Dr. MAHALINGAM
COLLEGE OF ENGINEERING AND TECHNOLOGY
Enlightening Technical Minds Estd. 1998
An Autonomous Institution
(Since 2011)

Dr. MAHALINGAM
COLLEGE OF ENGINEERING AND TECHNOLOGY
Affiliated to Anna University, Chennai; Approved by AICTE ; Accredited by NAAC with Grade 'A++'
Accredited by NBA - Tier1 (Mech, Auto, Civil, EEE, ECE, E&I and CSE)
Udumalai Road, Pollachi - 642 003. Tel: 04259-236030/40/50 Fax: 04259-236070 www.mcet.in

B.E. Automobile Engineering

2019 REGULATIONS

Detailed Syllabi for

Semester I to VIII

Department of Automobile Engineering

Vision

To offer cutting-edge technology in the broad area of automobile engineering and develop globally competitive engineers

Mission

- To develop automobile engineering graduates for a successful career in automotive industry around the globe through effective teaching-learning and training
- To develop the capability of graduates for creating innovative products/ systems to enhance the quality of life
- To inculcate in them the ability to solve societal problems through engineering and professional skills

Programme: B.E. Automobile Engineering

Programme Educational Objectives (PEOs) – Regulation 2019

B.E. Automobile Engineering graduates will:

PEO1.Technical expertise: Actively apply technical and professional skills in engineering practices to face industrial challenges around the globe

PEO2.Higher studies and research: Own their professional and personal development by continuous learning to create new knowledge

PEO3.Ethical knowledge: Conduct themselves in a responsible, professional and ethical manner supporting sustainable economic development, which enhances the quality of life

Programme Outcomes (POs) – Regulation 2019

On successful completion of B.E. Automobile Engineering programme, graduating students/graduates will be able to:

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

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

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

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

PO5. Modern tool usage: Create, select, and apply appropriate techniques,

resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

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

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

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

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

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

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

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

Programme Specific Outcomes (PSOs) - Regulation 2019

On successful completion of B.E. Automobile Engineering programme, graduating students/graduates will be able to:

PSO1. Analyze the systems behavior and optimize for the results using modeling, simulation and experiments.

PSO2. Design automotive components with due considerations of environment and sustainability.

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Programme: B.E Automobile Engineering

2019 Regulations

Curriculum for Semester I to VIII

Course Code	Course Title	Duration	Credits	Marks
19SHMG6101	Induction Program	3 Weeks	-	100

Semester I (2019 Batch)

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABC1101	Matrices and Calculus	3	1	0	4	100	AU, CE,EC, EE, EI MC, ME
19ENHG2101	Communication Skills – I	2	0	2	3	100	All
19PHBC2101	Physics for Mechanical Sciences	3	0	2	4	100	AU, MC, ME
19CSSC2001	C Programming	3	0	2	4	100	AU, MC, ME
19MESC4001	Engineering Drawing	1	0	3	2.5	100	AU, CS, IT,EC, EI, MC, ME
19PSHG3001	Wellness for Students	0	0	2	1	100	All
TOTAL		**12**	**1**	**11**	**18.5**	**600**	

Semester II (2019 Batch)

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABC1201	Ordinary Differential Equations and Complex Variables	3	1	0	4	100	AU, CE, EC, EE, EI, MC, ME
19ENHG2201	Communication Skills – II	2	0	2	3	100	All
19CHBC2201	Chemistry for Mechanical Sciences	3	0	2	4	100	AU, MC, ME
19MESC2001	Introduction to Engineering	2	0	2	3	100	AU, EC, EE, EI, MC, ME
19MESC2201	Engineering Materials	2	0	2	3	100	AU, MC, ME
19MECC3201	Engineering Practices Laboratory	0	0	3	1.5	100	AU, MC, ME
19PSHG3002	Personal Effectiveness	0	0	2	1	100	All
19CHMG6201	Environmental Sciences	1	0	0	-	100	All
TOTAL		**13**	**1**	**13**	**19.5**	**800**	

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Programme: B.E Automobile Engineering 2019 Regulations

Curriculum for Semester I to VIII

Course Code	Course Title	Duration	Credits	Marks
19SHMG6101	Induction Program	3 Weeks	-	100

Semester I (2020 Batch)

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABC1101	Matrices and Calculus	3	1	0	4	100	AU, CE,EC, EE, EI MC, ME
19ENHG2101	Communication Skills – I	2	0	2	3	100	All
19PHBC2101	Physics for Mechanical Sciences	3	0	2	4	100	AU, MC, ME
19CSSC2001	C Programming	3	0	2	4	100	AU, MC, ME
19MESC4001	Engineering Drawing	1	0	3	2.5	100	AU, CS, IT,EC, EI, MC, ME
19PSHG6001	Wellness for Students*	0	0	2	-	-	All
TOTAL		**12**	**1**	**11**	**17.5**	**500**	

Semester II (2020 Batch)

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABC1201	Ordinary Differential Equations and Complex Variables	3	1	0	4	100	AU, CE, EC, EE, EI, MC, ME
19ENHG2201	Communication Skills – II	2	0	2	3	100	All
19CHBC2201	Chemistry for Mechanical Sciences	3	0	2	4	100	AU, MC, ME
19MESC2001	Introduction to Engineering	2	0	2	3	100	AU, EC, EE, EI, MC, ME
19MESC2201	Engineering Materials	2	0	2	3	100	AU, MC, ME
19MECC3201	Engineering Practices Laboratory	0	0	3	1.5	100	AU, MC, ME
19PSHG6001	Wellness for Students*	0	0	2	1	100	All
19CHMG6201	Environmental Sciences	1	0	0	-	100	All
TOTAL		**13**	**1**	**13**	**19.5**	**800**	

*Annual Pattern

Semester III

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABC1301	Numerical Methods	3	1	0	4	100	AU, ME
19MESC1301	Engineering Mechanics	3	1	0	4	100	AU, MC, ME
19MECC2301	Fluid Mechanics and Hydraulic Machinery	3	0	2	4	100	AU, MC, ME
19AUCN1301	Production Processes	3	0	0	3	100	-
19AUSN2301	Automotive Engines	3	0	2	4	100	-
19AUCN3301	Production Technology Laboratory	0	0	3	1.5	100	-
19AUCN3302	Modeling and Drafting of Automotive Components Laboratory	0	0	3	1.5	100	-
XXXXXXXXXX	One Credit Course	0	0	2	1	100	All
TOTAL		**15**	**2**	**12**	**23**	**800**	

Semester IV

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABG1401	Probability and Statistics	3	1	0	4	100	AU, CE,CS, EC, EE, IT, ME
19MECC2401	Strength of Materials	3	0	2	4	100	AU, MC, ME
19AUCN1402	Mechanics of Machines	3	1	0	4	100	-
19AUCN2401	Automotive Electrical and Electronics	3	0	2	4	100	-
19AUCN3401	Fuels, Engine Performance and Emission Testing Laboratory	0	0	3	1.5	100	-
19PSHG6002	Universal Human Values 2: Understanding Harmony	2	1	0	3	100	All
19AUPN6401	Mini-Project	0	0	4	2	100	-
XXXXXXXXXX	One Credit Course	0	0	2	1	100	-
TOTAL		**14**	**3**	**13**	**23.5**	**800**	

Course Code	Course Title	Duration	Credits	Marks
19AUPN6001	Internship or Skill Development*	2/4 Weeks	1	100

*Refer to clause: 4.8 in UG academic regulations 2019

Semester V

Course Code	Course Title	Hours/ Week			Credits	Marks	Common to Programmes
		L	T	P			
19MECC2501	Problem solving using PYTHON for Mechanical Sciences	2	0	2	3	100	AU,ME,MC
19AUCN1501	Design of Automotive Elements	3	1	0	4	100	-
19AUCN2501	Engineering Thermodynamics and Heat Transfer	3	0	2	4	100	-
19AUCN2502	Automotive Embedded System	3	0	2	4	100	-
19AUEXXXXX	Professional Elective – I	3	0	0	3	100	-
19AUPNXXXX	Professional Elective – II (Online)	3	0	0	3	100	-
19AUOCXXXX	Open Elective - I	3	0	0	3	100	-
19AUCN3501	Vehicle Maintenance Laboratory	0	0	3	1.5	100	-
19PSHG6501	Employability Skills 1: Teamness and Interpersonal Skills	0	0	2	1	100	All
TOTAL		**17**	**1**	**11**	**26.5**	**900**	

Semester VI

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MECC1601	Finite Element Analysis	3	1	0	4	100	AU, ME
19MECC1602	Data Science for Engineers	3	0	0	3	100	AU, ME, MC
19AUCN2601	Automotive Chassis and Transmission	3	0	2	4	100	-
19AUEXXXXX	Professional Elective - III	3	0	0	3	100	-
19AUPNXXXX	Professional Elective – IV (Online)	3	0	0	3	100	-
19AUOCXXXX	Open Elective - II	3	0	0	3	100	-
19PSHG6601	Employability Skills 2: Campus to Corporate	0	0	2	1	100	All
19AUPN6601	Innovative and Creative Project	0	0	4	2	100	-
TOTAL		**18**	**1**	**8**	**23**	**800**	

Course Code	Course Title	Duration	Credits	Marks
19AUPN6002	Internship or Skill Development*	2/4 Weeks	1	100

