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

PRODUCT DESIGN AND MANUFACTURING

(MPD)

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

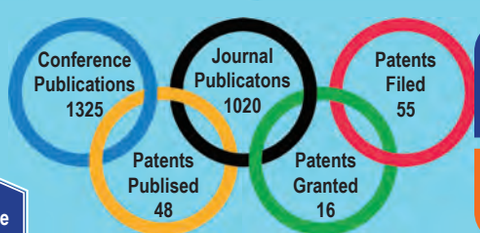
Five RVCE Alumni cleared Civil Services Exam in 2020-21

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



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 **Product Design and Manufacturing** graduates will be able to:
PO1: Independently carry out a research / investigation and development work to solve practical problems related to product design & manufacturing.
PO2: Write and present a substantial technical report / document in the field of product design & manufacturing.
PO3: Demonstrate a degree of mastery over the areas of product design. The mastery would be at a level higher than the requirements in the bachelor's in Mechanical Engineering
PO4: Use modern tools for the design and analysis of static and dynamic systems and mechanisms.
PO5: Adopt safety, ethical and environmental factors in product design and processes
PO6: Perform in multidisciplinary teams with sound interpersonal and management skills with a commitment to lifelong learning.

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M.Tech in Product Design & Manufacturing: MPD

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	22MPD12TL	Product Design	3	0	1	**4**	ME	Theory+Lab	1.5	100	3	100
3	22MPD13TL	Digital Manufacturing	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	22MPD1AXT	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**	ME/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
22MPD1A2T	Design For Sustainability and Safety	22IM1B2T	Financial Management
22MPD1A3T	Advanced Manufacturing Practices	22MPD1B3T	Robotics and Automation.
22MPD1A4T	Product Life Cycle Management	22MPD1B4T	Sheet Metal Forming and Plastic Design
22MPD1A5T	Product Data Management	22MPD1B5T	Surface Engineering

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	22MPD22TL	Industrial Ergonomics and Biomechanics	3	0	1	**4**	ME	Theory+Lab	1.5	100	3	100
3	22MPD23T	Product and Cost Analysis	3	0	0	**3**	ME	Theory	1.5	100	3	100
4	22XXX2CXT	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	22MPD24L	Advanced Product Design Lab	1	0	1	**2**	ME	Lab	1.5	50	3	50
7	22HSS25T	Professional Skills Development -I	0	0	2	**2**	HSS	Theory*	1.5	50	2	50

** External Agency will be conducting the classes and both CIE and SEE will be evaluated by the Agency.*

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Code	Elective C (Professional Elective)
22MMD2C1T	Design for Tribology
22MPD2C2T	Additive Manufacturing Technology
22MPD2C3T	GD&T and Digital Metrology
22MPD2C4T	Design for Manufacture and Assembly
22MPD2C5T	Electric Vehicle Technology

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	22MPD3EXT	Elective E (Professional Elective)	3	1	0	**4**	ME	Theory	1.5	100	3	100
3	22MPD32N	Internship	0	0	6	**6**	ME	Project	1.5	50	3	50
4	22MPD33P	Minor Project	0	0	6	**6**	ME	Project	1.5	50	3	50
						20						

Code	Elective E (Professional Elective)
22MPD3E1T	Product Planning and Marketing
22MPD3E2T	Reliability Engineering
22MPD3E3T	Mechatronics in Manufacturing System
22MPD3E4T	Lean Manufacturing
22MPD3E5T	Creative Engineering

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	22MPD41P	Major Project	0	0	18	**18**	ME	Project	1.5	100	3	100
2	22HSS42	Professional Skills Development-II	0	0	2	**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

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	:	22MPD12TL	**PRODUCT 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 P V Srihari				

UNIT - I	**8 Hrs**
Design as a Discipline: Mass production and professional designers-quality of life- get more, pay less- cost reduction and higher sophistication- products of dynamic culture. Product life cycle: Various stages of product life cycle- design stage-manufacturing and marketing/ implementation- usage and maintenance- the death of a product. Design phases: Design methodology- formulation- idea rack- short listing and selecting TWO idea- detailing- prototype preparation	
UNIT - II	**8 Hrs**
User centred Design survey: Importance on problem formulation, primary focus on people, target domain, clients and users, interaction, integrated approach, kinds of knowledge, style and peer group, user centred feedback. Need statement and Design requirements: Need statement, guidance for designers, independent of physical embodiment, major requirements and articulation. Specifications and Constraints: Quantitative and qualitative specifications and constraints, design space, refinement of design space, side stepping, various approaches like engineering, architectural, hybrid.	
UNIT - III	**9 Hrs**
Idea-Rack: Seeking several concepts, Usability considerations: flexibility, interdisciplinary design and interaction, design activities like original design, adaptive design, and variant design. Tools helpful in generating ideas like deep encounter, analogy, reversal, fusion of opposites, brainstorming, realizing new constraints. Optimization configuration Exploration: Conventional optimization vs configuration optimization, thumb rules, yield to nature's forces, light weight components, use of standard parts, design for manufacturing, material selection.	
UNIT - IV	**9 Hrs**
Concept Selection: Overview of methodology, concept screening, and concept scoring Concept Testing: Define the purpose of concept test, choose a survey population, choose a survey format, communicate the concept, measure customer response, interpret the result, reflect on the results and the process.	
UNIT - V	**8 Hrs**
Product Architecture: What is product architecture, implications of the architecture, establishing the architecture, variety and supply chain considerations, platform planning, related system level design issues. Industrial design: Assessing the need for industrial design, the impact of industrial design, industrial design process, managing the industrial design process, assessing the quality of industrial design.	
LABORATORY	**28 Hrs**
1. Product sketching, shading and lettering 2. Product Modelling using Solid works – commercial applications 3. Clay modeling 4. 3D printing of electrical components 5. Product Video Demonstration using Animaker 6. Human Bone Morphing using Synfig Studio 7. 3D printed product testing for strength and impact resistance 8. Laser Marking of 3D printed components	

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 concept communication concepts

Reference Books

1.Prashant Kumar, "Product Design" , PHI Learning Pvt. Ltd.,2012, ISBN:978-81-203-4427-3

2.Karl.T.Ulrich, Steven D Eppinger, "Product Design and Development", McGrawHill ,2000, ISBN- 13: 978-0078029066

3.A C Chitale and R C Gupta, "Product Design and Manufacturing", PH1, - 3rd Edition, 2003. ISBN- 13: 978-8120342828.

4.Sham Tickoo, "SOLIDWORKS 2018 for Designers", CADCIM Technologies,16th revised Edition Paperback, 2018.ISBN- 13: 567-8342828.

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	:	22MPD13TL	**Digital Manufacturing**	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 Gopalakrisna H D			

UNIT - I	**9 Hrs**
NC and CNC: Introduction, Components of Digital Manufacturing, N.C Part Programming: Introduction, NC/ CNC programming methods: Manual part programming for turning and milling centers, G codes, M codes, canned cycles, Programming with CAD/CAM integration, CAM packages for CNC part program generation, Practical Exercises on CNC part programming. Computer Controls in NC: CNC Technology: Functions of CNC Control in Machine Tools, Advantages of CNC, Direct Numerical Control (DNC Systems): Configuration of DNC system, Functions of DNC, Communication between DNC computer & MCU, Advantages of DNC.	
UNIT - II	**8 Hrs**
Adaptive Control: machining systems. Adaptive control optimization system, adaptive control constraint system, applications to machining processes, Benefits of Adaptive control Machining. Computerized Manufacturing Planning and Control Systems: Computer aided process planning, Variant and Generative approaches, Computer integrated production planning and control systems, Typical production planning and control system, Material planning systems, Capacity planning, Shop Floor Control, Automatic identification, Automated data collection systems	
UNIT - III	**8 Hrs**
Manufacturing Databases: Database Systems; Database Models; Database Design; Database Normalization; General Database Management Issues; Applications of Relational Databases and Future Trends; Manufacturing Resource Planning Systems Materials Requirements Planning: Manufacturing Resources Planning System (MRP II) Shop-Floor Data Collection Systems: Introduction; Computerized SFDC; Bar Codes; Electronic Labels; Other Types of SFDC System; The People Factor	
UNIT - IV	**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. Cloud and Fog: M2M Learning and Artificial Intelligence, AR, Industrial Internet Architecture Framework (IIAF), Data Management.	
UNIT - V	**9 Hrs**
Augmented Reality: The Role of Augmented Reality in the Age of Industry 4.0, Introduction, AR Hardware and Software Technology, Industrial Applications of AR, Maintenance, Assembly, 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.	
LABORATORY	28 Hrs
PART-A (NC Guide: CNC Simulation) Free form Program generation and Simulation for turning operations such as step turning, grooving, thread cutting, profile turning, drilling etc. Free form Program generation and Simulation for Milling operations such as End milling, face milling, pocket milling, slot milling, peck drilling etc. Demonstration of CNC milling and turning for generated programmes and operations PART-B (Roboguide: Robot with workstation Simulation) Design and simulation of robot workstations for material handling applications using Solid Works models, pallets, machines, tables, fixtures, and conveyors. Design and modelling of a robot workstation for welding applications including straight and curved connections. Demonstration of robot with system engineering component for various materials handling movement.	
Course Outcomes: After going through this course the student will be able to:	

CO1	:	Explain the working process and technology development in Digital Manufacturing
CO2	:	Apply the principles of DM in the manufacturing industry
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. Zude Zhou, Shane (Shengquan) Xie, Dejun Chen "Fundamentals of Digital Manufacturing Science" 2012.Springer ISBN 978-0-85729-564-4,..

