately forecast project costs, timelines, and quality.
CO2	:	Evaluate the budget and cost analysis of project feasibility.
CO3	:	Analyze the concepts, tools and techniques for managing projects.
CO4	:	Illustrate project management practices to meet the needs of Domain specific stakeholders from multiple sectors of the economy (i.e. consulting, government, arts, media, and charity organizations).

Reference Books:

1. Prasanna Chandra, Project Planning Analysis Selection Financing Implementation & Review, Tata McGraw Hill Publication, 8th Edition, 2010, ISBN 0-07-007793-2.
2. Project Management Institute, A Guide to the Project Management Body of Knowledge (PMBOK Guide), 5th Edition, 2013, ISBN: 978-1-935589-67-9
3. Harold Kerzner, Project Management A System approach to Planning Scheduling & Controlling, John Wiley & Sons Inc., 11th Edition, 2013, ISBN 978-1-118-02227-6.
4. Rory Burke, Project Management – Planning and Controlling Techniques, John Wiley & Sons, 4th Edition, 2004, ISBN: 9812-53-121-1

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100
QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.
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EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II

Course Code	:	22IS2D10T	**DATABASE AND INFORMATION SYSTEMS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:		Prof.Smitha G R				

UNIT - I **8 Hrs**

Advanced Database Models, Systems, and Applications : Enhanced Data Models: Introduction to Active, Temporal, Spatial, Multimedia, and Deductive Databases . Distributed Database Concepts : Distributed Database Concepts, Data Fragmentation, Replication, and Allocation Techniques for Distributed Database Design, Overview of Concurrency Control and Recovery in Distributed Databases

UNIT - II **8 Hrs**

Introduction to Information Retrieval and Web Search : Information Retrieval (IR) Concepts Retrieval Models, Types of Queries in IR Systems , Text Preprocessing , Inverted Indexing, Evaluation Measures of Search Relevance ,Web Search and Analysis, Trends in Information Retrieval .

UNIT - III **8 Hrs**

Information Systems, Organizations and Strategy: Organizations and information systems, How information systems impact organization and business firms, Using information systems to gain competitive advantage, management issues, Ethical and Social issues in Information Systems: Understanding ethical and Social issues related to Information Systems, Ethics in an information society, The moral dimensions of information society. A Case study on business planning.

UNIT - IV **9 Hrs**

Achieving Operational Excellence and Customer Intimacy: Enterprise systems, Supply chain management(SCM) systems, Customer relationship management(CRM) systems, Enterprise application. E-commerce: Digital Markets Digital Goods: E-commerce and the internet, E-commerce-business and technology, The mobile digital platform and mobile E-commerce, Building and E-commerce web site. A Case study on ERP.

UNIT - V **9 Hrs**

Managing Knowledge:
The knowledge management landscape, Enterprise-wide knowledge management system, Knowledge work systems, Intelligent techniques. Enhancing Decision Making: Decision making and information systems, Business intelligence in the enterprise. Business intelligence constituencies. Building Information Systems: Systems as planned organizational change, Overview of systems development.

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Understand the different models for Infromation Retrieval.
CO2	:	Appricieate the technology of Information Retrieval and Web Search
CO3	:	To understand the basic principles and working of information technology.
CO4	:	Describe the role of information technology and information systems in business.

Reference Books:

1. Kenneth C. Laudon and Jane P. Laudon: Management Information System, Managing the Digital Firm, Pearson Education, 14th Global edition, 2016, ISBN:9781292094007.

2. Fundamentals of Database Systems, Ramez Elmasri, Shamkant B. Navathe, 7th Edition, 2016, Published by Pearson, Copyright © , ISBN-10: 0133970779

3. James A. O' Brien, George M. Marakas: Management Information Systems, Global McGraw Hill, 10th Edition, 2011, ISBN: 978-0072823110.

4. Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke, 3rd Edition, 2003, McGraw-Hill, ISBN: 9780071231510

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

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EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

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3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II

Course Code	:	22IS2D11T	**MANAGEMENT INFORMATION SYSTEMS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:		Prof. Vanishree K				

UNIT - I **8 Hrs**

Overview: Introduction:
Professional Software Development, Software Engineering Ethics, Case studies. Software Processes: Models, Process activities, Coping with Change, Process improvement. The Rational Unified Process. Computer Aided Software Engineering. Agile Software Development: Introduction to agile methods, Agile development techniques, Agile project management and scaling agile methods. Information Systems in Global Business Today: The role of information systems in business today, Perspectives on information systems, Contemporary approaches to information systems

UNIT - II **9 Hrs**

Requirements Engineering and System Modeling:
Software Requirements: Functional and Non-functional requirements. Requirements Elicitation, Specification, Validation and Change. System Modeling: Context models, Interaction models, Structural models, Behavioural models, Model driven architecture. Information Systems, Organizations and Strategy: Organizations and information systems, How information systems impact organization and business firms, Using information systems to gain competitive advantage, management issues

UNIT - III **9 Hrs**

Development and Testing:
Design and implementation: Object oriented design using UML, Design patterns, Implementation issues, Open-source development. Software Testing: Development testing, Test-driven development, Release testing, User testing.
Securing Information Systems: System vulnerability and abuse, Business value of security and control, Establishing framework for security and control, Technology and tools for protecting information resources. A case study on cybercrime.

UNIT - IV **8 Hrs**

Advanced Software Engineering:
Dependable systems: Dependability properties, Sociotechnical systems, dependable processes, formal methods and dependability, A15 Availability and reliability, reliability requirements, Reliability measurements E-commerce: Digital Markets Digital Goods: E-commerce and the internet, E-commerce-business and technology, A Case study on ERP.

UNIT - V **8 Hrs**

Software Management:
Project Management: Risk Management, Managing People, Teamwork, Project Planning: Software Pricing, Plan driven development, Project Scheduling, Agile planning, Estimation Techniques, COCOMO cost modeling. Building Information Systems: Systems as planned organizational change, Overview of systems development.

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Understand and apply the fundamental concepts of software engineering for information systems.
CO2	:	Develop the knowledge about software engineering for management of information systems.
CO3	:	Interpret and recommend the use information technology to solve business problems.
CO4	:	Apply a framework and process for aligning organization's IT objectives with business strategy.

Reference Books:

1. Kenneth C. Laudon and Jane P. Laudon: Management Information System, Managing the Digital Firm, Pearson Education, 14th Global edition, 2016, ISBN:9781292094007.
2. Ian Sommerville,— Software Engineering, 9th Edition, Pearson Education, 2013, ISBN: 9788131762165
3. W.S. Jawadekar: Management Information Systems, Tata McGraw Hill, 2006, ISBN: 9780070616349.
4. James A. O' Brien, George M. Marakas: Management Information Systems, Global McGraw Hill, 10th Edition, 2011, ISBN: 978-0072823110

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3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II

Course Code	:	22MAT2D12T	**STATISTICAL AND OPTIMIZATION METHODS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. PRAKASH R			

UNIT - I **9 Hrs**

Random Vectors:
Probability models of N random variables, Vector notation, Marginal probability functions, Independence of random variables and random vectors, Functions of random vectors, Expected value vector and Correlation matrix, Gaussian random vectors, Expected values of sums, Probability density function of the sum of two random variables, Moment Generating Functions (MGF), MGF of the sum of independent random variables, Characteristic function and Probability generating function.

UNIT - II **8 Hrs**

Estimation: Point estimation, Estimator and estimate, Criteria for good estimates - unbiasedness, consistency, efficiency and sufficiency, Variance of a point estimator, Methods of point estimation - Method of moments and Method of maximum likelihood, Bayesian estimation of parameters.

UNIT - III **9 Hrs**

Inferential Statistics: Principles of Statistical Inference, Formulation of the problems with examples. Test of hypothesis - Null and alternative hypothesis, Procedure for statistical testing, Type I and Type II errors: level of significance, Rejection regions and power, Standard Normal null distribution (Z-test), Z-tests for means and proportions, Duality: two-sided tests and two-sided confidence intervals, P-value, Inference about variances, Special tests of significance for large and small samples (F, Chi – square, Z, t – test).