*Refer to clause: 4.8 in UG academic regulations 2019

Semester VII

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MECC1701	Artificial Intelligence and Machine Learning	3	0	0	3	100	AU, ME, MC
19AUCN1701	Electric, Hybrid and Fuel cell Vehicles	3	0	0	3	100	-
19AUCN1702	Vehicle Dynamics	3	1	0	4	100	-
19AUEXXXXX	Professional Elective –V	3	0	0	3	100	-
19AUENXXXX	Professional Elective – VI	3	0	0	3	100	-
19AUOCXXXX	Open Elective - III	3	0	0	3	100	All
19MECC3701	Simulation and Analysis Laboratory	0	0	3	1.5	100	-
TOTAL		**18**	**1**	**3**	**20.5**	**700**	

Semester VIII

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19AUPN6801	Project	0	0	16	8	200	-
TOTAL		**0**	**0**	**16**	**8**	**200**	

Course Code	Course Title	Duration	Credits	Marks
19AUPN6003	Internship or Skill Development*	8 /16 weeks	4	100

*Refer to clause: 4.8 in UG academic regulations 2019

Total Credits (2019 Batch only): 168.5

Total Credits (2020 Batch onwards): 167.5

Professional Electives

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
Design Stream							
19AUEN1001	Mechanics of Road Vehicles	3	0	0	3	100	-
19AUEN1002	Vehicle Safety and Comfort Systems	3	0	0	3	100	-
19AUEN1003	Hydraulic and Pneumatic Systems	3	0	0	3	100	-
19AUEN1004	Automotive Aerodynamics	3	0	0	3	100	-
19AUEN1005	Noise, Vibration and Harshness	3	0	0	3	100	-
19AUEN1006	Off Road Vehicles	3	0	0	3	100	-
19MEEC1002	Design for Manufacture, Assembly and Environment	3	0	0	3	100	ME,MC,AU
19MEEC1007	Design for Sheet Metal	3	0	0	3	100	ME,AU
Manufacturing Stream							
19AUEN1007	Computer Integrated Manufacturing	3	0	0	3	100	-
19AUEN1008	Production of Automotive Electrical Components	3	0	0	3	100	-
19AUEN1009	Jigs and Fixtures	3	0	0	3	100	-
19AUEN1010	Welding and Joining Technologies	3	0	0	3	100	-
19AUEC1001	Unconventional Machining Processes	3	0	0	3	100	MC,AU
19MEEC1008	Composite Materials	3	0	0	3	100	ME,MC,AU
19MEEC1011	Non-Destructive Testing Methods	3	0	0	3	100	ME,MC,AU
19MEEC1012	Lean Manufacturing	3	0	0	3	100	ME,AU
19MEEC1013	Logistics Engineering	3	0	0	3	100	ME,AU
19MEEC1024	New Product Development	3	0	0	3	100	ME,AU
19MEEC1025	Systems Engineering	3	0	0	3	100	ME,AU

Automobile and Service Stream							
19AUEN1011	Alternative Fuels for IC Engines	3	0	0	3	100	-
19AUEN1012	Automotive Fuels and Lubricants	3	0	0	3	100	-
19AUEN1013	Automotive Pollution Control	3	0	0	3	100	-
19AUEN1014	Automotive Air Conditioning Systems	3	0	0	3	100	-
19AUEN1015	Vehicle Body Engineering	3	0	0	3	100	-
19AUEN1016	Vehicle Maintenance	3	0	0	3	100	-
19AUEN1017	Transport Management	3	0	0	3	100	-
19AUEN1018	Reliability and Maintenance Engineering	3	0	0	3	100	-
19MEEC1014	Engineering Economics and Cost Analysis	3	0	0	3	100	ME,,AU
19MEEC1016	Quality Engineering	3	0	0	3	100	ME,MC,AU
19MEEC1017	Industrial Safety Management	3	0	0	3	100	ME,MC,AU
19AUEN1021	Electric vehicle Powertrains	3	0	0	3	100	-
19AUEN1022	Electric Vehicle Battery Technology	3	0	0	3	100	-

Telematics Stream

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19AUEN1019	Sensors for Automotive Application	3	0	0	3	100	-
19AUEN1020	Automated and Connected Vehicles	3	0	0	3	100	-
19AUEC1002	Fleet Management	3	0	0	3	100	ME,,AU
19AUEC1003	In-Vehicular Networks	3	0	0	3	100	ME,,AU
19AUEC1004	Automotive Infotronics	3	0	0	3	100	ME,,AU

Cutting Edge Technology Electives

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MEEC1019	Industrial IoT	3	0	0	3	100	ME,MC,AU
19MEEC1009	Additive manufacturing	3	0	0	3	100	ME,MC,AU
19MEEC1001	Product Life Cycle Management	3	0	0	3	100	ME,MC,AU
19MEEC1021	Java Programming For Mechanical Sciences	3	0	0	3	100	ME,,AU

19MEEC1022	Data Structures and Object Oriented Programming with C++	3	0	0	3	100	ME,,AU
19MEEC1023	Model Based Systems Engineering	3	0	0	3	100	ME,MC,AU

Open Electives

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
19AUOC1001	Automotive Fundamentals and Manufacturing	3	0	0	3	100
19AUOC1002	Project Management	3	0	0	3	100
19AUOC1003	Automotive ECU and Control	3	0	0	3	100
19AUOC1004	Electronics In Automobiles	3	0	0	3	100
19AUOC1005	Automotive Sensors	3	0	0	3	100
19AUOC1006	E-Mobility	3	0	0	3	100
19AUOC1007	Vehicle Design Engineering	3	0	0	3	100

Course Code: 19SHMG6101	Course Title: INDUCTION PROGRAM (common to all B.E/B.Tech programmes)
Course Category: Mandatory Non-Credit Course	**Course Level: Introductory**
Duration: 3 Weeks	**Max. Marks:100**

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Explain various sources available to meet the needs of self, such as personal items and learning resources
2. Explain various career opportunities, opportunity for growth of self and avenues available in the campus
3. Explain the opportunity available for professional development
4. Build universal human values and bonding amongst all the inmates of the campus and society

List of Activities:

1. History of Institution and Management: Overview on NIA Education Institutions-Growth of MCET – Examination Process-OBE Practices – Code of Conduct – Centre of Excellence
2. Lectures by Eminent People, Motivational Talk – Alumni, Employer
3. Familiarization to Dept./Branch: HoD Interaction – Senior Interaction – Department Association
4. Universal Human Value Modules: Module 1, Module 2,Module 3 and Module 4
5. Orientation on Professional Skill Courses
6. Proficiency Modules – Mathematics, English, Physics and Chemistry
7. Introduction to various Chapters, Cell, Clubs and its events
8. Creative Arts: Painting, Music and Dance
9. Physical Activity: Games and Sports, Yoga and Gardening
10. Group Visits: Visit to Local areas and Campus Tour

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain various sources available to meet the needs of self, such as personal items and learning resources through visit to local areas and campus	Understand
CO2: Explain various career opportunities and avenues available in the campus through orientation sessions	Understand
CO3: Explain the opportunity available for professional development through professional skills, curricular, co-curricular and extracurricular activities	Understand
CO4: Build universal human values and bonding amongst all the inmates of the campus and society for having a better life	Apply

Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	-	-	-	2	1	2	-	-	-	-
CO2	1	-	-	-	-	-	-	2	1	2	-	-	-	-
CO3	1	-	-	-	-	-	-	2	1	2	-	-	-	-
CO4	2	-	-	-	-	-	-	2	1	2	-	-	-	-

High-3; Medium-2; Low-1

Assessment Pattern

Component	Marks	Details
Attendance	10	Minimum 80% and 1 mark for every 2% observed
Knowledge Test	40	Objective type questions
Work plan for future	50	Career plan developed consulting mentor
Total	**100**	

Non-letter Grades

Marks Scored	Performance Level
70 & above	Good
30 – 69	Average
< 30	Fair

SEMESTER- I

Course Code: 19MABC1101	Course Title: MATRICES AND CALCULUS (Common to AU, CE, EC, EE, EI, MC, ME)		
Course Category: Basic Science		Course Level: Introductory	
L:T:P (Hours/Week) 3: 1: 0	Credits:4	Total Contact Hours:60	Max. Marks:100

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Determine the canonical form of a Quadratic form using Orthogonal transformation
2. Use different testing methods to check the convergence of infinite series.
3. Apply differential and integral calculus to determine the evolute of a curve and improper integrals
4. Apply partial derivatives to find extreme values of functions of two variables.
5. Apply multiple integrals to find area of plane curves and volume of solids.

UNIT I MATRICES 9+3

Rank of a matrix, System of linear equations, Symmetric, Skew symmetric and orthogonal matrices-(Definitions and examples only), Eigenvalues and Eigenvectors, Diagonalization of symmetric matrices through orthogonal transformation, Cayley-Hamilton Theorem, Transformation of quadratic forms to canonical forms through orthogonal transformation.

UNIT II SEQUENCES AND SERIES 9+3

Sequences- Definition and Examples, Series- Tests for convergence- Power series-series for exponential, trigonometric and logarithm functions - Comparison Test, Integral Test, Cauchy's root test, D Alembert's ratio test, Alternating series- Leibnitz's test.

UNIT III DIFFERENTIAL AND INTEGRAL CALCULUS 9+3

Curvature – Radius of curvature - Evolutes and Involutes, Evaluation of definite and improper integrals, Beta and Gamma functions and their properties.

UNIT IV MULTIVARIABLE DIFFERENTIATION 9+3

Limit, continuity, Mean value theorems and partial derivatives, Taylor's series and Maclaurin's series, Jacobian, Maxima, Minima and saddle points, Method of Lagrange's multipliers.