2. Lihni Wang, Andrew Y.C. Nee "Collabarative design and planning for digital manufacturing" Springer Series, 2009, ISBN 998-1-84882-286-3 3.

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

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): 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**
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 (for,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. Zude Zhou, Shane (Shengquan) Xie, Dejun Chen “Fundamentals of Digital Manufacturing Science” 2012.Springer ISBN 978-0-85729-564-4,

2. Lihni Wang, Andrew Y.C. Nee “Collabarative design and planning for digital manufacturing” Springer Series, 2009, ISBN 998-1-84882-286-3

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

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 Nagesh S				

UNIT - I	**8 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	**9 Hrs**
Components of Learning , 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	**9 Hrs**
Genetic Algorithms: Hypotheses, Genetic Operator, Fitness Function and Selection, an Illustrative Example, Hypothesis Space Search, Genetic Programming, Parallelizing Genetic Algorithms.	
UNIT - V	**8 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 Edition, 2014, ISBN
908-24-21-34

2.Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar" Foundations of Machine Learning", MIT Press,2012, ISBN
3576896754

3.Tom Mitchell, "Machine Learning", McGraw Hill, 3rdEdition, 1997, ISBN 405-345-672-123

4.MACHINE LEARNING - An Algorithmic Perspective, Second Edition, Stephen Marsland, 2015, ISBN 102234. 435

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	:	22MPD1A2T	**DESIGN FOR SUSTAINABILITY AND SAFETY**	CIE Marks	:	100
Credits L-T-P	:	3- 0 -0		SEE Marks	:	100
Hours	:	42L	*Elective A (Professional Elective)*	SEE Durations	:	3 Hr
Faculty Coordinator:			Dr H N Narasimha Murthy			

UNIT - I	**9 Hrs**
Introduction: Step-by-Step Approach, Ecodesign to Design for Sustainability, Products and Sustainability, environmental aspects, social aspects, financial aspects. drivers for industry	
UNIT - II	**8 Hrs**
Environment and Rehabilitation: Mined area, Habitats, Water bodies, Mangroves; Global Changes, Biodiversity concerns and precautionary principles, Evaluation of sustainable development	
UNIT - III	**9 Hrs**
Safety Education: Method of promoting safe practice - motivation – communication - role of agencies: DGFASLI, NSC, ASSE, HSE, OSHA-NEBOSH – creating awareness, awards, celebrations, safety posters, safety displays, safety incentive scheme and campaign.	
UNIT - IV	**8 Hrs**
Safety Education: Method of promoting safe practice - motivation – communication - role of agencies: DGFASLI, NSC, ASSE, HSE, OSHA-NEBOSH – creating awareness, awards, celebrations, safety posters, safety displays, safety incentive scheme and campaign.	
UNIT - V	**8 Hrs**
Case studies: Redesign HDPE Bottle, Mobility concepts, Photovoltaic Lantern, Car and bike rental system. Box Cutter, Safety Knife	

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

CO1	:	Describe the innovation processes for sustainable products, from product definition to sustainable manufacturing.
CO2	:	Design and develop a product focused on sustainability and collecting the user needs data, prioritizing that data, developing product specifications.
CO3	:	Evaluate the parameters for building product prototypes, and interacting with the customer/community during product development
CO4	:	Analyzing the fundamental tools and concepts of sustainable engineering to analyze engineering projects.

Reference Books

1.Ray Asfahl. C , David W. Rieske “Industrial Safety and Health Management” Pearson Prentice Hall, ISBN 9780134630564 , 2019, 3rd Edition

2. Willian P. Cunningham,Mary Ann Cunninggham, Principles of environmental science, McGraw Hill, ISBN-13 :
978-0078036071, 8th edition , 2016.

3. D.K. Asthana, MeeraAsthana, Environmental Science, S. Chand and co.3rd Edition, 2019, ISBN-978-8121927642,2010

4. Peter P. Rogers, Kazi F. Jalal and John A. Boyd, An Introduction to Sustainable Development. London: Earthscan,
ISBN: 978-1-84407-520-1, 3rd edition, 2008.

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	:	22MPD1A3T	**ADVANCED MANUFACTURING PRACTICES**	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 N V Nanjundaradhya				

UNIT - I	**9 Hrs**
Just in Time Production – Primary purpose, profit through cost reduction, elimination of over production, quality control, quality assurance, respect for humanity, flexible work force, JIT production adapting to changing production quantities, process layout for shortened lead Times, standardization of operation, automation. Sequence and Scheduling Used by Suppliers: Monthly and daily Information. sequenced withdrawal system by sequenced schedule table, problems and counter measures in applying the Kanban system to sub contractors	
UNIT - II	**9 Hrs**
Toyota Production System-The philosophy of TPS, basic frame work of TPS, Kanbans. determining the number of Kanbans in Toyota Production System, Kanban number under constant quantity withdrawal system, constant cycle, non-constant quantity withdrawal system. Kanban Systems- Supplier Kanban and the sequence schedule for use by suppliers - Later replenishment system by Kanban, Sequenced Withdrawal System and Circulation of the Supplier Kanban within Toyota. production smoothing in TPS, production planning, production smoothing, adaptability to demand fluctuations, sequencing method for the mixed model assembly line to realize smoothed production of goal.	
UNIT - III	**8 Hrs**
Just-in-Time Production with Total Quality Control just in time concept, cutting lot sizes, cutting set-up times, cutting purchase order costs, the JIT cause-Effect chain, Quality Improvements: scrap/quality improvements, motivational effects, responsibility effects, small group improvement activities, withdrawal of buffer inventory, the total quality control concept.	
UNIT - IV	**8 Hrs**
Total Quality Control-Introduction-Total Quality Control concepts, responsibility, learning from the west, TQC concepts categorized, goals, habit of improvement, perfection, basics, process control, easy to see quality control as facilitator, small lot sizes, housekeeping, Scheduling: Capacity scheduling, daily machine checking, techniques and Aids, exposure of problems, fool proof devices, tools of analysis, QC circles, TQC in Japanese-owned US electronics plant, TQC in Japanese-owned automotive plants.	
UNIT - V	**8 Hrs**
Plant Configurations: Introduction-ultimate plant configuration, job shop fabrication, frame welding, forming frame parts from tubing, dedicated production lines, overlapped production, the daily schedule, forward linkage, physical merger of processes, adjacency, Material Handling Systems: mixed models, automated production lines, pseudo robots, robots, CAD and manufacturing, conveyors and stacker cranes, automatic quality monitoring	

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

CO1	:	Explain the role of JIT, TPS and TQC strategies in production system
CO2	:	Analyze the various concepts of modern manufacturing practices
CO3	:	Apply the concepts of JIT and TPS in real time applications
CO4	:	Acquire knowledge in branding

Reference Books

1.Japanese Manufacturing Techniques, Richard Schonberger, Pearson Higher Education, 2010, ISBN-13-9780029291009, 3rd Edition

2. An Integrated Approach to Just In Time, Yasuhiro Monden, Toyota Production system, 4th Edition, 2011, ISBN-13-978-1439820971

3. Adult Lean Thinking, James Womack, Simon & Schuster, 2010, 4th Edition, ISBN 13: 9781439135952

4. The machine that changed the World - The story of Lean production, James P. Womack, Daniel T Jones, and Daniel Roos, Harper Perennial edition published, 2007, 2nd Edition ISBN-13-978-0743299794

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	:	22MPD1A4T	**PRODUCT LIFE CYCLE MANAGEMENT**	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 P V Srihari			

UNIT - I	**9 Hrs**
Product life cycle management: Need for PLM, Components of PLM, Product Data and Product workflow, Drivers for Change.	
UNIT - II	**9 Hrs**
The PLM Strategy, Developing a PLM Strategy, A Five-step Process, Strategy Identification and Selection, Strategy Elements, Implications of Strategy Elements, Policies, Strategy Analysis, Communicating the Strategy.	
UNIT - III	**8 Hrs**
Concurrent engineering, Cost of design changes, schemes for concurrent engineering, Design for manufacturing and assembly, robust design, failure mode and effect- analysis.	
UNIT - IV	**8 Hrs**
Product-line decision, Product mix, Product-line analysis, Product –line length	
UNIT - V	**8 Hrs**
An Overview of Branding Decisions, Branding Decision, Brand- Sponsor Decision, Brand-Name Decision, Brand- Strategy Decision, Brand- Repositioning Decision.	

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

CO1	:	Gain knowledge about phases of PLM components
CO2	:	Understand PLM strategy development.
CO3	:	Apply product line decisions.
CO4	:	Acquire knowledge in branding.

Reference Books

1. Product Lifecycle Management Paradigm for century Product Realization - John Stark, Springer-Verlag, 21st, London, 3rd printing - 2016. 441 pp., 3rd Edition, ISBN: 1-85233-810-5.
2. CAD/CAM Theory and Practice - Zeid, McGraw Hill.- 2014, 2nd Edition ISBN-13 978-0070151345
3. Product Life Cycle Management, Mandar M. Bidwe, First Edition, ISBN : 978-93-5563-114-5
4. Computer Integrated Design and Manufacturing, - Mark Henderson & Philip Wolfe, BedworthMcGraw Hill Inc, 4th Edition, 2011, ISBN-13-978-0070042049

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	:	22MPD1A5T	**PRODUCT DATA MANAGEMENT**	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 B W Shivaraj			

UNIT - I	**8 Hrs**
Centralized systems: Client Server Systems, Parallel Systems, Distributed Systems, Network Types, Parallel Database, Distributed Database, Purpose Of Database System. Advantages and disadvantages of Database systems.	
UNIT - II	**9 Hrs**
Product Data Management: Complexity in Product Development, General Description of PDM Basic functionality of PDM: Information architecture, PDM System architecture, Applications in PDM systems. Trends in PDM	
UNIT - III	**9 Hrs**
Document Management Systems: Document management and PDM, Document life cycle, Content Management, Document management and related technologies, Document management resources on the Internet.	
UNIT - IV	**8 Hrs**
Workflow Management in PDM: Structure Management, Engineering Change Management, Release Management, Version Management, Configuration Management, Build Management.	
UNIT - V	**8 Hrs**
PDM Implementation Case Studies: Sun Micro systems, Ericssion Radio systems, Matrix One, Team Centre, Windchill, Enovia. Standards in PDM, CM, SCM and CMM.	