UNIT - IV **8 Hrs**

Fuzzy Optimization:
Basic concepts of fuzzy sets - Operations on fuzzy sets, Fuzzy relation equations, Fuzzy logic control, Fuzzification, Defuzzificatiuon, Knowledge base, Decision making logic, Membership functions, Rule base.
Artificial Neural Networks: Introduction - Neuron model, Multilayer perceptions - Back propagation algorithm and its variants, Loss functions in artificial neural networks, Stochastic gradient descent method.

UNIT - V **8 Hrs**

Machine Learning Algorithms:
Data mining, Hierarchy Clustering, k-Means Clustering, Distance Metric, Data mining for Big data, Characteristics of Big data, Statistical nature of Big data, Support Vector Machines, Statistical Learning Theory, Linear Support Vector Machine, Kernel functions and Nonlinear Support Vector Machines.

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Illustrate the fundamental concepts of statistics, random variables, estimation, inferential statistics, fuzzy optimization and machine learning algorithms.
CO2	:	Derive the solution by applying the acquired knowledge of random variables, estimation, inferential statistics, fuzzy optimization and machine learning algorithms to the problems of engineering applications.
CO3	:	Evaluate the solution of the problems using appropriate statistical and probability techniques to the real world problems arising in many practical situations.
CO4	:	Compile the overall knowledge of statistics, probability distributions and estimation, tests of hypothesis and optimization gained to engage in life – long learning.

Reference Books:

1. Roy D. Yates, David J. Goodman, “Probability and Stochastic Processes”, 3rd Edition, An Indian Adaptation, Wiley, 2021, ISBN: 9789354243455.

2. Douglas C. Montgomery and George C. Runger, “Applied Statistics and Probability for Engineers”, 7th Edition, John Wiley & Sons, 2019, ISBN: 9781119570615.

3. Trevor Hastie Robert Tibshirani Jerome Friedman, “The Elements of Statistical Learning - Data Mining, Inference, and Prediction”, 2nd Edition, Springer, 2009 (Reprint 2017), ISBN-10: 0387848576, ISBN-13: 9780387848570.

4. Michael Baron, “Probability and Statistics for Computer Scientists”, 2nd Edition, CRC Press, 2014, ISBN- 13: 978-1-4822-1410-9.

5. Shai Shalev-Shwartz and Shai Ben-David “Understanding Machine Learning: From Theory to Algorithms”, 1st Edition, Cambridge University Press, 2014, ISBN: 978-1-107-05713-5.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II

Course Code	:	22ME2D13T	**INDUSTRY 4.0**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:		Dr. Gopalakrishna H D				

UNIT - I **8 Hrs**

Fundamentals of Industry 4.0
Introduction, Industry 4.0, RAMI 4.0 (Reference Architecture Model Industry 4.0), Servitization, Product Service-System (PSS) Industry 4.0 across the Sectors Introduction, Transportation 4.0: Multimodal Transportation Systems, Rail 4.0, Digital Transformation of Railways, Logistics 4.0 (Implications), Fundamentals of Industry 4.0, Introduction, Industry 4.0, RAMI 4.0 (Reference Architecture Model Industry 4.0), Servitization, Product Service-System (PSS)
Industry 4.0 across the Sectors
Introduction, Transportation 4.0: Multimodal Transportation Systems, Rail 4.0, Digital Transformation of Railways, Logistics 4.0 (Implications)

UNIT - II **8 Hrs**

The Concept of the IIoT: Modern Communication Protocols, Wireless Communication Technologies, Proximity Network Communication Protocols, TCP/IP, API: A Technical Perspective, Middleware Architecture.

UNIT - III **8 Hrs**

Data Analytics in Manufacturing: Introduction, Power Consumption in manufacturing, Anomaly Detection in Air Conditioning, Smart Remote Machinery Maintenance Systems with Komatsu, Quality Prediction in Steel Manufacturing.
Internet of Things and New Value Proposition, Introduction, Internet of Things Examples, IoTs Value Creation Barriers: Standards, Security and Privacy Concerns.
Advances in Robotics in the Era of Industry 4.0, Introduction, Recent Technological Components of Robots, Advanced Sensor Technologies, Artificial Intelligence, Internet of Robotic Things, Cloud Robotics.

UNIT - IV **9 Hrs**

Additive Manufacturing Technologies and Applications: Introduction, Additive Manufacturing (AM) Technologies, Stereo lithography, 3DP, Fused Deposition Modeling, Selective Laser Sintering, Laminated Object Manufacturing, Laser Engineered Net Shaping, Advantages of Additive Manufacturing, Disadvantages of Additive Manufacturing.
Advances in Virtual Factory Research and Applications, The State of Art, The Virtual Factory Software , Limitations of the Commercial Software.

UNIT - V **9 Hrs**

Augmented Reality: Definitions and application of AR, VR, MR, Limitations of AR, VR, Hardware devices and Software systems, Technical issues and challenges in AR, Industrial applications, IoT and the Need for Data Rationalization
Internet of Things (IoT), Internet of Things Vision, Internet of Things (IoT) Frameworks, Architecture of Internet of Things (IoT), Visualizing the Internet of Things (IoT), Essential Technologies of the Internet of Things (IoT), Key Technologies Involved in Internet of Things, Enablers of IoT, Collaborative Operations , Training.
Smart Factories: Introduction, Smart factories in action, Importance, Real world smart factories, The way forward.
A Roadmap: Digital Transformation, Transforming Operational Processes, Business Models, Increase Operational Efficiency, Develop New Business Models.

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Understand the opportunities, challenges brought about by Industry 4.0 for benefits of organizations and individuals
CO2	:	Analyze the effectiveness of Smart Factories, Smart cities, Smart products and Smart services
CO3	:	Apply the Industrial 4.0 concepts in a manufacturing plant to improve productivity and profits
CO4	:	Evaluate the effectiveness of Cloud Computing in a networked economy

Reference Books:

1. Alasdair Gilchrist, Industry 4.0 The Industrial Internet Of Things, Apress Publisher, ISBN-13 (pbk): 978-1-4842-2046-7
2. Alp Ustundag, Emre Cevikcan, Industry 4.0: Managing The Digital Transformation, Springer, 2018 ISBN 978-3-319-57869-9.
3.Ovidiu Vermesan and Peer Friess, Designing the industry - Internet of things connecting the physical, digital and virtual worlds, Rivers Publishers, 2016 ISBN 978-87-93379-81-7
4.Christoph Jan Bartodziej, The concept Industry 4.0- An Empirical Analysis of Technologies and Applications in Production Logistics, Springer Gabler, 2017 ISBN 978-3-6581-6502-4.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	22MMD24L	**Automation and IoT LAB**	CIE Marks	:	50
Credits L-T-P	:	1 - 0 - 1		SEE Marks	:	50
Hours	:	14L + 28P	*(Coding / Skill Laboratory)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Krishna M			
Content						**28 Hrs**

Lab Component: E-Mobility - to learn contraol mechanisms and algorithms, developing futuristic electric vehicle solutions. Smart Antenna systems and Measurements - utilize large electromagentic and microwave facility for multiple activities of R&D, etc. Visual computing - learn to execute intersisciplinary activities lincliding edge computing, parallel programming, AI&ML. Hydrogen & Green Technology - to work on hydrogen generation from gree power resources. Indutrial Automation - to work on industrial hydraulics, industrial pneumatics and PLCs. IoT - to work on verticles of IoT associated with design, implementationa and maintanance. Automotive Mechatronics - work on XEntry portal systems, model variants for technological advancements in new cars.WIRIN - to work on AI&ML, Computer vision and human machine interaction related to autonomous systems and robotics. Macroelectronics - to work on fabrication and characterisation of new class of materials, devices, and systems based on nanomaterials, MEMs, etc. Electrical Vehicle Technology - to work on the EV related to high voltage systems and low voltage systems, BMS. Robotics and Automation - to work on high end program enabled automation process.

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Understand the design phases
CO2	:	Formulate need statement and specifications
CO3	:	Evaluate concepts with testing
CO4	:	Learn state of the art concepts.