UNIT V MULTIVARIABLE INTEGRATION 9+3

Multiple Integration: Double integrals (Cartesian), Change of order of integration in double integrals, Change of variables (cartesian to polar and cartesian to spherical), Triple integrals (Cartesian) Applications: areas and volumes.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Determine the canonical form of a Quadratic form using Orthogonal transformation	Apply
CO2: Use different testing methods to check the convergence of infinite series.	Apply
CO3: Determine the evolute of a curve and evaluate improper integrals using beta gamma functions	Apply
CO4: Apply partial derivatives to find extreme values of functions of two variables .	Apply
CO5: Apply multiple integrals to find area of plane curves and volume of solids	Apply

Text Book(s):

T1. Erwin kreyzig, "Advanced Engineering Mathematics", 10th edition, John Wiley & Sons, 2015.

T2. Veerarajan T., "Engineering Mathematics for First Year" , Tata McGraw-Hill, New Delhi, 2011.

T3. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw-Hill, New Delhi, 1st edition,2017.

Reference Book(s):

R1. G.B.Thomas and R.L Finney, Calculus and Analytic Geometry, 9th edition, Pearson, Reprint, 2010.

R2. R2. N.P.Bali and Manish Goyel, "A Text book of Engineering Mathematics", Laxmi Publication, 9th edition, 2010.

R3. B.S.Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, 2014.

Web References:

1. https://onlinecourses.nptel.ac.in/noc16_ma05
2. https://nptel.ac.in/courses/122101003/2

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	1	1	-	1	-	1	-	-
CO2	3	2	1	1	-	-	1	1	-	1	-	1	-	-
CO3	3	2	1	1	-	-	1	1	-	1	-	1	-	-
CO4	3	2	1	1	-	-	1	1	-	1	-	1	-	-
CO5	3	2	1	1	-	-	1	1	-	1	-	1	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Tutorials / Quiz / Assignments	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19ENHG2101	Course Title: COMMUNICATION SKILLS – I (Common to all B.E/B.Tech Programmes)		
Course Category: Humanities		Course Level: Practice	
L:T:P (Hours/Week) 2: 0: 2	Credits:3	Total Contact Hours:60	Max. Marks:100

Pre-requisites:

- The student should have undergone English as his/her first or second language in school.

Course Objectives:

The course is intended to:

1. Listen and understand monologues and dialogues of a native speaker on par with B1 of CEFR level.
2. Speak in simple sentences to convey their opinion and ideas on par with B1 of CEFR level.
3. Read and infer a given text on par with B1 of CEFR level.
4. Draft basic formal written communication on par with B1 of CEFR level.

UNIT I LISTENING 15

Importance of active listening –Physical condition needed for active listening-Identifying relevant points while taking notes.- Framing questions at different linguistic contexts - Listening for specific details of concrete monologues and dialogues –Listening to organize ideas- Developing ideas –Listening to compose paragraphs – Paraphrasing the aural input.

UNIT II SPEAKING 15

Importance of note making to practice speaking - Traditional note making, developing Mind map - Collecting points from various sources - Identifying relevant ideas needed for the speech-Using mind-map to organize thought processing - Prioritizing the ideas - Types of sentences - Frequently used words (Institution, home and leisure) - Mother Tongue Influence - Expressing the thoughts in simple sentences-Tenses & Voices (Active & Passive) - Postures, gestures and eye contact - Intonation and Sentence stress - Express one's thoughts coherently.

UNIT III READING **15**

Reading strategies - Skimming -Scanning - Interpretation of visual data - Factual texts on subjects of relevance - Inferring texts –Reading to write a review –Checking the accuracy of reading while presenting the interpreted data – Reading to comprehend

UNIT IV WRITING **15**

Writing Simple and short sentences **-** Writing E-mail, Memo, Note and Message - Letter Writing - Importance of punctuations -- Identifying the main points - Organising the main ideas - Writing a draft.

Course Outcomes		**Cognitive Level**
At the end of this course, students will be able to:		
CO1:	Listen actively and paraphrase simple messages and specific details of concrete monologues and dialogues.	Apply
CO2:	Express one's views coherently in a simple manner.	Apply
CO3:	Read and comprehend factual texts on subjects of relevance.	Understand
CO4:	Write texts bearing direct meanings for different contexts maintaining an appropriate style.	Apply

Text Book(s):

T1. Whitby Norman, Business Benchmark Pre-intermediate to Intermediate Students' Book CUP Publications, 2nd Edition, 2014

T2. Wood Ian, Williams Anne, Cowper Anna, Pass Cambridge BEC Preliminary, Cengage Learning, 2nd Edition, 2015.

T3. Learners Book prepared by the Faculty members of Department of English.

Reference Book(s):

R1. BEC-Preliminary - Cambridge Handbook for Language Teachers, 2nd Edition, CUP 2000.

R2. Hewings Martin - Advanced Grammar in use - Upper-intermediate Proficiency, CUP,

Web References:

1. http://www.grammarinenglish.com
2. https://www.northshore.edu/support_centre /pdf/listen-notes.pdf
3. http://www.examenglish.com/BEC/BEC_Vantage.html

Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	1	1	2	1	3	-	1	**-**	**-**
CO2	-	-	-	-	-	1	1	2	1	3	-	1	**-**	**-**
CO3	-	-	-	-	-	1	1	2	1	3	-	1	**-**	**-**
CO4	-	-	-	-	-	1	1	2	1	3	-	1	**-**	**-**

High-3; Medium- 2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Assessment	CCET I	2,3,4	50	20
	CCET II	2,3,4	50	
	CCET III	2,3,4	50	
	Continuous Assessment - Practical	1,2	75	10
	Final Assessment - Practical	1,2	50	10
End Semester Examination	ESE	2,3,4	100	60
			Total	100

Course Code: 19PHBC2101		Course Title: PHYSICS FOR MECHANICAL SCIENCES (Common to AU, MC, ME)	
Course Category: Basic Science		Course Level: Introductory	
L:T:P(Hours/Week) 3: 0: 2	Credits:4	Total Contact Hours:75	Max. Marks:100

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Determine the equilibrium condition of particles and rigid bodies.
2. Understand the motion of a particle.
3. Study the properties of acoustics and their applications.
4. Extend the knowledge of thermal properties to their applications.
5. Understand the basic principles of thermodynamics.

UNIT I BASICS OF MECHANICS 9

Review of fundamental laws of mechanics – Physical quantities – scalars, vectors – Newton's law of mechanics, Gravitational law. Particles and rigid body, Concept of force and its effect on rigid body system of forces-Free body diagram-principle of transmissibility-equilibrium conditions- equilibrium of particles subjected to coplanar and non-coplanar force system – equilibrium of particles subjected to coplanar system of forces - Triangle law, Parallelogram law and Lami's theorem.

UNIT II KINEMATICS AND KINETICS OF PARTICLES 9

Kinematic parameters – displacement, velocity, acceleration and time. Types of motion – uniform, non-uniform motion, motion of particles in a plane – Rectinlear and curvilinear motion of particles – normal and tangential component – motion of projectile – Relative motion – Dependent motion. Kinetics of particles – Force and acceleration - D'Alembert's principle – Work energy, and impulse momentum method.

UNIT III PHYSICS OF SOUND 9

Classification of sound - decibel- Weber–Fechner law – Sabine's formula- derivation using growth and decay method – Absorption Coefficient and its determination – factors affecting acoustics of buildings and their remedies. Methods of sound absorptions: absorbing materials, paints - noise and its measurements, sound insulation and its measurements, impact of noise in machineries.

UNIT IV THERMAL PHYSICS **9**

Thermal conductivity, Specific heat capacity, Thermal shock resistance, Thermal stability, Thermal Expansion, Thermal insulation and Heat resistance.

Conduction – Co-efficient of the thermal conductivity – Cylindrical flow of heat – determination of thermal conductivity of bad conductor – Lee's disc method: theory and experiment – Conduction through compound media (series and parallel)

UNIT V ELEMENTS OF THERMODYNAMICS **9**

Concept of temperature – heat – thermodynamics – work – heat in thermodynamics – comparison of heat and work – internal energy – first law of thermodynamics – applications of the first law – second law of thermodynamics – the Carnot cycle – heat engine – heat pump – refrigerators – third law of thermodynamics.

List of Experiments **30**

1. Determination of Thermal Conductivity of the insulator – Lee's Disc.
2. Determination of velocity and compressibility of the given liquid – Ultrasonic Interferometer.
3. Determination of Young's modulus – Cantilever bending.
4. Determination of Rigidity modulus of the metallic wire – Torsional Pendulum.
5. Determination of Wavelength of laser and determination of particle size using laser.
6. Verify the triangular law of forces – Lami's theorem.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Use the laws of mechanics to determine the equilibrium condition of particles and rigid bodies.	Understand
CO2: Explain the motion of a particle.	Understand
CO3: Explain the properties of acoustics and their applications.	Understand
CO4: Explain the thermal properties of materials.	Understand
CO5: Explain the principles of thermodynamics.	Understand

Text Book(s):

T1. R. C. Hibbeller, “Engineering Mechanics: Combined Static and Dynamics”, Prentice Hall, 2010.

T2. V. Rajendran, “Engineering Physics”, Tata McGraw Hill Publishing Company limited. New Delhi, 2017.

T3. M.N.Avadhanulu and P.G.Kshirsagar, “Text Book of Engineering Physics”, S. Chand & Company Ltd., New Delhi, 2018.

Reference Book(s):

R1. Balasubramaniam "Callister's Material Science and Engineering", John Wiley and Sons Inc., Second Edition,2015.

R2. Brijlal & N. Subramaniam, “Heat & Thermodynamics”, S.Chand & Co., 2008.