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

CO1	:	Understanding the Product data base systems
CO2	:	Select the Product data base systems based on material and product
CO3	:	Analysing the Product data base and Product life cycle for new products
CO4	:	Evaluate the parameters for Product data base considerations based on process.

Reference Books

1. Implementing and Integrating Product Data Management and Software Configuration Management - 20 - Ivica
Cmkovic Ulf Asklund - Annita Persson Dahlqvist - Archtech House Publishers, ISBN-13:978-0970035226 – 2013

2. Product Data Management - Rodger Burden - Publisher: Resource Publishing- ISBN-10: 0970035225, 3rd edition, 2011.

3. Windchill 8.0 – PDM Link User's Guide- Parametric Technology Corporation (PTC),2008

4. The AutoCAD Database Book – Accessing and Managing CAD Drawing Information - Galgotia Publications - Third
Edition, ISBN-11: 3244035225

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 Bharatish 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, thermal and dynamic 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 : 110-230- 304
4. Finite Element method in machining processes, Angelos.P.Markopoulos, Srpinger series, 2013, ISBN: 978-1-4471-4330-10

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.Rajeswara Rao KVS				

UNIT - I	**8 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	**9 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	**8 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	**9 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, 3rd Edition, 2013

2.Financial Management-Text, Problems and Cases, Khan M Y & Jain P K, 8th Edition, 2018, McGraw Hill Education(India) Pvt. Ltd, 4th Edition ISBN: 9353162181 , 2010

3. Financial Management, I M Pandey, 11th Edition, 2015, Vikas Publishing House, 4th Edition, 2015, ISBN: 978932598229

4. Fundamentals of Financial Management, James C. Van Horne, 13th Edition, 2008, 5th Edition, 2013, 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	:	42 L	*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, 4th Edition SBN 978110715630
2. Mohsen Shahinpoor, A Robot Engineering Textbook, Harper & Row publishers, New York. ISBN:006045931X., 3rd Edition, 2017
3. Fu, Lee and Gonzalez, Robotics, control vision and intelligence, McGraw Hill International. ISBN:0070226253, 4th Edition, 2010
4. John J. Craig, Introduction to Robotics, Addison Wesley Publishing, 3rd Edition, 2013, 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

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	:	22MPD1B4T	**Sheet Metal Forming and Plastic Design**	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 Gangadhar Angadi			

UNIT - I	**9 Hrs**
Sheet Metal Operations: Classification of presses, sheet metal operations, shearing theory, cutting force, clearance between punch and die. Bending Die: Theory of bending, development of bend, U bending, V bending, Air Bending Process, bending force, spring back and its compensation Drawing: Theory of drawing, blank development, factors considered for designing a draw die (simple Numerical), defects in drawing	
UNIT - II	**8 Hrs**
Elements of Press Tool: Design of die plates, punches, punch holder plates, stripper plates, and calculation of stripping force, bolster plates, pilots, ejectors, shedders, pillar, bush, slender punches, stock guides and feeding device and die sets Types of Press Tools: Stage tools, progressive tools, compound tools, and combination tools	
UNIT - III	**9 Hrs**
Mould construction: Design of various injection mould elements, cores, cavities, and Inserts, fitting core and cavity inserts, guide pillars and bushes Feed systems: Design of gates, runners, impressions, layout, sprue, sprue pullers Parting Surfaces: Straight, stepped, curved parting surface Ejector System: Types of ejection, ejector pin, sleeve ejection, plate ejection, blade ejection, air ejection, ejection from fixed half, double ejection, delayed ejection Cooling System: Need for cooling, cooling solid cores and cavities, insert cooling, cooling long cores, cooling elements, Bubblers and baffles cooling system	
UNIT - IV	**8 Hrs**
Compression & Transfer Moulding: General description of Compression and Transfer moulding and its application in the processing of thermosetting materials, Faults, Causes and Remedies. Blow moulding: Introduction to blow moulding, types of blow moulding operations, concept of extrusion blow moulding and injection blow moulding. Multi daylight moulds: Single, double and triple daylight moulds	
UNIT - V	**8 Hrs**
Product design: Product design concepts – size, shape, function, aesthetics, life, tooling aspects on product design, process variables Vs product design, product design thumb rules for plastics, cost reduction through product design concepts, design of external, internal undercuts, side openings, hinges, design of ribs, bosses, molded holes, case studies	

Course Outcomes:

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

CO1	:	Explain the necessity of press tool and mould for manufacturing of different tools
CO2	:	Analyse the design constraints in the given problem
CO3	:	Apply the design rule for manufacturing of press tools and moulds
CO4	:	Design of press tools and mould for considering real time issues of Manufacturing, Testing and Assembly

Reference Books

1. Paquin J.R. and Crowley, Die Design Fundamentals, 3rd Edition, Industrial Press Inc. 2006. ISBN 13: 912-345-768

2. Ivana Suchy, “Handbook of Die Design”, 2nd Edition, New York-Mc GRAW-HILL, 2005, ISBN: 9780071462716,
0071462716

3. R. G. W Pye, Injection Mould Design, , 4th Edition, East-West Press Pvt. Ltd.-New Delhi, 2000, ISBN: 9788176710107, 4th Edition, 2010.

4. Harold Belofsky, Plastic product design and process engineering, Carl Hanser Verlag GmbH & Co, 1995, ISBN-13:
978-3446174177, 3rd edition, 2013.

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	:	22MPD1B5T	**Surface Engineering**	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 H N Narasimha Murthy				

UNIT - I	**9 Hrs**
Introduction: Purpose and need of surface engineering, surface and subsurface regions, properties for enhanced life and performance of mechanical components, classification of surface modification techniques, scope of surface engineering, role of surface properties which affect wear and friction behavior Surface Damage, Causes and Mechanisms: Material properties and its effect on performance of components, common factors leading to the deterioration of surfaces, types of wear and mechanisms and classical governing laws, techniques to evaluate damage of wear surfaces.	
UNIT - II	**8 Hrs**
Materials for Controlling the Wear: Materials properties and wear, materials properties required for better wear resistance, selection of materials for surface engineering, materials for surface modifications for specific applications Surface cleaning – Classification and selection of cleaning processes-alkaline cleaning, Solvent cold cleaning and vapour degreasing, Emulsion cleaning, Pickling and descaling.	
UNIT - III	**9 Hrs**
Surface Engineering by Changing the Surface Metallurgy: Hardening methods, re-melting of base metal or modified surfaces using laser and TIG, plastic deformation-based approaches Surface Engineering by Changing the Composition: Carburizing, nitriding, plasma carburizing and plasma nitriding, Surface modification by changing chemical composition, Surface modification using diffusion-based processes, ion beam-assisted deposition, boronizing.	
UNIT - IV	**8 Hrs**
Surface Modification by Developing Coating and Cladding: Metals for developing, coating, and cladding, weld surfacing, laser cladding, thermal spraying, electroplating, electroless process.	
UNIT - V	**8 Hrs**
Testing and Characterization of Engineered Surfaces: Surface properties, thickness, bond strength of coating by non-destructive testing (NDT), destructive testing of modified surfaces, XRD, SEM, EDAX, compositional analysis, visual inspection, optical and macroscopic examination.	

Course Outcomes:

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

CO1	:	Explain various forms of corrosion and basic concepts of surface engineering
CO2	:	Evaluate the different surface engineering processes with respect to industrial practices
CO3	:	Apply the knowledge of different spraying techniques in surface engineering
CO4	:	Analyze tests for assessment of wear and corrosion behaviour

Reference Books

1. Dheerendra Kumar Dwivedi, Surface Engineering, Spinger, 3rd edition, 2013, ISBN 978-81-322-3777-8 (2018)

2. Mathews, A., Advanced Surface Coatings: A Hand book of Surface Engineering, Spinger (2013), ISBN 322-3777-8

3. Sudarshan T S, 'Surface modification technologies - An Engineer's guide', Marcel Dekker, Newyork, (2010), ISBN 978-84251656

4. Strafford, K.N., Datta, P.K., and Gray, J.S., Surface Engineering Practice, Processes, Fundamentals and Applications in Corrosion and Wear, Ellis Harwood (2015). ISBN 324-346578

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: 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	:	22MPD22TL	**Industrial Ergonomics and Biomechanics**	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 Bharatish A			