Scheme of Continuous Internal Evaluation (CIE- Laboratory) : Only LAB Course 30 + 10 + 10 = 50. The Laboratory session is held every week as per the timetable and the performance of the student is evaluated in every session. The average of marks over number of experiments conducted over the weeks is considered for 30 Marks i.e (Lab Report, Observation & Analysis). The students are encouraged to implement additional innovative experiments in the lab (10 marks). At the end of the semester a test is conducted for 10 Marks (Lab Test). This adds to 50 Marks.

Scheme of Semester End Examination (SEE- Laboratory) : Only LAB Course 40 + 10 =50. Students will be evaluated for Write-up, Experimental Setup, Experiment Conduction with Results, Analysis & Discussions for 40 Marks and Viva will be conducted for 10 Marks adding to 50 Marks.

Only LAB Courses with 50 Marks

RUBRIC FOR CIE			RUBRIC FOR SEE	
Sl.No	Content	Marks	Content	Marks
1	Write Up, Setup, Conduction Results, Analysis & Discussions	30	1. Write Up, Setup, Conduction 2. Results, Analysis & Discussions	40
2	Innovative Experiment/Concept Design & Implementation	10		
3	Laboratory Internal	10	Viva Voce	10
	Total Marks	50	Total Marks	50

SEMESTER: II						
Course Code	:	**22HSS25T**	**PROFESSIONAL SKILL DEVELOPMENT- I**	CIE Marks	:	50
Credits L-T-P	:	2-0-0		SEE Marks	:	50
Hours	:	28L	*Common Course to all M.Tech Programs*	SEE Durations	:	2 Hrs
Faculty Coordinator:			Dr. C.Bindu Ashwini			

UNIT - I	4 Hrs
Communication Skills: Basics of Communication, Personal Skills & Presentation Skills – Introduction, Application, Simulation, Attitudinal Development, Self Confidence, SWOC analysis. Resume Writing: Understanding the basic essentials for a resume, Resume writing tips Guidelines for better presentation of facts. Theory and Applications.	
UNIT - II	8 Hrs
Quantitative Aptitude and Data Analysis: Number Systems, Math Vocabulary, fraction decimals, digit places etc. Simple equations – Linear equations, Elimination Method, Substitution method, Inequalities. Reasoning – a. Verbal - Blood Relation, Sense of Direction, Arithmetic & Alphabet. b. Non- Verbal reasoning - Visual Sequence, Visual analogy and classification. Analytical Reasoning - Single & Multiple comparisons, Linear Sequencing. Logical Aptitude, - Syllogism, Venn-diagram method, Three statement syllogism, Deductive and inductive reasoning. Introduction to puzzle and games organizing information, parts of an argument, common flaws, arguments and assumptions. Verbal Analogies/Aptitude – introduction to different question types – analogies, Grammar review, sentence completions, sentence corrections, antonyms/synonyms, vocabulary building etc. Reading Comprehension, Problem Solving,	
UNIT - III	6 Hrs
Interview Skills: Questions asked & how to handle them, Body language in interview, and Etiquette – Conversational and Professional, Dress code in interview, Professional attire and Grooming, Behavioral and technical interviews, Mock interviews - Mock interviews with different Panels. Practice on Stress Interviews, Technical Interviews, and General HR interviews	
UNIT - IV	5 Hrs
Interpersonal and Managerial Skills: Optimal co-existence, cultural sensitivity, gender sensitivity; capability and maturity model, decision making ability and analysis for brain storming; Group discussion(Assertiveness) and presentation skills;	
UNIT - V	5 Hrs
Motivation: Self-motivation, group motivation, Behavioral Management, Inspirational and motivational speech with conclusion. (Examples to be cited). Leadership Skills: Ethics and Integrity, Goal Setting, leadership ability.	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Develop professional skill to suit the industry requirement.
CO2	:	Analyze problems using quantitative and reasoning skills
CO3	:	Develop leadership and inter personal working skills.
CO4	:	Demonstrate verbal communication skills with appropriate body language.

Reference Books:

1. The 7 Habits of Highly Effective People, Stephen R Covey Free Press, 2004 Edition, ISBN: 0743272455
2. How to win friends and influence people, Dale Carnegie General Press, 1st Edition, 2016, ISBN: 9789380914787
3. Crucial Conversation: Tools for Talking When Stakes are High, Kerry Patterson, Joseph Grenny, Ron Mcmillan 2012 Edition, McGraw-Hill Publication ISBN: 9780071772204
4. Ethnus, Aptimithra: Best Aptitude Book ,2014 Edition, Tata McGraw Hill ISBN: 9781259058738

Phase *	Activity
I	Test 1 is conducted after the completion of 9 hours of training programme (3 Classes). Question paper will have two parts. Part A will be Quiz for 10 Marks and Part B for 50 Marks Descriptive answers.
II	Test 2 is conducted after the completion of 18 hours of training programme (6 Classes). Question paper will have two parts. Part A will be Quiz for 10 Marks and Part B for 50 Marks Descriptive answers. Total test marks will be reduced to 30 Marks and Total Quiz marks will be 20 Marks. Final CIE would be 50 Marks.
	CIE marks 20 Quiz + 30 Test = 50 Marks
Semester End Examination: SEE is conducted for 50 Marks for a duration of 2 hours.	

SEMESTER: III						
Course Code	:	22MPD31TL	**INDUSTRIAL IoT**	CIE Marks	:	100
Credits L-T-P	:	3-0-1		SEE Marks	:	100
Hours	:	42L+28P	*Professional Core - 5*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Krishna M			

UNIT - I	**8 Hrs**
Fundamentals of Industry 4.0 Introduction, Industry 4.0, RAMI 4.0 (Reference Architecture Model Industry 4.0), Servitization, Product Service-System (PSS) Industry 4.0 across the Sectors Introduction, Transportation 4.0: Multimodal Transportation Systems, Rail 4.0, Digital Transformation of Railways, Logistics 4.0 (Implications)	
UNIT - II	**9 Hrs**
SMARTness and Pervasive Computing Pervasive Computing, Problems of Pervasive Computing, Proposed Infrastructure for Pervasive (Ubiquitous) Computing: UbiCloud, Applications of Pervasive Computing, Healthcare, Two Stages of Pervasive Computing Development, Impact of Pervasive Computing, Differences between Traditional Networking and Pervasive Computing, . Typical Sensors needed in Pervasive Computing, Defining Smart Spaces, Attributes of Smart Spaces in Pervasive Computing, Pervasive Computing and Internet of Things (IoT) OPERATOR 4.0 Augmented Reality for O&M, Wearable Devices, Wearables and Localization Devices, Intelligent Health and Safety Devices for Operators, Sensors used in Wearable Devices, Collaborative Robotics in Industry 4.0, Human Factors in Industry 4.0: Ergonomic and Psychological Issues and Challenges	
UNIT - III	**9 Hrs**
The Industry 4.0 architecture and Cyber Physical Systems Cyber-Physical Systems (CPS), CPS 5C Level Architecture, Implementation of 5C CPS Architecture for Factories, Adaptive Clustering for Self-Aware Machine Analytics, Classic Applications of CPS, Classification of CPS in Context of Industry 4.0, Operational Technology (OT) and Information Technology (IT), IT and OT Convergence – Two Worlds Converging in Industrial IoT, Data and Optimization Across the Value Chain: Benefits and IT, OT and Cyber- Physical Systems in Smart Anything, Industry 4.0 Principles: Horizontal and Vertical Integration, Basic Functions and Uses of CPS, Practical Example of a Cyber Physical Systems: The Self-Modifying Machine, Digital Platforms Cybersecurity and Risk Cybersecurity in OT level, Cybersecurity in IT level, IT-OT Cybersecurity Convergence, Risks and threats of sharing data, Blockchains in cybersecurity	
UNIT - IV	**8 Hrs**
Cloud computing, data sources and data centers IT vs OT, CMMS, ERP, MES, EMS, PLM and other actors, Cloud Computing Taxonomies, Cloud Services, Data Repositories and Data Centers Big Data Analytics as Service Provider Connection: Sensors and Networks, Content or Context, Data Sharing and Collaboration, Big Data Analytics, Descriptive Analytics, Diagnostic Analytics, Prescriptive Analytics, What Types of Data Analytics Do Companies Choose	
UNIT - V	**8 Hrs**
IoT and the Need for Data Rationalization Internet of Things (IoT), Internet of Things Vision, Internet of Things (IoT) Frameworks, Architecture of Internet of Things (IoT), Visualizing the Internet of Things (IoT), Essential Technologies of the Internet of Things (IoT), Key Technologies Involved in Internet of Things, Enablers of IoT, Why the Internet of Things is Important?, The IoT Is Transforming Industry and Society, Types of Services of IoT, Internet of Things (IoT) Applications, The Internet of Things Today, The Internet of Things Tomorrow, Internet of Things (IoT) Ecosystem	