R3. A.Marikani, “Engineering Physics”, PHI Learning Pvt. Ltd., 2013.

Web References:

1. http://www.physicsclassroom.com/class/thermal
2. http://nptel.ac.in/course.php?disciplineId=115

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	1	1	-	1	-	1	1	-
CO2	2	1	-	-	-	-	1	1	-	1	-	1	1	-
CO3	2	1	-	-	-	-	1	1	-	1	-	1	1	-
CO4	2	1	-	-	-	-	1	1	-	1	-	1	1	-
CO5	2	1	-	-	-	-	1	1	-	1	-	1	1	-

High-3; Medium-; Low-1

Assessment pattern

	Assessment Component	CO. No.	Marks	Total
Continuous Assessment	CCET I	1,2	50	20
	CCET II	3,4	50	
	CCET III	5	50	
	Continuous Assessment – Practical	1,2,3,4,5	75	10
	Final Assessment – Practical	1,2,3,4,5	50	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19CSSC2001	Course Title: C PROGRAMMING (Common to AU, MC, ME)		
Course Category: Engineering Science		Course Level: Introductory	
L:T:P(Hours/Week) 3: 0: 2	Credits:4	Total Contact Hours:75	Max. Marks:100

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Explain about computer organization and problem solving techniques.
2. Write programs using appropriate programming constructs.
3. Develop programs using arrays, functions & strings.
4. Implement programs using pointers, structures & unions.
5. Write programs using files & preprocessor directives.

UNIT I INTRODUCTION **7**

Generation and Classification of Computers –Basic Organization of a Computer – Software development life cycle–Problem Solving Techniques, Algorithm, Pseudo code and Flow Chart.

UNIT II C PROGRAMMING BASICS **10**

Introduction to C programming – Structure of a C program – Keywords – Identifiers-Constants – Variables – Data Types– Operators and Expressions – Formatted & Unformatted I/O functions – Decision statements – Loop control statements.

UNIT III ARRAYS, FUNCTIONS & STRINGS **10**

Arrays: Characteristics – One-dimensional and Two-dimensional arrays

Functions: Declaration & Definition of function – Built in function–User defined function –Types of functions –Call by value &reference– Strings: Formatting strings–String handling functions.

UNIT IV POINTERS, STRUCTURES & UNION **9**

Pointers: Features and Types of pointers – Arithmetic operations with pointers–Pointers and Arrays –Structures: Features– Operations on Structures–Array of structures – Unions.

UNIT V FILES & PRE-PROCESSOR DIRECTIVES **9**

Introduction to Files –Stream and File Types–File operations (Open, close, read, write) – Command line arguments–Pre-processor Directives: Macro Expansion, File Inclusion, Conditional Compilation.

List of Exercises **30**

1. Programs to process data types, operators and expression evaluation (any1).
    a. To find area of rectangle/circle/square.
    b. To find the simple interest and compound interest.
2. Programs using decision and looping statements (any2).
    a. To find the maximum number among 3 given numbers.
    b. To check whether given year is leap year or not.
    c. To display the Fibonacci series.
    d. To find the factorial of a number.
3. Programs using Arrays.
    a. To search for particular number among N numbers (1D array).
    b. To compute matrix addition (2D array).
4. Programs using Functions and strings (any2).
    a. To swap two numbers using call by reference.
    b. To find the cube of a number.
    c. To manipulate strings using string functions.
    d. To check whether the string is palindrome or not.
5. Programs using Pointer, Structure &Union
    a. To perform arithmetic operations using pointers.
    b. To display the information of N students using Structure.
    c. To display the employee details using Union.
6. Programs using Files (any 1)
    a. To read the contents of a text file
    b. To copy the contents from one file into another

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain about computer organization and problem solving techniques	Understand
CO2: Write programs for the given scenario using appropriate programming constructs	Apply
CO3: Develop programs using arrays, functions & strings for the given scenario	Apply
CO4: Implement programs for given application using pointers, structures & unions	Apply
CO5: Write programs using files & preprocessor directives for simple problems	Apply

Text Book(s):

T1. Ashok N.Kamthane, Amit.N.Kamthane, “Programming in C”, 3rd Edition, Pearson Education, 2015.

Reference Book(s):

R1. Ajay Mittal, "Programming in C-A Practical Approach", 3rd Edition, Pearson Education, 2010.

R2. YashavantP.Kanetkar, "Let Us C", 16th Edition, BPB Publications, 2018.

R3. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", 2nd Edition, Oxford University Press,2013.

Web References:

1. http://www.cprogramming.com/
2. http://www.c4learn.com/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	2	-	-	-	2	-	-	-	1	-
CO2	3	2	1	2	2	-	-	-	2	-	-	-	1	-
CO3	3	2	1	2	2	-	-	-	2	-	-	-	1	-
CO4	3	2	1	2	2	-	-	-	2	-	-	-	1	-
CO5	3	2	1	2	2	-	-	-	2	-	-	-	1	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	50	20
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Continuous Evaluation of Laboratory Experiments	1,2,3,4,5	10	20
	Final Assessment of Laboratory Experiments	1,2,3,4,5	10	
End Semester Examination	ESE	1,2,3,4	100	60
			Total	100

Course Code: 19MESC4001	Course Title: ENGINEERING DRAWING (Common to AU, CS, IT, EC, EI, MC, ME)		
Course Category: Engineering Science		Course Level: Practice	
L:T:P (Hours/Week) 1: 0: 3	Credits:2.5	Total Contact Hours:60	Max. Marks:100

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Develop skills for communication of concepts and ideas.
2. Expose them to existing national standards related to technical drawings.

UNIT I ORTHOGRAPHIC PROJECTION 12

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning. Projection of points, Projection of straight lines located in the first quadrant. Determination of true lengths and true inclinations. Visualization principles –conversion of pictorial into orthographic views.

UNIT II PROJECTION OF SOLIDS 12

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by rotating object method.

UNIT III PROJECTION OF SECTIONED SOLIDS 12

Sectioning of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by cutting planes inclined to one reference plane and perpendicular to the other – Orthographic views of sections of simple solids.

UNIT IV DEVELOPMENT OF SURFACES 12

Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones.

UNIT V ISOMETRIC PROJECTION 12

Principles of isometric projection – Isometric scale –Isometric projections of simple solids and truncated solids.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Sketch the orthographic projections of the given pictorial view of the object using first angle projection.	Apply
CO2: Sketch the projections of simple solids such as prism, pyramid, cylinder and cone using rotating object method.	Apply
CO3: Sketch the projections of simple sectioned solids with all necessary dimensions meeting the standards.	Apply
CO4: Sketch the lateral surface of simple solids using straight line and radial line development methods.	Apply
CO5: Sketch the isometric view of simple solids and truncated solids using principles of isometric projection.	Apply

Text Book(s):

T1. Cencil Jensen, Jay D.Helsel and Dennis R. Short, " Engineering Drawing and Design", Tata McGraw Hill India, New Delhi, 7th edition, 2017.

T2. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, Gujarat, 53rd edition, 2015.

T3. K. V. Natrajan, "A Text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 48th edition, 2018.

Reference Book(s):

R1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill India, New Delhi, 2nd edition,2013.

R2. John K.C., "Engineering Graphics", PHI Learning, Delhi, 1st edition, 2009.

R3. Dhananjay A. Jolhe, "Engineering Drawing with an introduction to Auto CAD "Tata McGraw India, New Delhi, 3rd edition,2008.

PUBLICATIONS OF BUREAU OF INDIAN STANDARDS

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.

5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Web References:

1. http://nptel.ac.in/courses/112103019/
2. https://en.wikipedia.org/wiki/Engineering_drawing

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	2	3	2	-	1	-	1
CO2	3	2	2	2	-	-	-	2	3	2	-	1	-	1
CO3	3	2	2	2	-	-	-	2	3	2	-	1	-	1
CO4	3	2	2	2	-	-	-	2	3	2	-	1	-	1
CO5	3	2	2	2	-	-	-	2	3	2	-	1	-	1

High-3; Medium-2; Low-1

Assessment pattern

	Assessment component	**CO. No.**	**Marks**	**Total Marks**
Continuous Assessment	Each Lab Experiment	**1,2,3,4,5**	**75**	**75**
	Cycle Test 1	**1,2,3**	**50**	**25**
	Cycle Test 2	**4,5**	**50**	
	Total			**100**

Course Code:19PSHG3001	Course Title: WELLNESS FOR STUDENTS (Common to all B.E / B.Tech Programmes) **(2019 Batch Only)**		
Course Category: Humanities		**Course Level: Introductory**	
L:T:P(Hours/Week): 0: 0 :2	**Credits:1**	**Total Contact Hours:30**	**Max. Marks:100**

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Articulate the importance of wellness for success in life.
2. Understand the dimensions of wellbeing and relevant practices
3. Guide in adopting such practices to improve wellness
4. Reflect the impact of changes sensed on personal and social effectiveness

UNIT I WELLNESS - IMPORTANCE AND DIMENSIONS

Values and aspirations – goals – SMART Goals – means for achieving goals – job Vs career – success in life – attributes of successful persons. Maslow's Hierarchy of needs motivation – Concept of wellness – impact of absence of wellness – Wellness as important component to achieve success.

Wellbeing as per WHO – Dimensions of Wellbeing: Physical, Mental, Social, Spiritual – indicators and assessment methods – Guna – causes and impact – multiple dimensions of human structure (physical, astral, causal bodies) – human-panchabootha relationship.