UNIT - I	**8 Hrs**
Ergonomic Workspace Design: Contribution of ergonomics to work station design, ergonomic approach to work station design, work surface design, visual display terminals, case studies.	
UNIT - II	**8 Hrs**
Anthropometric Principles: Anthropometry and its use, types of anthropometric data, principles of applied anthropometry in ergonomics, application of anthropometry in product design, case studies.	
UNIT - III	**9 Hrs**
Introduction to Biomechanics: Qualitative and Quantitative analysis, Principles and Laws, forms of motion, Directional terms, Anatomical Reference Planes, Anatomical Reference Axes, joint movement terminology, muscle actions, Hill Muscle Model, force-motion principle	
UNIT - IV	**8 Hrs**
Kinetic Concepts for Human Motion: Basic Concepts, mechanical loads, effects of loading, tools for Measuring Kinetic Quantities, Vector Algebra, torque, static and dynamic equilibrium, anatomical levers, centre of gravity	
UNIT - V	**9 Hrs**
Biomechanics of Human Bone and muscle: Composition and Structure of Bone Tissue, Bone Growth and Development, bone response to stress, bone injuries, behavioural properties, structural organisation, skeletal muscle function, force–velocity relationship, length–tension relationship, stretch-shortening cycle, muscular strength, power, and endurance	
LABORATORY	**28 Hrs**
1.Fatigue Measurement in Humans : Perform Fatigue measurement in human being using Blood pressure, SpO2 and CO2 parameters 2.Anthropometry: Measure and analyze of anthropometric data in sitting and standing position 3.Human actuator Response: Assessment of force exerted by human actuators 4.Local Muscle Activity: Measurement of local muscle activity using EMG 5.Structural analysis of compression bone plate: Perform static Structural analysis of compression bone plate in ANSYS Workbench 6.Bending Behavior of Femur Bone: Analyze 3 point bending configuration of Femur bone in ANSYS Workbench 7.Analysis of Hip Implant: Static Structural analysis of hip implant made up of Titanium Alloy 8.Intervertebral Disc Analysis: Simulation of the creep deformation of an intervertebral disc 9.SMA for spinal Space: Static structural analysis of Spinal space made of Shape memory alloy (SMA) with thermal effect 10.Balloon-angioplasty of a Stent Analysis: Simulate mechanical responses as a result of expanding the balloon-stent assembly	

Course Outcomes:

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

CO1	:	Recognize the role of biomechanics and ergonomics and its areas of application in the work system.
CO2	:	Explain and apply the concepts of biomechanics and ergonomics in the evaluation of existing systems and design of new systems
CO3	:	Demonstrate an understanding of concepts of ergonomics and biomechanics
CO4	:	Design, develop, conduct and analysis ergonomic related experiments.

Reference Books

1 Susan J Hall, Basic Biomechanics, Sixth Edition, Tata McGraw hill, 2013, ISBN: 978-0-07-337644-8, 2013

2 Duane Knudson, Fundamentals of Biomechanics, Second Edition, Springer, ISBN 978-0-387-49311-4, 2012, 2014

3. Authors, Title, Editions, Publisher, Year, ISBN3 R S Bridger, Introduction to Ergonomics, Taylor & Francis, 2nd
Edition, 2003, ISBN: 0415273781.

4.Andreas C. Müller, Sarah Guido, Introduction to Machine Learning with Python, O'Reilly Media, Inc., First edition,
ISBN: 04345-15-215, 2014

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	:	22MPD23T	**PRODUCT AND COST ANALYSIS**	CIE Marks	:	100
Credits L-T-P	:	3- 1 - 0		SEE Marks	:	100
Hours	:	42L+28T	*(Professional Core - 4)*	SEE Durations	:	3 Hrs
Faculty Coordinator:		Dr B W Shivaraj				

UNIT - I	**8 Hrs**
Introduction: New product strategies, Decision Process, Market definition and entry strategy, Idea generation, Design process.	
UNIT - II	**8 Hrs**
Consumer Measurement process: Research Methods, Sampling, Attitude Scaling Perceptual Mapping: Perceptual Maps and Value Maps, Analytical methods to Perceptual Maps, Product Positioning.	
UNIT - III	**9 Hrs**
Manufacturing Planning: Selection of optimum process, Standardization, Break even analysis- application and area of use -problems -multi - product analysis and Process planning. Value Analysis: Types of value, Objectives and Steps, Case studies.	
UNIT - IV	**9 Hrs**
Cost Accounting: Cost estimation -difference -types -steps involved in cost estimation. Types of Cost: Cost Centres, Material cost-direct indirect, Overhead cost. Elements in overheads: Preparation of cost sheet, machine hour rate, apportioning methods Variance Analysis – Labour variance, Material variance and Overhead variance, Activity based costing - Introduction to target costing	
UNIT - V	**8 Hrs**
Cost Calculation: Cost calculation for machined components, welding, Sheet Metal and forged components - calculation of sales cost.	

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

CO1	:	Describe the product strategy and Perceptual Maps for Product Positioning
CO2	:	Apply suitable manufacturing process based on material and product
CO3	:	Evaluate the parameters for design considerations based on manufacturing process
CO4	:	Analyzing the Cost Accounting machined components for a given material

Reference Books

1. Glen L Urban, John R Hauser, “Design and Marketing of New Products”, Prentice Hall. New Jersey, 1993, ISBN :
978-0132015677, 4th Edition
2. T.R.Ranga and S C Sharma, “ Mechanical Estimating and Costing”,- Khanna Publishers- 2015. ISBN : 40:0257-02-0001, 3rd edition
3. Miles Lewrence, “ Technique for Value Analysis And Engineering”, McGraw Hill, New york-2000, ISBN : 65:0257-22-0004, 5th edition
4. Yasuhiro Monden Cost management in the New Manufacturing Age -, Productivity Press-1992, 1980, ISBN : 90:0777-02-0001, 6th edition

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 Bharatish 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. 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.
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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	:	22MPD2C2T	**ADDITIVE MANUFACTURING TECHNOLOGY**	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 Gopalakrishna H D				

UNIT - I	**9 Hrs**
Design for Additive Manufacturing- Design for improved functionality, Design for material reduction, Design guidelines for AM in general, Design for Powder based systems, Design for Resign based systems, Design for Extrusion based systems, Design for Jetting based systems, Generative Design, Topology optimization, Analysis of DesignsBasic Principles and Development of AM Technology: Conventional Machining Processes, Development of CAD/CAM systems, Advantages and Limitations; Concurrent Engineering; Data Format; Rapid Prototyping Technologies, Laminated Object Manufacturing, Generic AM Process, Distinction between Am and CNC, CAD and other Technology, Classification of AM Process; Metal and Hybrid systems; Steps in AM process;	
UNIT - II	**8 Hrs**
Powder Bed Fusion Processes: Introduction, Materials, Powder Fusion Mechanisms, Process Parameters and Modeling, Laser, UV and IR; Process Benefits and Drawbacks. Extrusion-Based Systems: Introduction, Basic Principles, Plotting and Path Control, Fused Deposition Modeling.	
UNIT - III	**9 Hrs**
Stereo lithography: Materials, Processes parameters, advantages and limitations; Material and Binder Jetting: Evolution, Materials, Material Processing Fundamentals, Material Jetting Machines, Process Benefits, binding materials and systems. Laser Engineered Net Shaping (LENS) : Materials, Process Parameters & Systems Post Processing of additive manufactured parts.	
UNIT - IV	**8 Hrs**
Design for Additive Manufacturing: Design for Manufacturing and Assembly, AM Unique Capabilities, Core DFAM Concepts and Objectives, CAD Tools for AM. Applications for Additive Manufacture: Introduction, The Use of AM to Support Medical Applications, Aerospace and Automotive Applications.	
UNIT - V	**8 Hrs**
Rapid Tooling: Introduction, Direct and Indirect AM tooling process; Production of Injection Molding Inserts, EDM Electrodes, Investment Casting and Other Systems, RTV Silicone Tooling, Calcium silicate based castable tooling. Choosing the right AM process and materials, Construction of basic AM machines, Post-processing of AM parts	

Course Outcomes:

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

CO1	:	Explain the working process and technology development of Additive Manufacturing
CO2	:	Apply the principles of AM in manufacturing industry advantage.
CO3	:	Analyze the concepts of AM in Production Process
CO4	:	Evaluating the techniques involved in AM

Reference Books

1. Ian Gibson, David Rosen, Brent Stucker, “Additive Manufacturing Technologies”- Springer, 2ndEdition. ISBN 978-1-4939-2112-6

2. Chee Kai Chua, Kah Fai Leong, “3D Printing and Additive Manufacturing, Principles and Applications”, 4th Ed, ISBN 978-9-8145-7140-1

3. Amit Bandyopadhyay, Susmita Bose “ Additive Manufacturing”, CRC Press 2015 ISBN 9781482223590

4. Lihni Wang, Andrew Y.C. Nee “Collabarative design and planning for digital manufacturing” Springer Series, 2009, ISBN 998-1-84882-286-3

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: II						
Course Code	:	22MPD2C3T	**GD&T and Digital Metrology**	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 Gangadhar Angadi			