LABORATORY	28 Hrs

1. Familiarization with Arduino and perform necessary software installation
2. To interface LED/Buzzer with Arduino and write a program to turn ON LED for 1 sec after every 2 seconds
3. To interface Push button/Digital sensor (IR/LDR) with Arduino and write a program to turn ON LED when push button is pressed or at sensor detection
4. To interface DHT11 sensor with Arduino and write a program to print temperature and humidity readings
5. To interface motor using relay with Arduino and write a program to turn ON motor when push button is pressed
6. To interface OLED with Arduino and write a program to print temperature and humidity readings on it
7. To interface Bluetooth with Arduino and write a program to send sensor data to smartphone using Bluetooth
8. To interface Bluetooth with Arduino and write a program to turn LED ON/OFF when 10 is received from smartphone using Bluetooth
9. Write program on Arduino to upload temperature and humidity data to thingspeak cloud
10. Write a program on Arduino to retrieve temperature and humidity data from thingspeak cloud
11. Write a program to display temperature and humidity on BLYNK open-source platform.
12. Write a program to log the data to SD card acquired from the sensors
13. Design a fire alarm system that triggers a sprinkler and notifies the user when a fire is detected
14. Design a system to monitor the air pollution

Course Outcomes:

After going through this course the student will be able to:

CO1	:	Understand the opportunities, challenges brought about by Industry 4.0 for benefits of organizations and individuals
CO2	:	Analyze the effectiveness of Smart Factories, Smart cities, Smart products and Smart services
CO3	:	Apply the Industrial 4.0 concepts in a manufacturing plant to improve productivity and profits
CO4	:	Evaluate the effectiveness of Cloud Computing in a networked economy

Reference Books

1. Diego Galar Pascual, Pasquale Daponte, Uday Kumar " Handbook of Industry 4.0 and SMART Systems, Taylor & Francis Group,Reprint 2021, ISBN 978-1-032-10343-3

2.Alasdair Gilchrist, Industry 4.0 The Industrial Internet Of Things, Apress Publisher, ISBN-13 (pbk): 978-1-4842-2046-7

3. Alp Ustundag, Emre Cevikcan, Industry 4.0: Managing The Digital Transformation, Springer, 2018 ISBN 978-3-319-57869-9.

4. Ovidiu Vermesan and Peer Friess, Designing the industry - Internet of things connecting the physical, digital and virtual worlds, Rivers Publishers, 2016 ISBN 978-87-93379-81-7

Scheme of Continuous Internal Evaluation (CIE): 10 + 30 + 30 + 30 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The average of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks will be reduced to 30 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (10), Video based seminar /presentation /demonstration (20) adding upto 30 marks.

Laboratory: Conduction of laboratory exercises, Lab report & observation & analysis (30 Marks), Lab Test (10 Marks) & Innovative Experiment/Concept Design & Implementation (10 Marks) adding up to 50 Marks. The final marks will be reduced to 30 Marks.

Scheme of Semester End Examination (SEE) for 100 marks: Each unit consists of TWO Questions of 16 Marks each. Answer FIVE full questions selecting one from each unit (from 1 to 5). Question No. 11 is compulsory (Laboratory component) for 20 Marks.

Rubric for CIE & SEE for Integrated Theory courses with Laboratory

RUBRIC of CIE			***RUBRIC of SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	10	Each unit consists of TWO questions of 16 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5). Question No. 11 is compulsory (Laboratory component) for 20 Marks.		
2	Tests - T1 & T2	30			
3	Experiential Learning - EL1 & EL2	30	1 & 2	Unit-1: Question 1 or 2	16
4	Laboratory	30	3 & 4	Unit-2: Question 3 or 4	16
	Total Marks	100	5 & 6	Unit-3: Question 5 or 6	16
NO SEE for Laboratory			7 & 8	Unit-4: Question 7 or 8	16
			9 & 10	Unit-5: Question 9 or 10	16
			11	Laboratory Component (Compulsory)	20
				Total Marks	100

SEMESTER: III						
Course Code	:	22MMD3E1T	**FRACTURE MECHANICS**	CIE Marks	:	100
Credits L-T-P	:	3- 1 - 0		SEE Marks	:	100
Hours	:	42	*Elective E (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. L J Kirthan			

UNIT - I **9 Hrs**

Introduction: The Fracture Mechanics Approach to Design, Early Fracture Research, Historical Perspective The Liberty Ships, Post-War Fracture Mechanics Research, , The Energy Criterion, The Stress-Intensity Approach, Time-Dependent Crack Growth and Damage Tolerance, Effect of Material Properties on Fracture, A Brief Review of Dimensional Analysis. Linear Elastic Fracture Mechanics: An Atomic View of Fracture, Stress Concentration Effect of Flaws, The Griffith Energy Balance, Comparison with the Critical Stress Criterion, Modified Griffith Equation, The Energy Release Rate, Instability and the R-Curve, Reasons for the R-Curve Shape, Load Control vs. Displacement Control, Structures with Finite Compliance, Stress Analysis of Cracks, The Stress Intensity Factor, Relationship between K and Global Behaviour, Effect of Finite Size , Principle of Superposition, Weight Functions, Relationship between K and G.

UNIT - II **8 Hrs**

Crack-Tip Plasticity: The Irwin Approach, The Strip-Yield Model, Comparison of Plastic Zone Corrections, Plastic Zone Shape, K -Controlled Fracture, Plane Strain Fracture: Fact vs. Fiction, Crack tip Triaxiality, Effect of Thickness on Apparent Fracture Toughness, Plastic Zone Effects, Implications for Cracks in Structures.Mixed-Mode Fracture: Propagation of an Angled Crack, Equivalent Mode I Crack, Bi-axial Loading. Interaction of Multiple Cracks, Coplanar Cracks, Parallel Cracks. Mathematical Foundations of Linear Elastic Fracture Mechanics, Plane Elasticity, Cartesian Coordinates, Polar Coordinates, Crack Growth Instability Analysis, Crack-Tip Stress Analysis, Generalized In-Plane Loading, The Westergaard Stress Function.

UNIT - III **8 Hrs**

Elastic-Plastic Fracture Mechanics: Crack-Tip-Opening Displacement, The Contour Integral, J as a Path-Independent Line Integral , J as a Stress Intensity Parameter , The Large Strain Zone , Laboratory Measurement of J , Relationships Between J and CTOD, Crack-Growth Resistance Curves, Stable and Unstable Crack Growth, Computing J for a Growing Crack, J Controlled Fracture. Dynamic and Time Dependent Fracture: Dynamic Fracture and Crack Arrest, Rapid Loading of a stationary crack, Rapid Crack Propagation and Arrest, Crack Speed, Elasto dynamic crack-tip parameters, Dynamic Toughness, Crack Arrest, Dynamic Contour Integrals.