UNIT II PRACTICES FOR PHYSICAL WELLNESS THROUGH YOGA

Simplified Physical Exercises: Hand, Leg, Neuromuscular breathing, eye exercises, kapalabathy, makarasanam 1 & 2, body massage, 14-points acupressure – Suryanamaskar - relaxation. Simple asanas.

UNIT III PRACTICES FOR PHYSICAL WELLNESS THROUGH EXERCISES

Fitness as a subset of Wellness – health related physical fitness – skill related physical fitness. Exercises related ailment and injuries – safety and precautions – first aid.

Fitness development: Muscular strength – exercises (calisthenics): pull-up, sit-up, push-up and weight training; Explosive power – exercises: vertical jump, long jump; Cardio respiratory endurance – exercises: walking, jogging, treadmill, stair climbing, bicycling, skipping; Flexibility – exercises: stretching.

Speed, agility, balance and coordination – exercises: sprint, cone drill, ladder drill, hurdle drill, ball throw – mental agility exercises.

UNIT IV PRACTICES FOR MENTAL WELLNESS

Meditation: Mind and its functions – mind wave frequency – Agna, Thuriyam and Shanthi meditation – introspection: analysis of thoughts, moralization of desire, neutralization of anger and eradication of worries – simple mindfulness exercises.

UNIT V PRACTICES FOR SOCIAL AND SPIRITUAL WELLNESS

Kayakalpa yoga – youthfulness and life force - cultural education – greatness of guru – universal compassion – fivefold culture. Greatness of friendship and social welfare – individual, family and world peace – blessings and benefits.

Food & sleep for wellness: balanced diet – good food habits for better health (anatomic therapy) – hazards of junk food – food and the gunas.

Course Outcomes	**Cognitive/ Affective**
At the end of this course, students will be able to:	
CO1: Explain the concept of wellness and its importance to be successful in career and life	Understand
CO2: Explain the dimensions of wellness and practices that can promote wellness	Understand
CO3: Demonstrate the practices that can promote wellness	Respond
CO4: Sense and improve the wellness periodically and its impact on personal effectiveness	Value
CO5: Maintain harmony with self, family, peers, society and nature	Internalize

Text Book(s):

T1. Reading material and workbook prepared by PS team of the college

Reference Book(s):

R1. Vethathiri Maharishi Institute for Spiritual and Intuitional Education, Aliyar ,“Value education for harmonious life (Manavalakalai Yoga)”, Vethathiri Publications, Erode, I Ed. (2010).

R2. Dr.R.Nagarathna, Dr.H.R.Nagendra, “Integrated approach of yoga therapy for positive health”, Swami Vivekananda Yoga Prakashana, Bangalore, 2008 Ed.

R3. Tony Buzan, Harper Collins, The Power of Physical Intelligence (English).

Course offering:

Orientation programme (3 days)	CO1 and CO2
Student practice (weekly review classes)	CO3
Student journal writing (interim reviews)	CO4 and CO5

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	1	1	1	1	-	-	1	-	-
CO2	-	-	-	-	-	1	1	1	1	-	-	1	-	-
CO3	-	-	-	-	-	1	1	1	1	-	-	1	-	-
CO4	-	-	-	-	-	1	1	1	1	-	-	1	-	-
CO5	-	-	-	-	-	1	1	1	1	-	-	1	-	-

High-3; Medium-2; Low-1

Assessment Pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	**Yoga:** Physical Exercises, KayaKalpa Meditation Assessment of student's workbook	1,2,3,4,5	 15 15 10	75
	Sports: Physical Exercises, KayaKalpa Assessment of student's workbook		 20 15	
End Semester Examination (combined for yoga and sports)	Written test (MCQ and short answers) Physical exercises Viva-voce	1,2,3,4,5	30 50 20	Marks out of 100 is reduced to 25
			Total	100

End semester mark out of 100 is reduced to 25 marks. The student should get a total of 50 marks put together for a pass.

Scheme of wellness measurement:

#	Wellbeing Dimensions	Sub-dimensions	Wt. in total score	Measurement	Sub-dim score
1	Physical Wellbeing (40%)	BMI	16	weight & height	16
		Flexibility	12	Sit & reach test	12
		Endurance (Energy)	12	12 min Cooper run test	12
2	Mental wellbeing (30%)	Attention/ Concentration	12	Stroop test	15
		Memory	9	Digit Forward and Backward Test.	15
3	Social wellbeing (20%)	Inter-personal	10	IDEA & General Health Questionnaire	10
		Emotional wellbeing	5	IDEA questionnaire	5
		Self concept	5	IDEA questionnaire	5
4	Spiritual Wellbeing (10%)	Guna	10	Guna Questionnaire	10
		Total	100%		100

END OF SEMESTER- I

SEMESTER- II

Course Code: 19MABC1201	Course Title: ORDINARY DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLES (Common to AU, CE, EC, EE, EI, MC, ME)		
Course Category: Basic Science		Course Level: Introductory	
L:T:P (Hours/Week) 3: 1: 0	Credits:4	Total Contact Hours:60	Max. Marks:100

Pre-requisites:

- Matrices and Calculus

Course Objectives:

The course is intended to:

1. Explain the concepts of vector differentiation and integration.
2. Construct analytic functions.
3. Use the concept of complex integration to evaluate definite integrals.
4. Determine the solution of second and higher order ordinary differential equations.
5. 5. Apply Laplace transform techniques to solve ordinary differential equations.

UNIT I VECTOR CALCULUS 9+3

Gradient, Divergence, Curl, Line integrals, Surface integrals, Volume integrals, Theorems of Green, Gauss and Stokes (without proof) , Simple applications involving cubes, spheres and rectangular parallelepipeds.

UNIT II COMPLEX VARIABLES (DIFFERENTIATION) 9+3

Cauchy-Riemann equations – Analytic functions – Properties – Harmonic functions – Finding harmonic conjugate – Conformal mapping (w=z+a, w= az, w=1/z) – Mobius transformation and their properties.

UNIT III COMPLEX VARIABLES (INTEGRATION) 9+3

Contour integrals – Cauchy Integral formula (without proof) – Cauchy Integral theorem – Taylor's series – Singularities of analytic functions – Laurent's series–Residues – Cauchy Residue theorem (without proof) – Evaluation of real definite integrals around unit circle and Semi-circle (Excluding poles on the real axis).

UNIT IV ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDERS **9+3**

Second and higher order linear differential equations with constant coefficients – Second order linear differential equations with variable coefficients (Cauchy - Euler equation–Legendre's equation) – Method of variation of parameters – Solution of first order simultaneous linear ordinary differential equations.

UNIT V LAPLACE TRANSFORM **9+3**

Laplace Transform – Properties of Laplace Transform – Laplace transform of integrals – Laplace transform of periodic functions -Inverse Laplace transforms - Convolution theorem – Solution of ordinary differential equations by Laplace Transform method– Applications on engineering problems.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the concepts of vector differentiation and integration.	Apply
CO2: Use the concept of complex variables to construct analytic functions	Apply
CO3: Use the concept of complex integration to evaluate definite integrals.	Apply
CO4: Determine the solution of second and higher order ordinary differential equations	Apply
CO5: Apply Laplace transform techniques to solve ordinary differential equations	Apply

Text Book(s):

T1. Erwinkreyzig, "Advanced Engineering Mathematics", 10th edition, John Wiley & Sons, 2015.

T2. Veerarajan T., "Engineering Mathematics for First Year" , Tata McGraw-Hill, New Delhi, 2011.

T3. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw-Hill, New Delhi, 1st edition, 2017.

Reference Book(s):

R1. G.B.Thomas and R.L Finney, "Calculus and Analytic Geometry", 9th edition, Pearson, Reprint, 2010.

R2. N.P.Bali and Manish Goyel, "A Text book of Engineering Mathematics", Laxmi Publication, 9th edition, 2010.

R3. B.S.Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 43rd edition, 2014.

Web References:

1. https://onlinecourses.nptel.ac.in/noc16_ma05
2. https://nptel.ac.in/courses/122101003/2

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	-	1	-	2	1	-
CO2	3	2	1	1	-	-	-	1	-	1	-	2	1	-
CO3	3	2	1	1	-	-	-	1	-	1	-	2	1	-
CO4	3	2	1	1	-	-	-	1	-	1	-	2	1	-
CO5	3	2	1	1	-	-	-	1	-	1	-	2	1	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Tutorials / Quiz / Assignments	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19ENHG2201	Course Title: COMMUNICATION SKILLS - II (Common to all B.E / B.Tech Programmes)		
Course Category: Humanities		Course Level: Practice	
L:T:P (Hours/Week) 2: 0: 2	Credits:3	Total Contact Hours:60	Max. Marks:100

Pre-requisites:

- Communication Skills -I

Course Objectives:

The course is intended to:

1. Listen and understand monologues and dialogues of a native speaker on par with B2 of CEFR level.
2. Speak in simple sentences to convey their opinion and ideas on par with B2 of CEFR level.
3. Read and infer a given text on par with B2 of CEFR level.
4. Draft basic formal written communication on par with B2 of CEFR level.

UNIT I LISTENING 15

Importance and purpose of attentive listening - Importance and purpose of intensive listening - Body Language – active listening on complex and abstract themes- Correlating Ideas related to listening input – importance of empathetic- listening for main ideas – paraphrase – compound and complex sentences - Developing ideas - Compose paragraphs.

UNIT II SPEAKING 15

Jotting down ideas collected from listening to speak – organising the ideas – Expressing one's view coherently – Understanding grammatical elements (Noun – Pronoun Antecedent) – Expressing ideas assertively – Answering questions during presentations – Understanding the use of discourse markers – word stress and sentence stress – voice modulation and pauses – Highlighting significant points – interpretation of visual data – Using verbal cues –Preparing simple hand - outs.