UNIT - I	**9 Hrs**
Introduction to GD&T: Uses, Advantages over Coordinate dimensioning and tolerancing: Cylindrical tolerance zone, maximum material condition and Datums specified in order of precedence. Fundamental Drawing Rules, Units of Linear and Angular Measurement. Geometric characteristic symbols, Datum feature symbol, Feature control frame, Material conditions, GD&T terms, Fundamental Rules for drawing. Datums: Datum Feature Selection and Identification, Datum Features, Datum Targets.	
UNIT - II	**9 Hrs**
Form and Orientation: Flatness tolerance and unit, Straightness tolerances, straightness of a median line and median plane, Circularity tolerance, Cylindricity tolerance, Free-State Variation. Orientation: Parallelism of a flat surface, parallelism of an axis, perpendicularity of a flat surface, Tangent plane, perpendicularity of an axis, angularity of a flat surface, angularity of an axis. Position: Position Tolerance, Regardless of Feature Size, Maximum Material Condition, Shift Tolerance, Least Material Condition, Boundary Conditions, Zero Positional Tolerance at MMC.	
UNIT - III	**8 Hrs**
Coaxiality and Concentricity: Comparison between Position, Runout, and Concentricity, Specifying Coaxiality at MMC, Composite Positional Control of Coaxial Features, Tolerancing a Plug and Socket. Runout and Profile: Circular Runout, Total Runout, Specifying Runout and Partial Runout, Multiple Datum Features, Face and Diameter Datums, Profile: Application of Datums, Radius Refinement with Profile, Combing Profile Tolerances with Other Geometric Controls, Coplanarity, Profile of a Conical Feature, Composite Profile.	
UNIT - IV	**8 Hrs**
Tolerance Stack-Up Analysis: Importance, Need, Manufacturing Considerations in Engineering Design, Technical Drawing, Converting Plus/Minus Dimensions and Tolerances into Equal-Bilaterally Toleranced Dimensions, Tolerance Stack Analysis, Worst-Case Tolerance Analysis, Rules for Assembly Shift, Worst-Case Tolerance Stack-Up in Symmetric and Asymmetric Dimensional Tolerance, Statistical Tolerance Analysis, Understanding Material Condition Modifiers	
UNIT - V	**8 Hrs**
Digital Metrology: Metrology and Digitalization, Implementation Strategy, Data Acquisition, Setup Fundamentals for Measurement and Data Acquisition, Length Measurement in Open Loop, Thermal Measurement and Data-Acquisition Considerations, Data Transfer to Cloud, Internet of Things (IoT) Metrology, Closed-Loop Data Analysis- (In-Process Inspection), Digital Twin Metrology Inspection. Advanced Methods for Optical Nondestructive Testing (ONDTs): Introduction, Principles, Material Properties, Application of Thermal or Mechanical Loads for NDT, Selected Measurement Techniques Suitable for Optical NDT, Optical Methods for NDT: Thermography, Fringe Reflection Technique (FRT), Digital Speckle Shearography, and Laser Ultrasound.	

Course Outcomes:

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

CO1	:	Demonstrate an understanding of all the symbols, terms and rules used in GD&T.
CO2	:	Analyse the acceptability of manufactured parts based on GD&T requirements.
CO3	:	Apply the GD&T symbols on an engineering drawing to completely specify the form and limits of variation of features.
CO4	:	Design the product/assembly for real time applications in manufacturing and inspection

Reference Books

1. Gene Cogorno - Geometric Dimensioning and Tolerancing for Mechanical Design, , 2nd Edition,McGraw-Hill, 2006,
ISBN-13:978-0071772129

2. Georg Henzold - Geometrical Dimensioning and Tolerancing for Design, Manufacturing and Inspection, 2nd Edition,
Elsevier Ltd., 2006, ISBN-13: 978-0-7506-6738-8

3. Bob Campbell and Edward S. Roth- Integrated Product Design and Manufacturing Using Geometric Dimensioning
and Tolerancing, CRC Press, 3rd edition, 2003, ISBN: 0-8247-8890-7

4. Meadows, James D - Geometric dimensioning and tolerancing (ASME Y14.5-2009)-ASME Press 2009, 4th edition, ISBN:
978-0-9714401-6-6

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	:	22MPD2C4T	**Design for Manufacture and Assembly**	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 Bharatish A			

UNIT - I	**9 Hrs**
Introduction to Design for Manufacture & Assembly: Steps in DFMA, Advantages of DFMA, Limits, Fits and Tolerances, hole and shaft basis, Geometrical Dimensioning & Tolerances, , Three datum – functional, machining and manufacturing, numericals	
UNIT - II	**8 Hrs**
Design for Metal Casting – Compute the dimensions for Pattern, Mould, influence of parting line, cast holes, special sand cores, numericals, Pressure Die Casting: Die casting alloys, machine selection, operation, sub-systems, optimum number of cavities, design principles	
UNIT - III	**8 Hrs**
Design for Injection Moulding – Injection moulding systems – injection subsystem, machine sizing, materials for injection moulding and its properties, injection mould design – cavity and core, operation and cycle time, Design for Sheet Metal Processing: Design of moulds for shearing, piercing, bending, deep drawing, progressive die operation	
UNIT - IV	**9 Hrs**
Electrical Connections and Wire Harness Assembly, classification of electrical interconnection, types of electrical Connections, types of Wires and Cables, preparation and assembly times, assembly and installation, analysis method	
UNIT - V	**8 Hrs**
Design for High-Speed Automatic Assembly and Robot Assembly, Design of Parts for High-Speed Feeding and Orienting, Additional Feeding Difficulties, High-Speed Automatic Insertion, General Rules for Product Design for Automation, Design of Parts for Feeding and Orienting, product design for robot assembly.	

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

CO1	:	Understand the basic manufacturing processes and electrical connections
CO2	:	Develop the assembly conditions and identify the datums
CO3	:	Design the parts for ease of pressure die casting, injection moulding and robot assembly
CO4	:	Formulate the DFMA work analysis sheet for various manufacturing processes

Reference Books

1. Product Design for Manufacture and Assembly, Geoffrey Boothroyd, Peter Dewhurst, Winston Knight Marcel Dekker, Inc., New york - Second Revision, ISBN O 8247-0584-X, 2013

2.Designing for Manufacturing, Harry Peck, Pitman Publications, 2nd edition, 2010, ISBN: 1-805233-810-5

3.Dimensioning and Tolerance for Quantity Production, Merhyle F Spotts, Englewood Cliffs, Prentice Hall, 5th edition, ISBN: 2-95433-956-6, 2012

4. Design for manufacturing – a structured approach, CorradoColig. BH publishers, 2012, ISBN: 2-95433-956-6

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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	:	22MPD2C5T	**ELECTRIC VEHICLE TECHNOLOGY**	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 Gopalakrishna H D			

UNIT - I	**9 Hrs**
Overview of EVs and challenges: Components of EVs - architecture of EVs - EV market and promotion-infrastructure needs - EV makers - Comparison in reference of: Energy source, Pollution, Energy diversification, Efficiency, Capital & operating cost, Performance. Classifications: Classification of EVs in reference to: Propulsion devices, Energy sources, Energy carriers, Pure Electric Vehicles (PEV) - Hybrid Electric Vehicles (HEV) and Plug-in Hybrid Electric Vehicles (PHEV) - Configurations: BEV, FCEV.	
UNIT - II	**9 Hrs**
Design Considerations: Aerodynamic Considerations, Rolling Resistance, Transmission Efficiency, Consideration of Vehicle Mass, Electric Vehicle Chassis and Body Design, Issues in Design. Design of Ancillary Systems: Heating and Cooling Systems, Design of the Controls, Power Steering, Choice of Tyres, Wing Mirrors, Aerials and Luggage Racks, Electric Vehicle Recharging and Refueling Systems. Electric Vehicle Modelling: Tractive Effort, Modelling Vehicle Acceleration, Modelling Electric Vehicle Range, Numerical.	
UNIT - III	**8 Hrs**
Batteries, Flywheels and Supercapacitors: Battery Parameters, Lead Acid Batteries, Nickel-Based Batteries, Sodium-Based Batteries, Lithium Batteries, Metal–Air Batteries, Supercapacitors and Flywheels, Battery Charging, The Designer's Choice of Battery, Batteries in Hybrid Vehicles, Battery Modelling, Battery Management Systems. Fuel Cells: Hydrogen Fuel Cells, Thermodynamics, Connecting Cells in Series, Water Management in the PEMFC, Thermal Management of the PEMFC, Fuel Cell System, Practical Efficiency of Fuel Cells, Hydrogen as a Fuel- Reforming, Efficiency, Storage.	
UNIT - IV	**8 Hrs**
EV Drives: BEV, HEV, FCEV, EV motor drive technologies - IC engine vehicle force - speed characteristics (5-gears), BEV force - speed characteristics (fixed gears) - Comparison between ICE vehicles & BEV - Requirement of EV motor compared to industrial motors - classification of EV motors (DC, Induction, BLDC, PMSM) – Types, Principle, Construction, Control - Electric Drive Train and its types and Power Converters.	
UNIT - V	**8 Hrs**
Types of Chargers: AC charging and DC charging - On board and off board charger specification - Type of Mode of charger Mode 2, Mode 3 and Mode 4 - EVSE associated charging time calculation - Selection and sizing of fast and slow charger (AC & DC) - AC Pile Charger, DC Pile Charger. Modelling and Vehicle Dynamic Control: Modelling and Characteristics of EV/HEV Powertrains Components - ICE Performance Characteristics - Electric Motor Performance Characteristics - Battery Performance Characteristics -Transmission and Drivetrain Characteristics - Regenerative Braking Characteristics. Control of Electric and Hybrid Electric Vehicle Dynamics - Fundamentals of Vehicle Dynamic Control (VDC) Systems - VDC Implementation on Electric and Hybrid Vehicles.	

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

CO1	:	Explain the basics of electric and hybrid electric vehicles, their architecture, technologies and modelling.
CO2	:	Discuss and implement different energy storage technologies used for electric vehicles and their management system
CO3	:	Analyze various electric drives and its integration techniques with Power electronic circuits suitable for electric vehicles.
CO4	:	Analyse the requirement for model based EV designs and its infrastructure needs.

Reference Books

1 James Larminie, John Lowry, "Electric Vehicle Technology Explained", Wiley Publisher, 2nd Edition, 2012, 2nd Edition ISBN:9781119942733.

2.Iqbal Hussain, "Electric & Hybrid Vehicles –Design Fundamentals", Second Edition, CRC Press, 2011, ISBN 0-8493-1466-5

3.Davide Andrea,"Battery Management system for large Lithium Battery Packs", ARTECH HOUSE 4th Edition 2010, ISBN-13 978-1-60807-104-3

4. F. BADIN, Ed, Hybrid Vehicles from Components to System", Editions Technip, Paris, 2013, 3rd Edition, ISBN 978-2-7108-0994-4.