UNIT - IV **9 Hrs**

Application to Structures: KI for Part-Through cracks, influence coefficients for polynomial stress distributions, weight functions for arbitrary loading, primary, secondary and residual stresses. CTOD design curve, Failure Assessment Diagrams (FAD), original concept, J-based FAD, application to welded structures, incorporating weld residual stresses, weld misalignment, weld strength mismatch. Primary vs. Secondary stresses in FAD Method, Ductile-tearing Analysis with FAD. Fatigue Crack Propagation, Similitude in Fatigue, Empirical Fatigue Crack Growth Equations, Crack Closure , A Closer Look at Crack-Wedging Mechanisms, Effects of Loading Variables on Closure,

The Fatigue Threshold, The Closure Model for the Threshold, A Two-Criterion Model, Threshold Behaviour in Inert Environments, Variable Amplitude Loading and Retardation, Linear Damage Model for Variable Amplitude Fatigue, Reverse Plasticity at the Crack Tip, The Effect of Overloads and Under loads , Models for Retardation and Variable Amplitude Fatigue.

UNIT - V **8 Hrs**

Fracture Testing of Metals & Non-Metals: General Considerations, specimen configurations, Specimen orientation, Fatigue Precracking, Instrumentation, Side grooving, KIC testing, ASTM E399, K-R Curve Testing, Specimen design, experimental measurement of K-R curves, J-testing of metals, CTOD testing, Fracture testing of weldments. Fracture Toughness Measurements in Engineering Plastics, Klc Testing, J-Testing, Qualitative Fracture Tests on Plastics.Computational Fracture Mechanics, Overview of Numerical Methods, The Finite Element Method, The Boundary Integral Equation Method, Traditional Methods in Computational Fracture Mechanics, Stress and Displacement Matching, Elemental Crack Advance, Contour Integration, Virtual Crack Extension: Stiffness Derivative Formulation, Virtual Crack Extension: Continuum Approach.

Course Outcomes:

After going through this course the student will be able to:

CO1	:	Demonstrate the material failure for any combination of applied stresses

CO2	:	Ability to Assess the failure conditions of a structure
CO3	:	Determine the stress intensity factor for simple components of simple geometry
CO4	:	To conduct fracture testing of metals & non-metals and learn computational fracture mechanics using FEM

Reference Books

1. FractureMechanics: Fundamentals and Applications, T. L. An rson, Taylor and Francis Fourth Edition, 2005. ISBN: 977-3-735689-37-8

2. Elementary Engineering Fracture Mechanics, David Broek, Kl er Academic Publishers, 4th revised Edition. ISBN-13-978-9024726561, 1982

3. Elements of Fracture Mechanics, Prashanth Kumar, Tata McGr -Hill Education, ISBN (13): 978-0-07-065696-3, 2009

4. Fracture Mechanics, E.E. Gdoutos, Kluwer Academic Publishi , Boston, 1993. ISBN: 947-1-272683-32-9

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

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EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE

Sl.No	Content	Marks
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	100

RUBRIC for SEE

Q. No	Contents	Marks
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
1 & 2	Unit-1: Question 1 or 2	20
3 & 4	Unit-2: Question 3 or 4	20
5 & 6	Unit-3: Question 5 or 6	20
7 & 8	Unit-4: Question 7 or 8	20
9 & 10	Unit-5: Question 9 or 10	20
	Total Marks	100

SEMESTER: III						
Course Code	:	22MPD3E2T	**RELIABILITY ENGINEERING**	CIE Marks	:	100
Credits L-T-P	:	3- 1 - 0		SEE Marks	:	100
Hours	:	42L+28T	*Elective E (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. G R Rajkumar			

UNIT - I	**8 Hrs**
Basic Probability Theory: Parameters and Reliability concepts, Rules for combining Probabilities of events, Failure Density and Distribution functions, Bernoulli's trials, Binomial distribution, Expected value and standard deviation for binomial distribution, Numericals Introduction to Probability Distributions: Normal, Poisson and Binomial distribution. Control Charts: Variable Chart – X Bar chart, R-chart and Sigma chart. Attribute Chart: P – Chart, nP Chart, C-Chart and U – Chart. Numericals.	
UNIT - II	**9 Hrs**
Network Reliability Evaluation: Basic concepts – Evaluation of network Reliability and Unreliability, Series systems, Parallel systems, Series - Parallel systems, partially redundant systems – Types of redundancies - Evaluation of network Reliability Unreliability using conditional probability method – Paths based and cutset based approach – complete event tree and reduced event tree methods. Numericals	
UNIT - III	**8 Hrs**
Failure Data Analysis: Introduction to Failure data analysis, Failure Data, Quantitative measures, MTTF, MTBF, Bathtub Curve, Mean Life, Life Testing, Problems, Introduction to Failure Mode and Effect Analysis. Numericals. Reliability Improvement and Allocation: Difficulty in achieving reliability, Methods for improving reliability during design, Different techniques available to improve reliability, Optimization, Reliability-Cost trade off, Prediction and Analysis.	
UNIT - IV	**9 Hrs**
Discrete Markov Chains & Continuous Markov Processes Basic concepts, Stochastic transitional Probability matrix, time dependent probability evaluation, Limiting State Probability evaluation, Absorbing states, Markov Processes-Modelling concepts, State space diagrams, time dependent reliability evaluation of single component repairable model, Evaluation of Limiting State Probabilities of TWO, two component repairable models – Frequency and duration concepts, Frequency balance approach. Numericals.	
UNIT - V	**8 Hrs**
Reliability Life Testing Methods: Reliability Life Testing - Test time calculations, Burn-in testing, Acceptance testing, accelerated life testing and Experimental Design - Reliability Growth Testing - Growth process, Idealized growth curve and other growth modals. Goodness of Fit tests - Chi-square goodness of fit test, Bartlett's test for the exponential distribution, Mann's test for the weibull distribution, Kolmogorov, smirnov test for normal and lognormal distributions and tests for the power law process model.	

Course Outcomes:

After going through this course the student will be able to:

CO1	:	Explain the concepts of reliability and probability theory.
CO2	:	Evaluate network Reliability and Unreliability for systems.
CO3	:	Analyse the various sampling and failure data analysis for reliability improvement
CO4	:	Develop Reliability Life Testing Methods for a given model

Reference Books

1.Reliability Engineering - A K Govil - Prentice Hall – 2010, ISBN: 012535487-10

2.Reliability Engineering - E. Balagurusamy, Tata McGraw Hill, 2012, ISBN: 525-526-845-254

3.Reliability Evaluation of Engineering Systems - Roy Billinton and Ronald N. Allan, Reprinted in India B. S. Publications, 2013, ISBN(13):978-1489906878

4.Concepts in Reliability Engineering- Srinath L S - Affiliated East-West Press Private Limited, New Delhi, India. ISBN(13)-978-8176710480, 2005

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: III						
Course Code	:	22MMD3E3T	**ADVANCED FINITE ELEMENT ANALYSIS**	CIE Marks	:	100
Credits L-T-P	:	3- 1 - 0		SEE Marks	:	100
Hours	:	42L+28T	*Elective E (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. L J Kirthan			

UNIT - I	**8 Hrs**
Mathematical Preliminaries Set Notation, Function Notation, Vectors, Matrices, Tensors, Partial Differential Equations, Variational Calculus.Finite Element Basics. Weak Form of PDEs, Linear Time-Dependent Heat Equation, Finite Element Basis Functions, Time Integration.	
UNIT - II	**9 Hrs**
BENDING OF PLATES AND SHELLS Review of Elasticity Equations – Bending of Plates and Shells – Finite Element Formulation of Plate and Shell Elements - Conforming and Non-Conforming Elements – C0 and C1 Continuity Elements –Degenerated shell elements- Application & Examples.	
UNIT - III	**8 Hrs**
NON-LINEAR PROBLEMS Introduction – Iterative Techniques – Material non-linearity – Elasto Plasticity – Plasticity – Visco Plasticity – Geometric Non linearity – large displacement Formulation–Solution procedureApplication in Metal Forming Process and Contact Problems.	
UNIT - IV	**8 Hrs**
DYNAMIC PROBLEM Direct Formulation – Free, Transient and Forced Response – Solution Procedures –Eigen solution- Subspace Iterative Technique – Response analysis-Houbolt, Wilson,Newmark – Methods – Explicit & Implict Methods- Lanchzos, Reduced method for large size system equations.	
UNIT - V	**9 Hrs**
Dynamic Fracture, Stochastic Finite Elements, Contact, Mesh Generation, Multi-scale Methods, Multi-physics Problems. Error Estimates And Adaptive Refinement Error norms and Convergence rates – h refinement with adaptivity – Adaptive refinement.	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Explain the fundamentals of finite element methods
CO2	:	Develop the knowledge to analyses, structures under static and dynamic conditions.
CO3	:	Selection of numerical techniques for solving engineering problems
CO4	:	Explore the use of finite element method knowledge to implement industrial project