UNIT III READING 15

Reading strategies - Skimming & Scanning – Inferring meaning - Barriers to reading – sub vocalisation, Eye fixation, Regression – Speed Reading Techniques - read different types texts and their context with speed – Note making – Reading a review – Paraphrasing - Reading to comprehend.

UNIT IV WRITING 15

Reported speech & Concord (Subject - verb Agreement) – structure of the report – Report

writing- Proposal –Plagiarism –references –appendices – Techniques for report writing – Registers.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Listen actively and empathetically, and paraphrase discussions and presentations on complex and abstract themes and topics.	Apply
CO2: Express one's views coherently, fluently and confidently highlighting the significant points with supporting details.	Apply
CO3: Read and comprehend with speed, different texts and their contexts reasonably at moderate speed.	Understand
CO4: Write detailed reports on variety of subjects synthesizing information gathered during listening & reading citing appropriate references.	Apply

Text Book(s):

T1. Whitby Norman, Business Benchmark Upper Intermediate Students' Book CU Publications, 2nd Edition,2014.

T2. Learners Book prepared by the Faculty members of Department of English.

Reference Book(s):

R1. Cambridge BEC Vantage - Practice Tests, Self-study Edition, Cambridge University Press, 2002.

R2. Hewings Martin - Advanced Grammar in use - Upper-intermediate Proficiency, CUP, Third Edition

Web References:

1. http://www.grammarinenglish.com
2. https://www.northshore.edu/support_centre /pdf/listen-notes.pdf
3. 3. http://www.examenglish.com/BEC/BEC_Vantage.html

Course Articulation Matrix

CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	2	1	3	-	1	-	-
CO2	-	-	-	-	-	-	-	2	1	3	-	1	-	-
CO3	-	-	-	-	-	-	-	2	1	3	-	1	-	-
CO4	-	-	-	-	-	-	-	2	1	3	-	1	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Assessment	CCET I	2,3,4	50	20
	CCET II	2,3,4	50	
	CCET III	2,3,4	50	
	Continuous Assessment - Practical	1,2	75	10
	Final Assessment - Practical	1,2	50	10
End Semester Examination	ESE	2,3,4	100	60
			Total	100

Course Code: 19CHBC2201	Course Title: CHEMISTRY FOR MECHANICAL SCIENCES (Common to AU, MC, ME)		
Course Category: Basic Science		**Course Level: Introductory**	
L:T:P (Hours/Week) 3: 0: 2	**Credits:4**	**Total Contact Hours:75**	**Max. Marks:100**

Pre-requisites

- Higher Secondary Chemistry I and II

Course Objectives

The course is intended to:

1. Calculate hardness of water based on water quality parameters.
2. Explain batteries based on their characteristics, construction, working principle and applications.
3. Explain the mechanism of corrosion and its control techniques.
4. Identify a suitable plastic for a specific engineering application.
5. Describe the characteristics of fuel and lubricants.

UNIT I WATER TECHNOLOGY **9**

Hardness (Definition, Types, Units) - problems - Estimation of Hardness (EDTA Method) - Water softening - Carbonate conditioning and Calgon conditioning - Demineralization (Ion-Exchange Method) - Water Quality Parameters - Municipal Water Treatment - Desalination - Reverse Osmosis. Effluent discharge standards for Sewage Treatment Plants (STP) - pH, TSS, BOD, COD, NH_4-N, N-total and Fecal Coliform - Construction and working of a typical Sequential Batch Reactor STP.

UNIT II ELECTROCHEMISTRY AND BATTERIES **9**

Cells – Types of cells – Galvanic and electrolytic cells – emf and its measurement – Nernst equation - Batteries – Characteristics and Classifications of batteries, Construction, working and applications - Dry cells, Alkaline battery, Lead –Acid battery, Nickel-Cadmium battery, Lithium ion battery, Hydrogen -Oxygen Fuel Cell.

UNIT III CORROSION AND ITS CONTROL **9**

Corrosion – dry and wet corrosion – mechanism of electrochemical corrosion – galvanic corrosion and concentration cell corrosion - Factors influencing corrosion. Corrosion control methods – Cathodic protection methods, Metallic coating – Galvanizing - Tinning – Chrome plating - Electroless plating of plastics (Nickel plating) - Powder coating - Electrophoretic deposition.

UNIT IV POLYMERS, PLASTICS AND COMPOSITES 9

Polymers – homo polymer and copolymer. Thermoplastics - thermosetting plastics - thermoplastic elastomers(TPE). Engineering plastics - PA, PC, PVC and Nylon 6, 6 – synthesis, properties and applications. Polymer Additives and Reinforcements-Thermal and light stabilizers, antioxidants, and flame retardants - Polymer composites – FRP and ceramic matrix composites.

UNIT V FUELS AND LUBRICANTS 9

Automotive fuels - Petrol, Diesel, CNG, Blended fuels - composition, properties and uses. Gross calorific and Net calorific value. Knocking in petrol and diesel engines – octane number and cetane number. Lubricants - importance of lubrication - Classification of lubricants **-** properties of liquid lubricants and its significance - Total Acid number and Total Base Number. Greases – common grease types and properties. Components of grease - Base Oil, Additives and Thickener. NLGI consistency number.

List of Experiments 30

1. Estimation of Hardness of water by EDTA method.
2. Determination of corrosion rate by weight loss method.
3. Estimation of Fe^{2+} by potentiometric titration
4. Determination strength of acid by pH metry.
5. Conductometric titration of strong acid against strong base.
6. Determination of molecular weight of polymer by Viscometric method.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Calculate hardness of water based on water quality parameters associated with water conditioning methods.	Understand
CO2: Explain batteries based on their characteristics, construction, working principle and applications.	Understand
CO3: Explain the mechanism of corrosion and its control techniques.	Understand
CO4: Identify a suitable plastic for a specific engineering application.	Understand
CO5: Describe the characteristics of fuel and lubricants based on their composition and applications.	Understand

Text Book(s):

T1. Jain & Jain, “Engineering Chemistry” 17th edition, Dhanpat Rai Publishing Compan Ltd, New Delhi, 2018.

T2. Wiley Engineering Chemistry, 2nd edition, Wiley India Pvt Ltd, New Delhi. 2011.

Reference Book(s):

R1. Dara S.S.,and Umare S.S., “A Text book of Engineering Chemistry” ,S.Chand& Co Ltd,New Delhi, 2014.

R2. V.R.Gowariker ,N.V.Viswanathan and JayadevSreedhar,”Polymer Science,” New Age International (P) Ltd, Chennai, 2006.

R3. RenuBapna and Renu Gupta, “Engineering Chemistry” ,Macmillan India Publisher Ltd, 2010.

R4. Jeffery G.H.,BassettJ.,Mendham J.and Denny R.C.,Vogel’s “Text Book of Quantitative Chemical Analysis” ,Oxford, ELBS ,London, 2012.

R5. Shoemaker D.P. and C.W.Garland.,” Experiments in Physical Chemistry”, Tata McGraw-Hill Pub.Co.,Ltd., London, 2009.

Web References:

1. http://nptel.ac.in/courses/122101001/downloads/lec.23.pdf
2. http://nptel.ac.in/courses/118104004/
3. http://nptel.ac.in/courses/104105039/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	1	1	-	3	3	-	3	1	-
CO2	2	1	-	-	-	1	1	-	3	3	-	3	1	-
CO3	2	1	-	-	-	1	1	-	3	3	-	3	1	-
CO4	2	1	-	-	-	1	1	-	3	3	-	3	1	-
CO5	2	1	-	-	-	1	1	-	3	3	-	3	1	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	20
	CCET II	3,4	50	
	CCET III	5	50	
	Continuous Assessment – Practical	1,2,3,4,5	75	10
	Final Assessment – Practical	1,2,3,4,5	50	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19MESC2001	Course Title: INTRODUCTION TO ENGINEERING (Common to AU, EC, EE, EI, MC, ME)		
Course Category: Engineering Science		Course Level: Introductory	
L:T:P (Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours:60	Max. Marks:100

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Explain the career opportunities in engineering.
2. Explain how to acquire engineering competencies.
3. Explain how to remain, relevant and versatile as an engineer.
4. Observe engineering products and processes.
5. Take ownership for learning and development.
6. Identify and rectify unsafe conditions and acts.

UNIT I CAREER OPPORTUNITIES IN ENGINEERING 5

Technicians, engineers and scientists, history of engineering. 17 sustainable development goals set by UNO, concept of small e to big E. career choices for an engineer, types of industries, academia and research as career choices, entrepreneurship as a career choice, various departments in engineering industries, roles available in engineering industries. innate skills, learnt skills (competencies), graduate attributes, roles of engineers and the corresponding competencies, career opportunities in engineering in terms of roles & competencies

UNIT II DEVELOPING SPECIFIC SKILLS AND COMPETENCIES 5

OBE Model, PEOs and POs, technical POs, professional POs, mapping with Graduate attributes, Classification of courses, resources available in the campus and e-resources, resources and facilities available to acquire specific competencies, on-campus and off-campus activities, the methods by which students can systematically involve in activities, significance of professional skill courses, plan for utilizing the resources and facilities to develop specific competencies.

UNIT III STAYING RELEVANT THROUGH CONTINUOUS IMPROVEMENT/ENVIRONMENTAL VERSATILITY 7

Rate of change, technology life cycle (TLC), features of a dynamic and complex environment in which students operate or will operate, impact of globalization & technical advancements,

importance of remaining, relevant and versatile in a dynamic and complex environment with the help of technology life cycle, activities/process to remain relevant and versatile, environmental scanning, Life- long learning.