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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: 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 .

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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***		
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	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.

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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.

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Rubric for CIE & SEE Theory courses

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			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 TRANSPORT 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 García Zuazola “Intelligent Transport Systems: Technologies and Applications” Wiley Publishing ©2015, ISBN:1118894782 9781118894781

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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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	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

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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).		
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			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

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	:	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.
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	:	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.
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		
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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	:	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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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).		
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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.

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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).		
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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	:	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	:	22MPD24L	**Advanced Product Design 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. Bharatish A				

Content	**28 Hrs**
1.Product disassembly Experiments- Disassemble a laptop and analyze the multiple standard parts 2.Design concept and Design synthesis- Generate a design layout, DFMA worksheet and design for disassembly 3.Alternative design: Generate Alternate Concepts using Adobe, Concept App and Figma tool 4.Animation: Animate the product disassembly using Autodesk Fusion 360 5. I design tool: Create Product User Interface using Figma and Framer tools 6. 3D prototyping: Prototype the standard parts using 3D printer	

Course Outcomes:

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

CO1	:	Understand the programming concepts
CO2	:	Formulate need statement and specifications
CO3	:	Evaluate the CNC programs with testing
CO4	:	Design and simulate the workstation

Reference Books

1.Prashant Kumar, “Product Design” , PHI Learning Pvt. Ltd.,2012, ISBN:978-81-203-4427-3

2.Karl.T.Ulrich, Steven D Eppinger, “Product Design and Development”, McGrawHill ,2016, ISBN-13:978-0078029066

3.A C Chitale and R C Gupta, “Product Design and Manufacturing”, PH1, - 3rd Edition, 2003. ISBN-13:978-8120342828.

4.Sham Tickoo, “SOLIDWORKS 2018 for Designers”, CADCIM Technologies,16th revised Edition Paperback,2018.ISBN- 13: 567-8342828, 2013

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 completion 9 of hours of training program (3 Class) for 50 marks Part A- Quiz for 15 Marks and Part B for 50 Marks (Descriptive answers). Part B – 50 Marks is consolidated to 35 and total marks on 50 is 15 + 35 = 50 Marks.
II	Test 2 is conducted after completion 18 hours of training program (6 Class) for 50 marks Part A- Quiz for 15 Marks and Part B for 50 Marks (Descriptive answers). Part B – 50 Marks is consolidated to 35 and total marks on 50 is 15 + 35 = 50 Marks.
	Average of 2 tests is considered as final CIE 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 Gopalakishna 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)	
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

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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
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	:	22MPD3E1T	**Product Planning and Marketing**	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 T S Roopa			

UNIT - I	**8 Hrs**
Introduction : Product definition, characteristics of successful product development, who designs and develops product, organization structure, Morphology of product design, product development process.	
UNIT - II	**9 Hrs**
Product planning : The product planning proces, Identifying opportunities, Evaluate and prioritize projects, allocate resources and plan timing complete pre-project planning, reflect all the results and process.	
UNIT - III	**9 Hrs**
Opportunity Identification : Market definition and entry strategy, desirable characteristics of markets, market profile analysis, market segmentation, market selection, perceptual positioning - overview, core concept of marketing, emerging concepts in marketing	
UNIT - IV	**8 Hrs**
Product Positioning : Preference analysis and benefits. Segmentation - Role of preference in product positioning, proactive product positioning, Analytic preference models and estimation methods, Benefit segmentation, managerial use of preferences model.	
UNIT - V	**8 Hrs**
Forecasting sales potential - Role of purchase potential in design process, models of purchase potential, model of sales formation, managerial use of purchase models. Lauching the products & strategy for testing new products. planning and tracking launch of durable and industrial products advertising testing and product quality testing.	

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

CO1	:	Understand the concept of product and product development process understand the product planning process.
CO2	:	Understand the project planning process
CO3	:	Gain the knowledge about marketing and positioning of the product.
CO4	:	Understand forecasting and launch of products.

Reference Books

1. Karl T. Ulrich, Steven & Eppinger product pregn and Development McGraw Hill publications 5th Edition 2012, ISBN 978-0-07-340477-6

2. Glem Urban. John't Hauser Ruga & marketing of New prodiute A prentice Hall Englewoodl cliffs New Jersey,2010 3rd edition, ISBN 023-213-456-523

3.Kenneth B. Kahn, Product planning essentials, SAGE publications, 2015, ISBN: 9780761919995, 2013, 4th edition, ISBN 213-315-45698

4. William L. Moore & Edgar product planning Management A Pessemier, 2010, 5th edition, ISBN 203-321-203-142

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	:	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	**8 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	**9 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, 4th Edition
2.Reliability Engineering - E. Balagurusamy, Tata McGraw Hill, 2012, ISBN: 1235845-254, 3rd edition
3.Reliability Evaluation of Engineering Systems - Roy Billinton and Ronald N. Allan, Reprinted in India B. S. Publications, 2013, 5th edition, ISBN: 525-526-845-254
4.Concepts in Reliability Engineering- Srinath L S - Affiliated East-West Press Private Limited, New Delhi, India. – 2018, ISBN: 235-516-456, 4th edition

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: III						
Course Code	:	22MPD3E3T	**Mechatronics in Manufacturing System**	CIE Marks	:	100
Credits L-T-P	:	3- 1 - 0		SEE Marks	:	100
Hours	:	42L	*Elective E (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:		Dr S K Harish				

UNIT - I	8 Hrs
INTRODUCTION TO MECHATRONICS: Definition, Systems, Measurement systems, Control systems-open loop and closed loop control system, Basic elements of a closed loop system, Examples for mechatronic system-water level controller, engine management system, digital camera, washing machine etc. Benefits of mechatronic system, Evolution of mechatronic system. TRANSDUCERS AND SENSORS: Sensors and transducers, Performance terminology, Sensors: Displacement, Position, Proximity sensor, Velocity, Force, Fluid pressure, Liquid flow, Liquid level, Temperature, Light, Selection of sensors, Input data by switches.	
UNIT - II	9 Hrs
SIGNAL CONDITIONING: Operational amplifier, Protection, Filtering, Wheatstone bridge, Digital signals, Multiplexer, Data acquisition, Digital signal processing, Pulse modulation. MECHANICAL AND ELECTRICAL ACTUATION: types of motion, kinematic chains, cams, gear trains, ratchet and pawl, belt and chain drives, bearings, mechanical aspects of motor selection, mechanical switches, solid state switches, solenoids, DC motor, AC motor, stepper motors, servo motors, induction motors.	
UNIT - III	9 Hrs
BASIC AND DYNAMIC SYSTEM MODELS: mathematic models, mechanical system building block, electrical system building block, fluid system building block, thermal system building blocks. SYSTEM MODELS: engineering system, rotational-translational systems, electromechanical systems, Hydro-Mechanical systems. Dynamic responses of systems: modelling dynamic systems, first-order system, second-order systems, performance measure for second order systems, system identification.	
UNIT - IV	8 Hrs
SYSTEM TRANSFER FUNCTIONS: Transfer functions, first order systems, second order systems, system in series, system with feedback loops, effect of pole location on transient response. FREQUENCY RESPONSE: Sinusoidal input, phasors, frequency response, bode plots, performance specifications, stability.	
UNIT - V	**8 Hrs**
CLOSED LOOP CONTROLLERS: Continuous and discrete processes, control modes, two step mode, proportional mode, derivative control, integral control, PID controller, digital controller, control system performance, controller tuning, velocity control, adaptive control. MICROPROCESSOR AND MICROCONTROLLER: Basic structure of a microprocessor system, architecture, technique used to find faults in microprocessor based system, basic structure of micro-controller, architecture, program development using flow charts.	

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

CO1	:	Understand the working principle of various types of sensors, signal conditioner, drives and control system.
CO2	:	Apply the basic mathematical model to various stages of mechatronic system.
CO3	:	Analyse the functioning of mechatronics system for real-time implementation.
CO4	:	Evaluate the mechatronic system for reliability and better performance.

Reference Books

1.Mechatronics - Electronic Control Systems in Mechanical and Electrical Engineering, W.Bolton, Pearson Education-2005, ISBN: 0273742868.

2.Mechatronics by HMT Ltd. – Tata Mc GrawHill -2000. 2nd Edition, ISBN: 007463643X

3.Mechatronics-Principles, Nitaigour Premchand Mahalik, Concepts and Applications, Tata Mc Graw Hill –2003, 4th edition ISBN:0070483744

4.Fluid Power, Anthony Esposito, Pearson Education-Sixth Edition-2011, ISBN:0135136903

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: III						
Course Code	:	22MPD3E4T	**Lean Manufacturing**	CIE Marks	:	100
Credits L-T-P	:	3- 1 - 0		SEE Marks	:	100
Hours	:	42L	*Elective E (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr S K Harisha			

UNIT - I	**9 Hrs**
Framework of Toyota Production System: Just in time production system. JIT Logic -Pull system Japanese approach to production elimination of waste - JIT implementation requirements JIT application for job shops, Case studies. Adaptable Kanban System: Kanban rules, supplier Kanban and sequence schedule used by supplier, Monthly information & daily information.	
UNIT - II	**8 Hrs**
The rise of mass production: The rise & fall of Mass Production Mass production, work force, organization, tools, product –logical limits of Mass production, Sloan as a necessary compliment to Ford. Case study:- Rouge Production Plant. The rise of lean production: - Birth place, concrete example, company as community, Final assembly plant, product development and engineering	
UNIT - III	**8 Hrs**
Reduction of setup times- Concepts and Techniques: Setup Concepts, practical procedures for reducing setup time. Standardization of operations: Machine layout, multi-function workers and job rotation. Improvement activities to reduce work force and increase worker morale -foundation for improvements.	
UNIT - IV	**8 Hrs**
House of Lean -5S's and Waste Walks, Visual Management, Value Stream Mapping, Understanding the current state and designing the future state. Managing lean enterprise: - Finance, Career ladders, geographic spread and advantages of global enterprise.	
UNIT - V	**9 Hrs**
Six sigma concepts: History, definitions, Statistical definitions, quality levels, Technical aspects, Six sigma for all: benefits to organizations, customers, suppliers and employers, Design for Six Sigma, DMAIC principles, DMADV principles, merits and demerits. Case Studies: Operation redesign program, Kaizen event-based lean program, High-volume focused factory project, Kaizen event based focused factory pilot, Assembly production unit project.	