Reference Books

1. Bathe K.J., “Finite Element Procedures in Engineering Analysis”, Prentice Hall, ISBN: 0-13-301458-4, 1996
2. T.J.R. Hughes (2000), The Finite Element Method: Linear Static and Dynamic Finite Mechanics, Butterworth-Heinemann.Element Analysis, Dover Publications. ISBN(13)-978-0486411811
3. O. C. Zienkiewicz and R. L. Taylor (2000), The Finite Element Method: Volume 2 Solid Mechanics, Butterworth-Heinemann. ISBN: 0 7506 5055 9
4. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, Concepts and Applications of Finite Element Analysis, 4th Edition, ISBN: 978-0-471-35605-9

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100
QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.
TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom’s Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks will be reduced to 40 Marks.
EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER III							
Course Code	:	22MMD32N	**INTERNSHIP**	CIE Marks	:	50
Credits L-T-P	:	0 - 0 - 6		SEE Marks	:	50
Hours/Week	:	12		SEE Durations	:	3 Hrs

Guidelines:

1. The duration of the internship shall be for a period of 6 weeks on full time basis after II semester final exams and before the commencement of III semester.
2. The student must submit letters from the industry clearly specifying his / her name and the duration of the internship on the company letter head with authorized signature.
3. Internship must be related to the field of specialization of the respective PG programme in which the student has enrolled.
4. Students undergoing internship training are advised to report their progress and submit periodic progress reports to their respective guides.
5. Students have to present the internship activities carried out to the departmental committee and only upon approval by the committee, the student can proceed to prepare and submit the hard copy of the final internship report. 6. The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be softbound in Ivory color for PG circuit Programs and Light Blue for Non-Circuit Programs.

Course Outcomes: After going through the internship the student will be able to

CO1: Apply Engineering and Management principles to solve the problems
CO2: Analyze real-time problems and suggest alternate solutions
CO3: Communicate effectively and work in teams
CO4: Imbibe the practice of professional ethics and lifelong learning

Scheme of Continuous Internal Evaluation (CIE):

The evaluation committee shall consist of Guide, Professor, Associate Professor/Assistant Professor. The committee shall assess the presentation and the progress reports.

The evaluation criteria shall be as per the rubrics given below:

Reviews	Activity	Weightage
I	Application of Engineering knowledge in industries, ability to comprehend the functioning of the Organization/ Departments.	40%
II	Importance of Resource Management, Environment and Sustainability. Demonstration and Presentation of Internship work with Report Submission	60%

Scheme for Semester End Evaluation (SEE):

The SEE examination shall be conducted by an external examiner (domain expert) and an internal examiner. Evaluation shall be done in batches, not exceeding 6 students per batch.

SEMESTER III							
Course Code	:	22MMD33P	**MINOR PROJECT**	CIE Marks	:	50
Credits L-T-P	:	0 - 0 - 6		SEE Marks	:	50
Hours/Week	:	12		SEE Durations	:	3 Hrs

Guidelines:

1. Each project group will consist of maximum of two students.
2. Each student / group has to select a contemporary topic that will use the technical knowledge of their program of study after intensive literature survey.
3. Allocation of the guides preferably in accordance with the expertise of the faculty.
4. The minor project would be performed in-house.
5. The implementation of the project must be preferably carried out using the resources available in the department/college.

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

CO1: Conceptualize, design and implement solutions for specific problems.
CO2: Communicate the solutions through presentations and technical reports.
CO3: Apply resource managements skills for projects.
CO4: Synthesize self-learning, team work and ethics.

Scheme of Continuous Internal Examination

Evaluation shall be carried out in three reviews. The evaluation committee shall consist of Guide, Professor and Associate Professor/Assistant Professor.

Phase *	Activity	Weightage
I	Approval of the selected topic, formulation of Problem Statement and Objectives with Synopsis submission	20 %
II	Mid-term seminar to review the progress of the work with documentation	40 %
III	Oral presentation, demonstration and submission of project report	40 %

* Phase wise rubrics to be prepared by the respective departments

CIE Evaluation shall be done with weightage / distribution as follows:

• Selection of the topic & formulation of Problem Statement and Objectives	10 %
• Design and simulation/ Algorithm development/ Experimental setup	25 %
• Conducting experiments/ Implementation / Testing	25 %
• Demonstration & Presentation	25 %
• Report writing	15 %

Scheme of Semester End Examination (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

- Brief write up about the project 05%
- Methodology and Experimental Results & Discussion 20%
- Presentation / Demonstration of the Project 25%
- Report 20%
- Viva Voce 30%

SEMESTER IV							
Course Code	:	22MMD41P	**MAJOR PROJECT**	CIE Marks	:	100
Credits L-T-P	:	0 - 0 - 18		SEE Marks	:	100
Hours/Week	:	36		SEE Durations	:	3 Hrs

Guidelines:
1. Major Project is to be carried out for a duration of 18 weeks
2. Students must adhere to the Project Presentation Schedule, report to their guide on a weekly basis and get their Project diary signed by their guide 4. Students must execute the Major Project individually and not in teams.
5. It is mandatory for the students to present/publish their project work in National/International Conferences or Journals
6. The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be soft bound and in Ivory color for PG circuit Programs and Light Blue for Non-Circuit Programs

Course Outcomes: After completing the course, the students will be able to
CO1: Conceptualize, Design and Implement solutions for specific problems.
CO2: Communicate the solutions through presentations and technical reports.
CO3: Apply project and resource managements skills, professional ethics and societal concerns
CO4: Synthesize self-learning, sustainable solutions and demonstrate life-long learning

Scheme of Continuous Internal Examination
Evaluation shall be carried out in three reviews. The evaluation committee shall consist of Guide, Professor, Associate Professor/Assistant Professor.

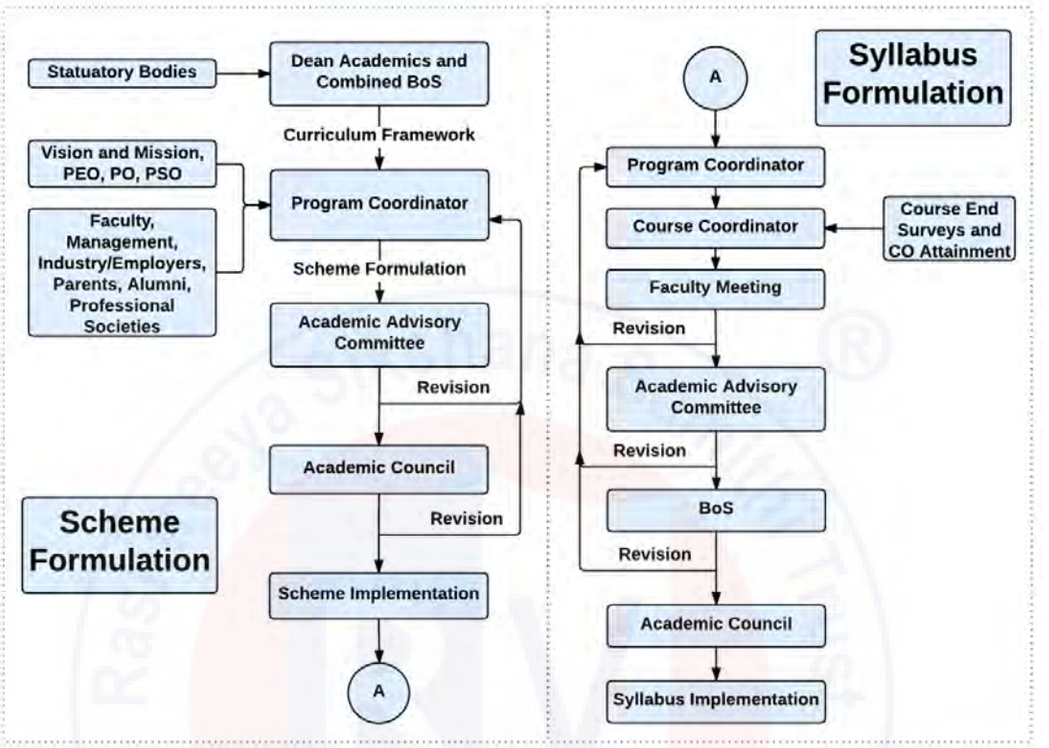
Phase *	Activity	Weightage
I	Selection of Project Title, Formulation of Problem Statement and Objectives	20 %
II	Design, Implementation and Testing	40 %
II	Experimental Result & Analysis, Conclusions and Future Scope of Work, Report Writing and Paper Publication	40 %