UNIT IV OBSERVE EVERY PRODUCT AND PROCESSES WITH AN ENGINEERING PERSPECTIVE AND INQUISITIVENESS **4**

Product -Need, purpose - primary and secondary function, various stages of manufacturing and its processes. Product - assembly of several simple engineering devices/systems. Product-Parts, principles and laws (mechanical, electrical and electronics), functional relationship between the parts, role of programming in engineering products. Significance of materials and their advancements in improvements in product.

UNIT V LEARNING AND DEVELOPMENT LEVERAGINGTHE RESOURCES AND INFRASTRUCTURE **6**

Process Of Learning, Situated Learning with Examples, Own Learning (Not Copying), Differences between Real Life and Simulated Environment, the Sprit Of Experimentation, Various Learning Enablers, Measure the performance against the plan.

UNIT VI UNSAFE CONDITIONS AND ACTS AND FOLLOWS ENVIRONMENT FRIENDLY PRACTICES **3**

Safety-definition, importance of personal safety. Statistics of road accidents. Unsafe condition and unsafe act- definition, cause and effects, identification of the unsafe conditions and acts in home/hostel, labs, class rooms, public places. Importance of environment friendly practices.

LISTOF EXERCISES: **30**

1. Career opportunities with roles and responsibilities.
2. Observe every product and processes with an engineering perspective and inquisitiveness.
    a. Primary and Secondary functions of products and their equivalents.
    b. Primary and Secondary functions of parts of the products, their manufacturing processes and materials.
    c. Structural and functional relations of the product.
3. Safe and unsafe acts and conditions in day-to-day life and professional practices.
4. Skills for Hobby project (At least TWO)
    a. Soldering and de-soldering practices.
    b. Circuit and component testing using multi-meter &CRO.
    c. Battery operated circuit connections and testing.
    d. Simple switching circuits using relays and transistors.
    e. Adhesives used in part assembly.

Course Outcomes At the end of this course, students will be able to:	Cognitive Level
CO1: Explain the career opportunities in engineering in terms of roles & competencies.	Understand
CO2: Explain how a student can acquire the competencies.	Understand
CO3: Explain how to remain, relevant and versatile in a dynamic and complex environment.	Understand
CO4: Observe every product and processes with an engineering perspective and inquisitiveness.	Apply
CO5: Choose to take ownership for his/her learning and development leveraging the resources and infrastructure.	Understand
CO6: Identify and rectify unsafe conditions and acts and follow environment friendly practices.	Understand

Text Book(s):

T1. Worksheets and Handouts prepared by MCET team.

Reference Book(s):

R1. L. A Bloomfield, “How things work: The physics of everyday life”, Wileys 5th Edition, 2013

R2. C. Mason, “How things work,” Usborne Publishing Ltd 2009.

R3. D.K. Publishing, “How things work encyclopedia”, 2009.

R4. R. J. Segalat, “How things work”, Edito-Service Vol.I-IV, 1990.

Web References:

1. https://en.wikibooks.org/General_Engineering_Introduction/Engineering_Science
2. https://science.howstuffworks.com/engineering-channel.html

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	2	2	1	3	1	-	1	1	-
CO2	2	1	-	-	-	2	2	1	3	1	-	1	1	-
CO3	2	1	-	-	-	2	2	1	3	1	-	1	1	-
CO4	3	2	1	1	-	2	2	1	3	1	-	1	1	-
CO5	2	1	-	-	-	2	2	1	3	1	-	1	1	-
CO6	2	1	-	-	-	2	2	1	3	1	-	1	1	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO. No.	Marks	Total
Continuous Assessment	CCET I	1,2	50	20
	CCET II	3,4	50	
	CCET III	5	50	
	Continuous Assessment – Practical	1,2,3,4,5,6	75	10
	Final Assessment – Practical	2,4	50	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19MESC2201	Course Title: ENGINEERING MATERIALS (Common to AU,MC, ME)		
Course Category: Engineering Science		Course Level: Introductory	
L:T:P(Hours/Week) 2: 0: 2	Credits:3	Total Contact Hours:60	Max. Marks:100

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Calculate the crystal parameters.
2. Analyze the phase diagram.
3. Choose an appropriate ferrous and nonferrous alloy.
4. Select an appropriate powder metallurgy technique.
5. Select an appropriate heat treatment process.

UNIT I CRYSTAL PHYSICS **9**

Introduction: Crystalline and Non crystalline materials. Single crystal , Polycrystalline materials Anisotrophic crystal parameters: Atomic radius, Number of atoms per unit cell, Coordination number, atomic packing factor for SC , BCC , FCC and HCP- Crystal planes: Miller indices, Braggs law . Interplanar distance- Polymorphism and allotrophy. Crystal imperfections: Point , line , surface and volume , grain boundary and its role in mechanical properties.

UNIT II CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS **9**

Constitution of alloys- Solid solutions- Substitutional and Interstitial. Phase diagrams- Interpretation of Phase diagram, Lever rule, Gibbs phase rule. cooling curve for pure metal, binary solid solution and binary eutectic system. Iron – Iron Carbide equilibrium diagram. Micro constituents in Fe3C diagram (Austenite, Ferrite, Cementite, Pearlite, Martensite, Bainite), Pearlite transformation.

UNIT III FERROUS AND NONFERROUS ALLOY **9**

Ferrous alloy: Effect of alloying elements on properties of steel (Mn, Si, Cr, Mg, V and W). Properties and applications of stainless steel and Tool steel. Cast Iron-White, Malleable, Grey and Spheroidal Cast Iron-Properties and Applications. Non Ferrous alloy: Aluminium and its alloys, Copper and its alloys, Magnesium and its alloys, Titanium and its alloys, Nickel and its alloys- Composition, Properties and Applications. Industrial standards for alloys and other materials - alloying elements and inclusion of ceramics materials.

9

UNIT IV POWDER METALLURGY

Need of powder metallurgy products-Advantages and limitation of P/M-Stages in P/M-Need for additives in P/M-secondary process of P/M products-mechanical-physical-chemical methods of powder production-compaction and sintering techniques of P/M-particle size analysis

UNIT V HEAT TREATMENT **9**

Heat treatment process-purpose heat treatment – Process parameters. Bulk treatment: Annealing, Normalizing, Tempering, Quenching (Process parameter, application). Isothermal transformation Diagram (TTT Diagram). Cooling curves superimposed on TTT diagram. CCR. Harden ability- Definition. Method to determine Harden ability- Jominy end quench test.

List of Experiments **15**

1. Determine the hardness of the given specimen.
2. Determine the toughness of the given specimen.
3. Draw the microstructure of cast iron, steel and aluminum using Metallurgical microscope.
4. Prepare a specimen using mounting press for metallographic examination.
5. Microstructure characterization of the polished specimen.

Course Outcomes **At the end of this course, students will be able to:**	**Cognitive Level**
CO1: Explain the crystal parameters for different crystal structure and its influences on mechanical properties of bulk materials.	Understand
CO2: Analyze the phase diagram of an alloy by Gibbs phase rule and infer its property for a given composition.	Understand
CO3: Choose an appropriate Ferrous and Non-ferrous alloy for a suitable application.	Understand
CO4: Select an appropriate powder metallurgy technique, based on the functional requirement of the product.	Understand
CO5: Select an appropriate heat treatment process for the given ferrous alloy such as steel, cast iron for a suitable application.	Understand

Text Book(s):

T1. William D Callister “Material Science and Engineering”, John Wiley and Sons, 2014.

T2. Sidney H Avner “Introduction to Physical Metallurgy”, Tata McGRAW-Hill, 2017.

T3. Anup Goel, SS Sabharwal, “Engineering Materials and Metallurgy”, Technical Publication, 2014.

Reference Book(s):

R1. Raghavan.V “Materials Science and Engineering”, Prentice Hall of India Pvt., Ltd., 2015.

R2. Dieter G. E., “Mechanical Metallurgy”, McGraw Hill Book Company, 2013.

R3. Kenneth G. Budinski. “Engineering Materials”, Prentice Hall of India, New Delhi 2010.

R4. Y. Lakhtin, “Engineering Physical Metallurgy”, CBS Publisher, New Delhi, 2012.

Web References:

1. http://nptel.ac.in/courses/113106032/
2. http://www.nptel.ac.in/courses/112108150/
3. https://en.wikipedia.org/wiki/Materials_science

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	3	1	-	2	-	1
CO2	2	1	-	-	-	-	-	1	3	1	-	2	-	1
CO3	2	1	-	-	-	-	-	1	3	1	-	2	-	1
CO4	2	1	-	-	-	-	-	1	3	1	-	2	-	1
CO5	2	1	-	-	-	-	-	1	3	1	-	2	-	1

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO. No.	Marks	Total
Continuous Assessment	CCET I	1,2	50	20
	CCET II	3,4	50	
	CCET III	5	50	
	Continuous Assessment – Practical	1,2,3,4,5	75	10
	Final Assessment – Practical	1,2,3,4,5	50	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19MECC3201	Course Title :ENGINEERING PRACTICES LABORATORY (Common to AU, MC, ME)		
Course Category: Professional Core		Course Level: Practice	
L:T:P (Hours/Week) 0: 0: 3	Credits:1.5	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Draw the basic symbols of electrical and electronic components and identify the elements.
2. Execute soldering practice for electrical and electronic circuits.
3. Demonstrate the basic carpentry, fitting, plumbing, sheet metal and welding operations.