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

CO1	:	Explain the concepts of Lean manufacturing
CO2	:	Examine the causes of waste in the various organizational processes.
CO3	:	Apply tools and practices of lean manufacturing system for process improvement
CO4	:	Create plans and implementation techniques for the lean manufacturing system in businesses.

Reference Books

1.A Study of the Toyota Production System, Shigeo Shingo , Andrew P. Dillon, Productivity Press,2012, ISBN 9780915299-17-8., 2nd edition

2.The Machine that changed the World. The Story of Lean Production, James P Womack, Daniel T Jones, and Daniel
Roos, Harper Perennial edition published 2013, ISBN 13: 9780060974176, 2nd Edition

3.A Commonsense Approach to a Continuous Improvement Strategy, Gemba Kaizen, Second Edition Hardcover,ISBN-10 : 0071790357. 2012

4.Value Stream Mapping: How to Visualize Work and Align Leadership for Organizational Transformation Paperback – 2016 by Karen Martin , Mike Osterling, ISBN-10: 9352601831. 5.Lean And Six Sigma – Six Sigma Black Belt (2007
BOK): Enterprise-Wide Deployment Paper Back by Suvabrata Mitra, ASIN : B00H1XSLFA.

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RUBRIC for CIE

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1	Quizzes - Q1 & Q2	20
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RUBRIC for SEE

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9 & 10	Unit-5: Question 9 or 10	20
	Total Marks	100

SEMESTER: III						
Course Code	:	22MPD3E5T	**Creative 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:		Girish Kumar R				

UNIT - I	**8 Hrs**
INTRODUCTION Need for design creativity – creative thinking for quality – essential theory about directed creativity. Creative thinking, blocks to creativity, factors that influence creative design, engineering design and creative design, influence of society, technology and business on creativity, force field analysis, market pull & technology push, attribute of a creative person, creative thinking in groups, creating a creative climate. CREATIVITY & PRODUCT DESIGN Need or identification of a problem, market survey, data collection, review & analysis, problem definition, Kipling method, challenge statement, problem statement initial specifications.	
UNIT - II	**8 Hrs**
IDEA GENERATION Brain storming, analogy technique or synectics, check list, trigger words, morphological method, interaction matrix method, analysis of interconnected decision making, CREATIVE THINKING PROBLEM / OPPORTUNITY Pictures of situation, environment, quantification, Heros, boundary conditions, record-discuss-clarify-verify, recording of ideas, evaluation of ideas, detail design, prototyping, product deployment, useful life assessment, recycling.	
UNIT - III	**8 Hrs**
EMOTIONAL DESIGN Emotional Design – Three levels of Design – Viceral, Behavioral and Reflective- design by individual and design in groups, designs with personality – machines that senses emotions and induce emotions- Robots, personality products, products for games, fun, people and places; Simulation – dimensional or mathematical, virtual simulation, physical simulation, scale down models.	
UNIT - IV	**9 Hrs**
THEORY OF INVENTIVE PROBLEM SOLVING (TRIZ) Common features of good solutions – resolve contradiction, use available resource, increase the ideality, trade-off, inherent contradiction, 30 key TRIZ principles – multifunction, preliminary action, compensation, nested doll, blessing in disguise, segmentation, separation, regional influences, symmetry change, opaque & porous, inflate and deflate, color, recycle & recover, phase transformation, energy, imaging, environment, composition, economical, surface response, equipotential, static & dynamic, continuous & intermittent, servo systems, smart systems, dimensions.	
UNIT - V	**9 Hrs**
Creative Engineering Design Assessment (CEDA) Understanding CEDA, directions for administering CEDA, theoretical Framework, properties of CEDA, Sample Design problems.	

Course Outcomes:

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

CO1	:	Explain the Importance of creativity in Engineering
CO2	:	Formulate ways towards Idea generation and problem solving
CO3	:	Understand and apply concepts of Emotional Design
CO4	:	Synthesize the creative design with analysis to develop new products

Reference Books

1. Creative Engineering Design Synthesis, Amaresh Chakrabarti, Springer, 2009, ISBN 213-25475647
2. Rousing Creativity: Think New Now, Floyd Hurt, Crisp Publ Inc. ISBN 1560525479,2010, 2013
3. Emotional Design, Donald A. Norman,Perseus Books Group New York , ISBN 123-1-118-027-6, 2012
4. Creative Engineering- Design Assessment,Background, Directions, Manual,Scoring Guide and Uses, Christine
Charyton, , Springer publications, 2014. ISBN 1560525479,2010

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Rubric for CIE & SEE Theory courses

RUBRIC for CIE

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	Total Marks	100

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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	:	22MPD32N	**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	:	22MPD33P	**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	:	22MPD41P	**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.

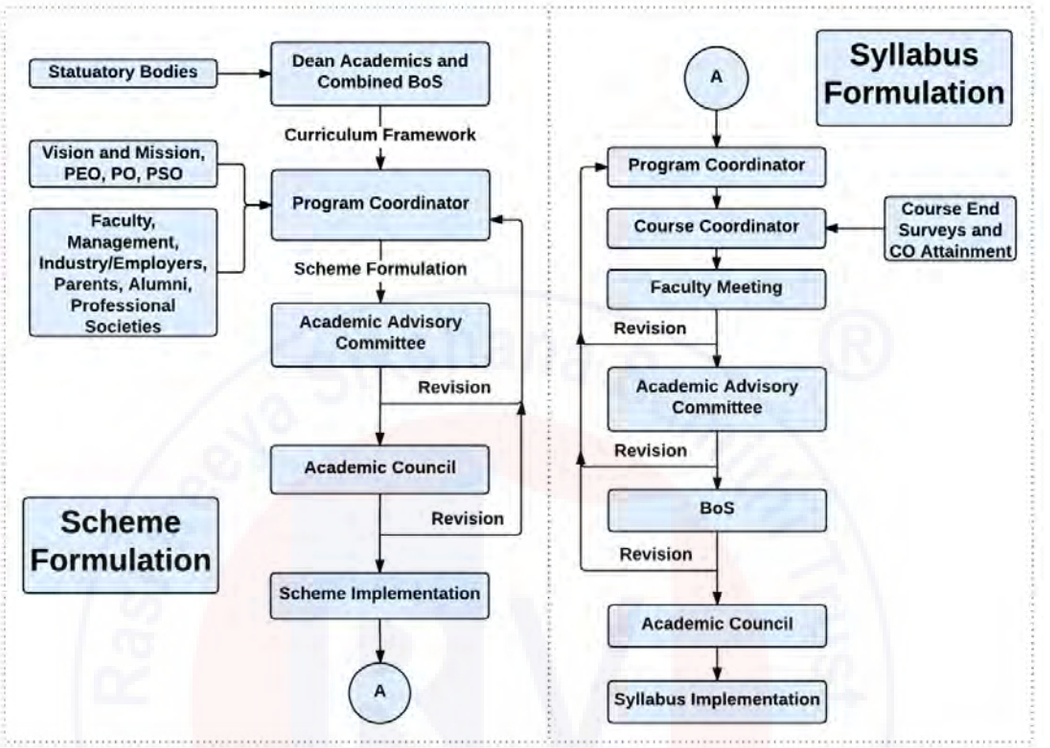
Phase *	Activity	Weightage
I	Selection of Project Title, Formulation of Problem Statement and Objectives	20 %
II	Design, Implementation and Testing	40 %
II	Experimental Result & Analysis, Conclusions and Future Scope of Work, Report Writing and Paper Publication	40 %