* Phase wise rubrics to be prepared by the respective departments

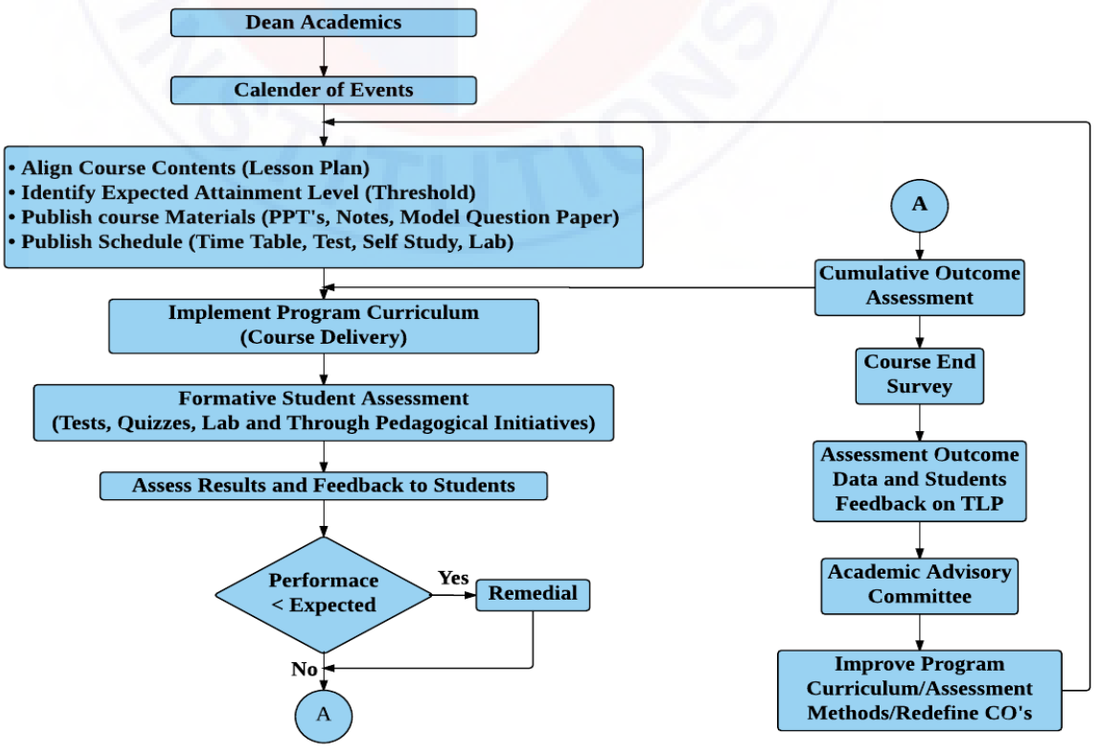
Scheme for Semester End Evaluation (SEE):
Major Project SEE evaluation shall be conducted in two stages. This is initiated after fulfilment of submission of Project Report and CIE marks.
Stage-1 Report Evaluation: Evaluation of Project Report shall be done by the Guide and an External examiner.
Stage-2 Project Viva-voce: Major Project Viva-voce examination is conducted after receipt of evaluation reports from Guide and External examiner.

SEE procedure is as follows:			
Report Evaluation	Internal Examiner: 100 Marks	**= 200**	
	External Examiner: 100 Marks	200 / 2 = **100**	**A**
Viva-Voce	Jointly evaluated by Internal Guide & External Evaluator	**= 100**	**B**
	Total Marks = (A + B) / 2 =	**100**	

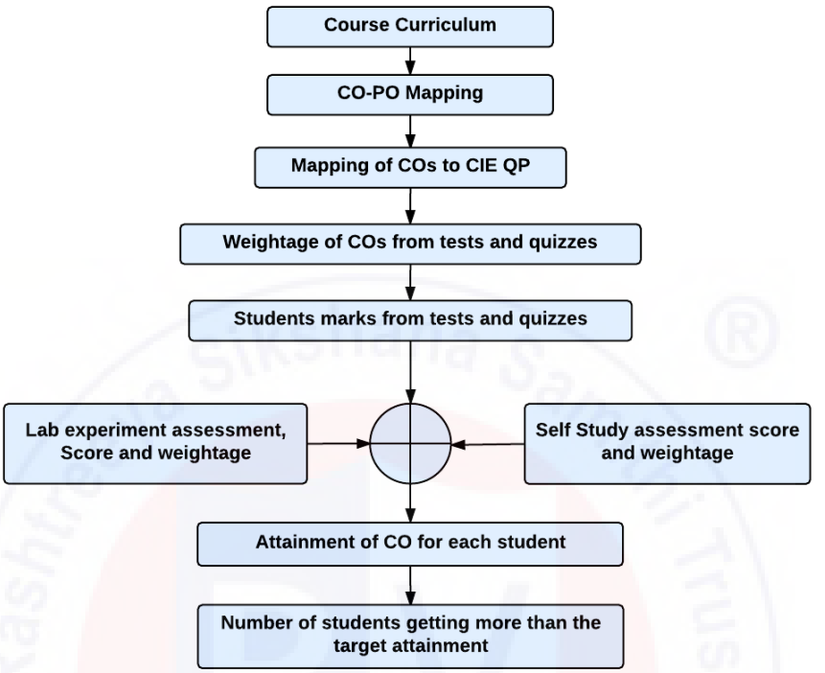
Curriculum Design Process



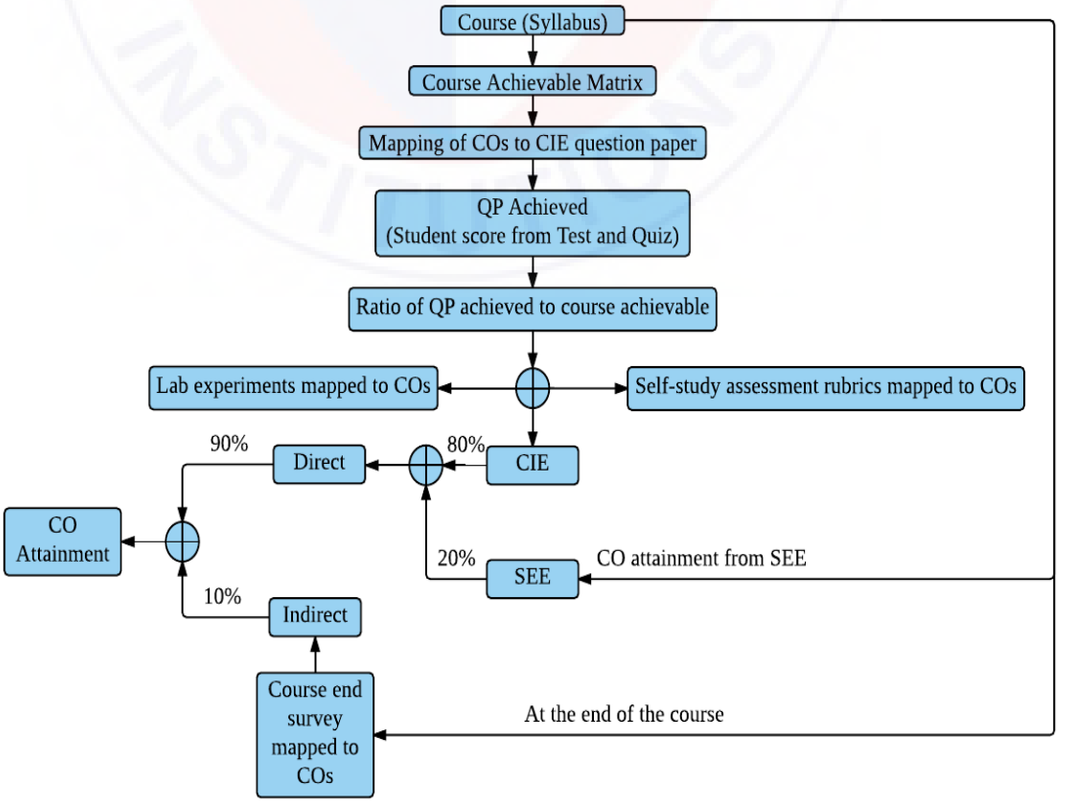
Academic Planning And Implementation



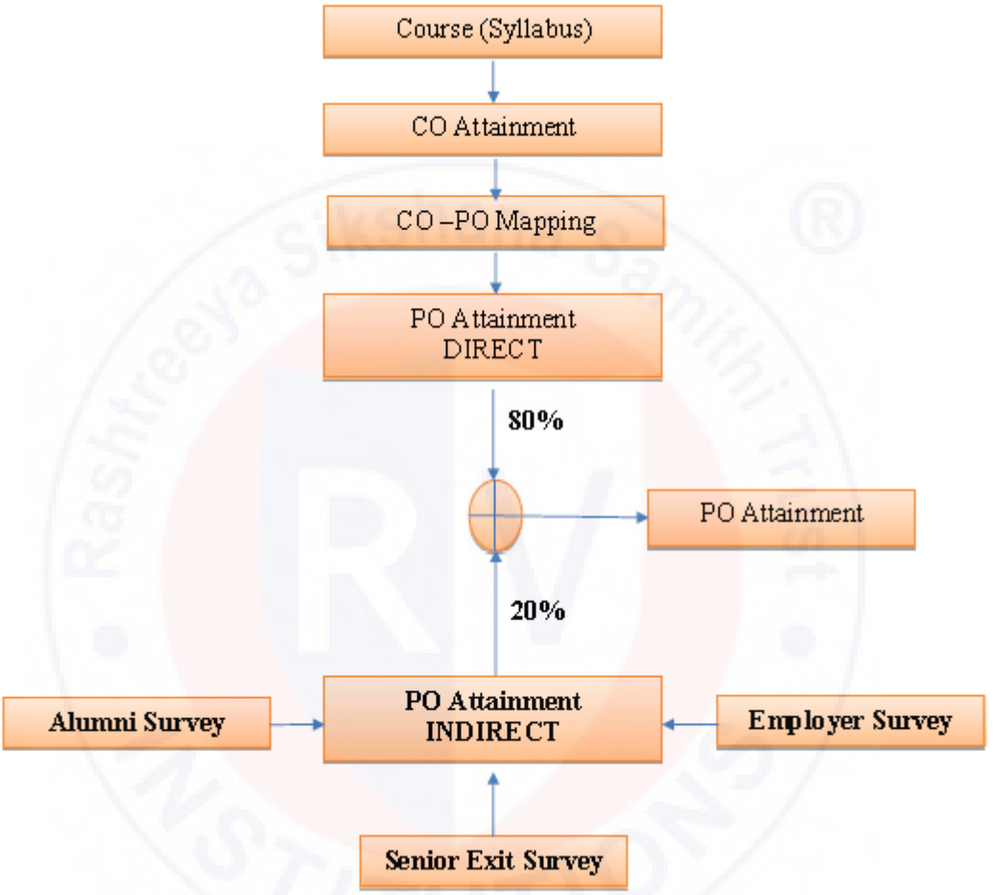
Process For Course Outcome Attainment



Final CO Attainment Process



Program Outcome Attainment Process



Innovative Clubs of RVCE

1	**Ashwa Racing**	Ashwa Mobility Foundation (AMF) is a student R&D platform that designs and fabricates Formula theme race cars and future mobility solutions to tackle urban transportation problems.
2	**Astra Robitcs**	Team involved in the design, fabrication and building application specific robots.
3	**Coding Club**	To facilitate students the skills, confidence, and opportunity to change their world using coding and help them become successful in GSoC, ACM-ICPC, and other recognized coding competitions.
4	**Entrepreneurship Development Cell**	E-Cell is a student run body that aims to promote entrepreneurship by conducting workshops, speaker sessions and discussions on business and its aspects. We possess a mentor board to help startups grow.
5	**Frequency Club**	Team aims at contributing in both software and hardware domains mainly focusing on Artificial Intelligence, Machine Learning and it's advances.
6	**Garuda**	Design and development of supermileage urban concept electric car. Indigenous development of E-mobility products.
7	**Jatayu**	Build a low cost Unmanned Aerial Vehicle capable of Autonomous Navigation, Obstacle Avoidance, Object Detection, Localization, Classification and Air Drop of a package of optimum weight.
8	**Solar Car**	Build a roadworthy solar electric vehicle in order to build a green and sustainable environment.
9	**Team Antariksh**	Team Antariksh is a Space Technology Student Club whose goal is to understand, disseminate and apply the engineering skills for innovation in the field of Space technology. designing Nano-Satellite payload for ISRO PS4 Orbital platform, RVSAT-1 along with developing experimental rockets of various altitude.
10	**Team Chimera**	Building a Formula Electric Car through Research and Development in E-Mobility. Electrifying Formula Racing.
11	**Helios Racing**	Team involved in design, manufacturing and testing of All-Terrain Vehicles and other supportive tasks for the functioning of the team. Participating in BAJA competitions organized by SAE in India and the USA.
12	**Team Hydra**	Developing autonomous underwater vehicles and use it for various real world applications such as water purification, solid waste detection and disposal etc.
13	**Team Krushi**	Develop low cost equipments, which help farmers in cultivating and harvesting the crops. Use new technology applications to reduce the labour time hand cost for farmers. Aims at developing implants for Tractors.
14	**Team vyoma**	Design, fabrication and testing of radio controlled aircrafts and research on various types of unmanned aerial vehicles.
15	**Team Dhruva**	Organizing activities like quizzes based on astronomy.Stargazing and telescope handling sessions.Construction of a standard observatory. working on small projects with organizations like ICTS, IIA, ARIES etc.
16	**Ham club**	To popularize Amateur Radio as a hobby among students, alongside exploring technical innovations in the communications domain. Intended to provide human capital for service to the nation at times of natural calamities.

NCC

NCC

एकता और अनुशासन

NSS

राष्ट्रीय सेवा योजना
NATIONAL SERVICE SCHEME

"Not me but you"
" Education through Community Service & Community Service through education"

Cultural Activity Teams

1. **AALAP (Music club)**
2. **DEBSOC (Debating society)**
3. **CARV (Dramatics club)**
4. **FOOTPRINTS (Dance club)**
5. **QUIZCORP (Quizzing society)**
6. **ROTARACT (Social welfare club)**
7. **RAAG (Youth club)**
8. **EVOKE (Fashion team)**
9. **f/6.3 (Photography club)**
10. **CARV ACCESS (Film-making club)**

VISION

Leadership in Quality Technical Education, Interdisciplinary Research & Innovation, with a Focus on Sustainable and Inclusive Technology

MISSION

- To deliver outcome based Quality education, emphasizing on experiential learning with the state of the art infrastructure.
- To create a conducive environment for interdisciplinary research and innovation.
- To develop professionals through holistic education focusing on individual growth, discipline, integrity, ethics and social sensitivity.
- To nurture industry-institution collaboration leading to competency enhancement and entrepreneurship.
- To focus on technologies that are sustainable and inclusive, benefiting all sections of the society.

QUALITY POLICY

Achieving Excellence in Technical Education, Research and Consulting through an Outcome Based Curriculum focusing on Continuous Improvement and Innovation by Benchmarking against the global Best Practices.

CORE VALUES

Professionalism, Commitment, Integrity, Team Work, Innovation

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