* Phase wise rubrics to be prepared by the respective departments

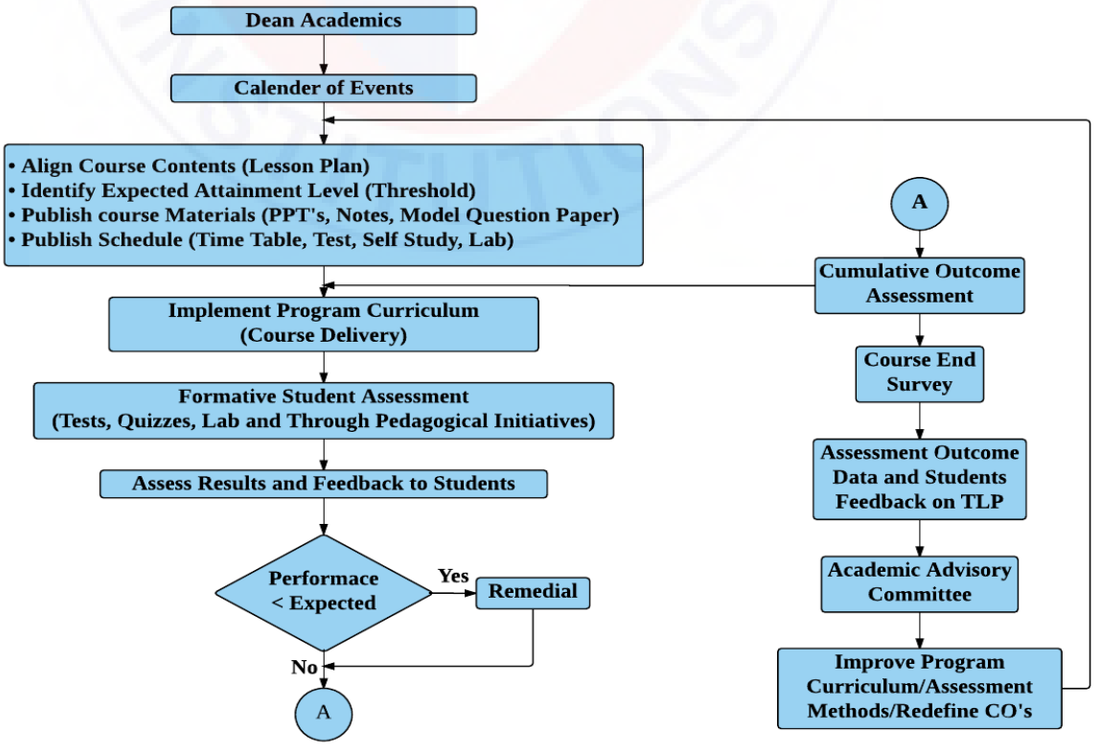
Scheme for Semester End Evaluation (SEE):
Major Project SEE evaluation shall be conducted in two stages. This is initiated after fulfilment of submission of Project Report and CIE marks.
Stage-1 Report Evaluation: Evaluation of Project Report shall be done by the Guide and an External examiner.
Stage-2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

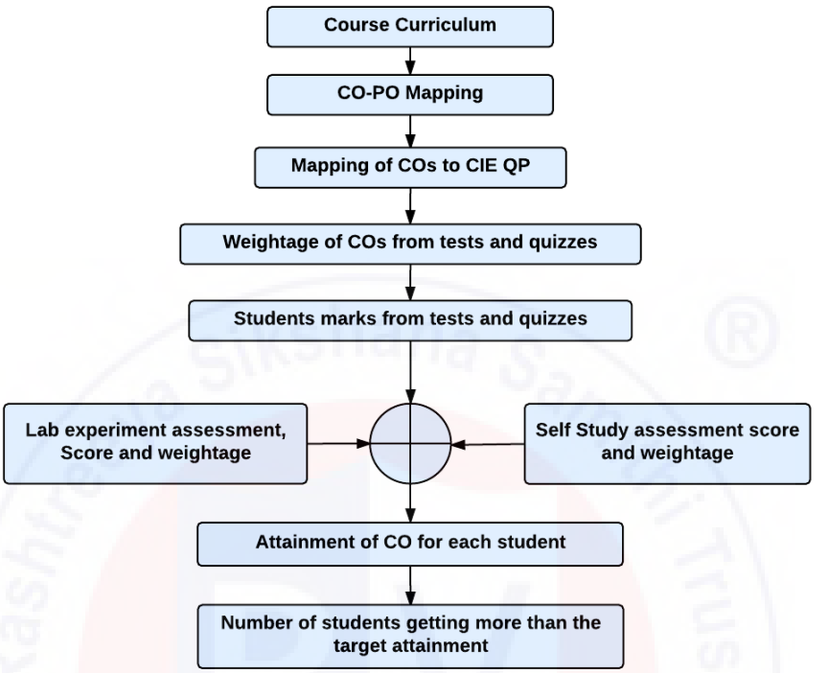
Curriculum Design Process



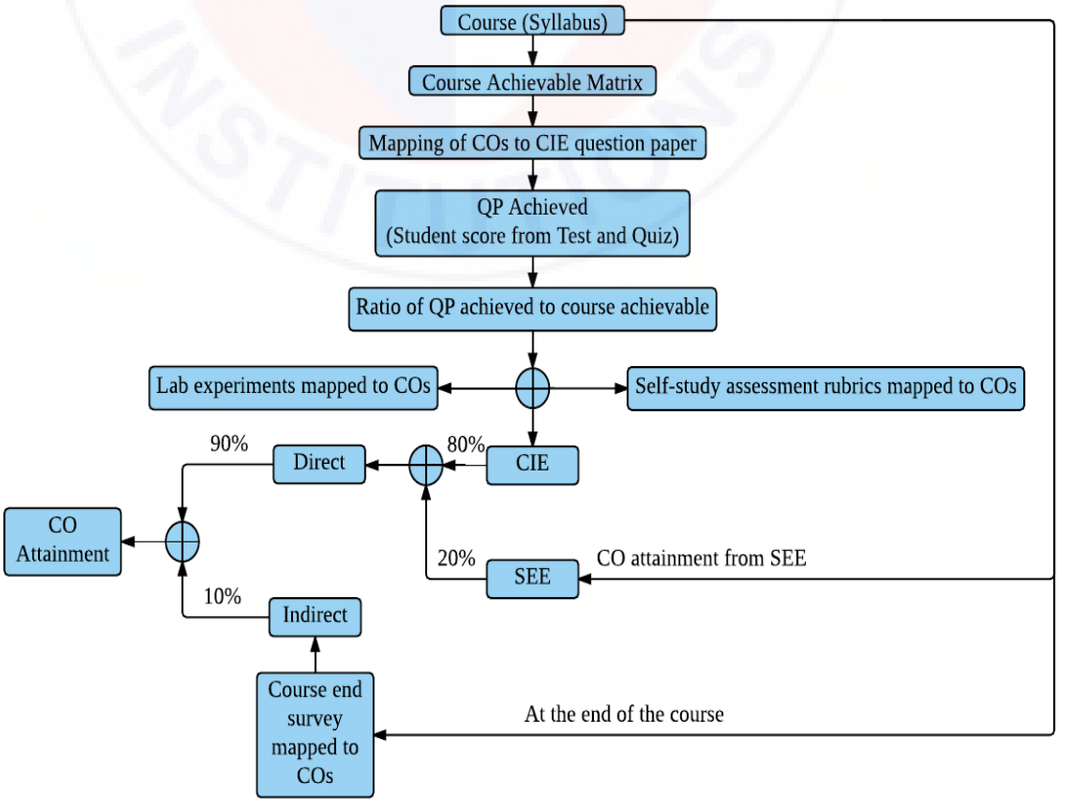
Academic Planning And Implementation



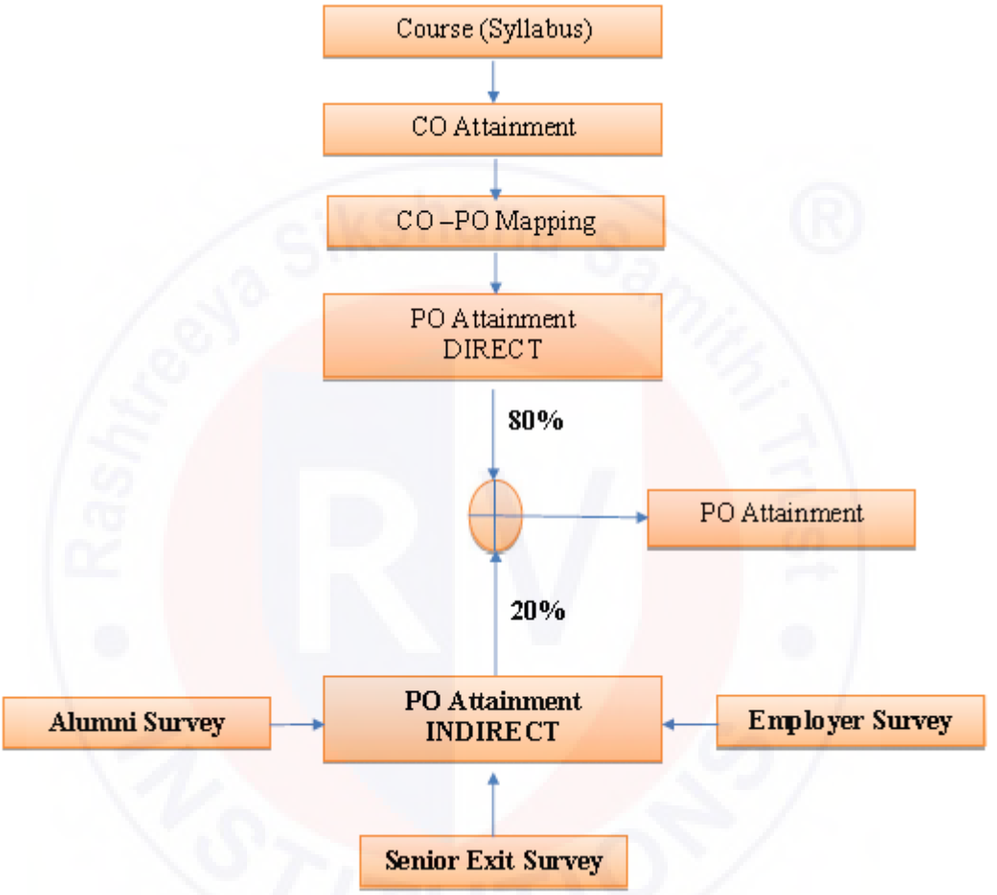
Process For Course Outcome Attainment



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

RV COLLEGE OF ENGINEERING®
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www.rvce.edu.in