List of Experiments:

[A] Electrical & Electronics:

1) Symbols of electrical and electronic components and study of electrical drawing.
2) Insulation Testing using Megger.
3) Soldering practice of simple circuit and testing.
4) Fluorescent tube, staircase and house wiring.
5) Verification of Kirchhoff's current and voltage law.

[B] Civil & Mechanical:

1) Make a wooden Tee joint to the required dimension.
2) Make a "V" filling to the required dimension using fitting tools.
3) Make a tray in sheet metal to the required dimension.
4) Assemble the pipeline connections with different joining components for the given layout.
5) Weld a butt joint using welding process to the required dimension.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Draw the basic symbols of electrical and electronic components from a given circuit.	Apply
CO2: Connect the electrical and electronic components and other house holding items as per the given circuit.	Apply
CO3: Verify the Kirchhoff's laws as per the given circuit.	Apply
CO4: Make a wooden 'T' joint, metal 'V' joint, sheet metal 'TRAY', pipeline with various joining components and a permanent joint using various workshop tools as per the given dimensions.	Apply

Reference(s):

R1. Jeyachandran.K, Natarajan.S & Balasubramanian.S, "A Primer on Engineering Practices Laboratory", Anuradha Publications, TamilNadu (India), 2016.

R2. 19EPL21 - Engineering practices laboratory Manual.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	-	-	2	3	2	-	-	-	1
CO2	3	2	2	2	1	-	-	2	3	2	-	-	-	1
CO3	3	2	2	2	1	-	-	2	3	2	-	-	-	1
CO4	3	2	2	2	1	-	-	2	3	2	-	-	-	1

High-3; Medium-2; Low-1

Assessment pattern

	Assessment component	CO. No.	Marks	Total Marks
Continuous Assessment	Each Lab Experiment	1,2,3	75	75
	Cycle Test 1	Batch I: 1, 2 Batch II: 3	50	25
	Cycle Test 2	Batch I: 3 Batch II: 1, 2	50	
			Total	100

Course Code: 19PSHG3002	Course Title: PERSONAL EFFECTIVENESS (Common to all B.E/ B.Tech Programmes) (2019 Batch Only)		
Course Category: Humanities		Course Level: Introductory	
L:T:P (Hours/Week) 0: 0: 2	Credits:1	Total Contact Hours:30	Max.Marks:100

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Set SMART goals for academic, career and life.
2. Identify strength, weaknesses and opportunities.
3. Plan for achieving the goals.
4. Apply time management techniques.
5. Create time and pursue activities of self-interest.

UNIT I THE IMPORTANCE OF ENVISIONING

Importance of positive self-perception – Principle of dual creation (Everything gets created twice – Envisioning) - Understanding Vision and mission statements - Writing personal mission statements – 'Focus' as a way of life of most successful people – Importance of goal setting – Importance of planning and working to time.

UNIT II FUNDAMENTAL PRINCIPLES OF GOAL SETTING AND WORKING TO TIME

Clarifying personal values, interests and orientations – Awareness of opportunities ahead – Personal SWOT analysis - Principles driving goal setting: Principle of response and stimuli, Circle of influence and circle of concern, What you see depends on the role you assume.

UNIT III GOAL SETTING AND ACTION ORIENTATION

Potential obstacles to setting and reaching your goals - Five steps to goals setting: SMART goals, Inclusive goals, Positive stretch, Pain vs gain, Gun-point commitment – Importance of action orientation - Converting goals to actionable tasks – Establishing road map – Using Gantt chart for planning and progress.

UNIT IV TIME MANAGEMENT - TOOLS AND TECHNIQUES

Pareto 80-20 principle of prioritization – Time quadrants as a way to prioritize weekly tasks - The glass jar principle - Handling time wasters – Assertiveness, the art of saying 'NO' – Managing procrastination.

UNIT V PUTTING INTO PRACTICE

Practicals: Using the weekly journal – Executing and achieving short term goals – Periodic reviews.

Course Outcomes	**Cognitive/ Affective**
At the end of this course, students will be able to:	
CO1:Identify the strengths, weaknesses and opportunities	Apply
CO2:Set well-articulated goals for academics, career, and personal aspirations	Apply
CO3:Establish the road map to realize the goals	Apply
CO4:Apply time management techniques to complete planned tasks on time	Apply
CO5:Create time and pursue activities of self-interest that add value	Value

Text book(s):

T1. Reading material, workbook and journal prepared by PS team of the college.

Reference Book(s):

R1. Stephen R Covey, “First things first”, Simon & Schuster U.K, Aug 1997.

R2. Sean Covey, “Seven habits of highly effective teenagers”, Simon & Schuster U.K, 2004.

Course offering:

Orientation programme (2 days)	CO1 and CO2
Student practice (weekly review classes)	CO3
Student journal writing (interim reviews)	CO4 and CO5

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	1	1	-	1	1	1	1	-	-
CO2	-	-	-	-	-	1	1	-	1	1	1	1	-	-
CO3	-	-	-	-	-	1	1	-	1	1	1	1	-	-
CO4	-	-	-	-	-	1	1	-	1	1	1	1	-	-
CO5	-	-	-	-	-	1	1	-	1	1	1	1	-	-

High-3; Medium-2;Low-1

Assessment Pattern

	Assessment Component	CO. No.	Marks	Total
Continuous Assessment	**Yoga:** Physical Exercises, KayaKalpa Meditation Assessment of student's workbook	1,2,3,4,5	15 15 10	75
	Sports: Physical Exercises, KayaKalpa Assessment of student's workbook		20 15	
End Semester Examination (combined for yoga and sports)	Written test (MCQ and short answers) Physical exercises Viva-voce	1,2,3,4,5	30 50 20	Marks out of 100 is reduced to 25
			Total	100

Course Code: 19PSHG6001	Course Title: WELLNESS FOR STUDENTS (Common to all B.E/ B.Tech Programmes) (2020 Batch Only)		
Course Category: Humanities		Course Level: Introductory	
L:T:P(Hours/Week) 0: 0: 2	Credits:1	Total Contact Hours:30	Max. Marks:100

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Set SMART goals for academic, career and life
2. Apply time management techniques
3. Articulate the importance of wellness for success in life.
4. Understand the dimensions of wellbeing and relevant practices

UNIT I GOAL SETTING

Understanding Vision and mission statements - Writing personal mission statements – 'Focus' as a way of life of most successful people. Clarifying personal values, interests and orientations – Awareness of opportunities ahead – Personal SWOT analysis - Principles driving goal setting: Principle of response and stimuli, Circle of influence and circle of concern, What you see depends on the role you assume. Potential obstacles to setting and reaching your goals - Five steps to goals setting: SMART goals, Inclusive goals, Positive stretch, Pain vs gain, Gun-point commitment.

UNIT II TIME MANAGEMENT - TOOLS AND TECHNIQUES

Importance of planning and working to time. Pareto 80-20 principle of prioritization – Time quadrants as a way to prioritize weekly tasks – The glass jar principle - Handling time wasters – Assertiveness, the art of saying 'NO' – Managing procrastination

UNIT III PRACTICES FOR PHYSICAL WELLNESS

Concept of wellness – impact of absence of wellness - Wellness as important component to achieve success. Wellbeing as per WHO - Dimensions of Wellbeing: Physical, Mental, Social, Spiritual – indicators and assessment methods

Simplified Physical Exercises. Fitness as a subset of Wellness – health related physical fitness - skill related physical fitness. Joint movements, Warm up exercises, simple asanas, WCSC simplified exercises.

UNIT IV PRACTICES FOR MENTAL WELLNESS

Meditation: Mind and its functions - mind wave frequency – Simple basic meditation – WCSC meditation and introspection tables. Greatness of friendship and social welfare – individual, family and world peace – blessings and benefits.

Food & sleep for wellness: balanced diet - good food habits for better health (anatomic therapy) – hazards of junk food - food and the gunas

UNIT V PUTTING INTO PRACTICE

Practicals: Using the weekly journal – Executing and achieving short term goals – Periodic reviews.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Set well-articulated goals for academics, career, and personal aspirations	Understand
CO2: Apply time management techniques to complete planned tasks on time	Understand
CO3: Explain the concept of wellness and its importance to be successful in career and life	Understand
CO4: Explain the dimensions of wellness and practices that can promote wellness	Understand
CO5: Demonstrate the practices that can promote wellness	Understand

Text book(s):

Reading material, workbook and journal prepared by PS team of the college.

Reference Book(s):

R1. Stephen R Covey, “First things first”, Simon & Schuster UK, Aug 1997.

R2. Sean Covey, “Seven habits of highly effective teenagers”, Simon & Schuster UK, 2004.

R3. Vethathiri Maharishi Institute for Spiritual and Intuitional Education, Aliyar, “Value education for harmonious life (Manavalakalai Yoga)”, Vethathiri Publications, Erode, I Ed. (2010).

Course offering: (Annual Pattern)

CO1, CO2 and CO5	Can be conducted in Odd semester
CO3, CO4 and CO5	Can be conducted in Even semester
Student journal writing (interim reviews)	CO1 to CO5

Evaluation:

Continuous assessment: 75 marks

Personal Effectiveness = 35 marks (Odd Sem)

Yoga and physical Exercise (Even Sem)

Physical Exercises = 20 marks

Meditation = 10 marks

Assessment of student's workbook = 10 marks

End Semester Examination (combined for yoga and sports):

Written test (MCQ and short answers) = 30 marks

Physical exercises = 50 marks

Viva-voce = 20 marks

Total = 100 marks

End semester mark out of 100 is reduced to 25 marks.

The student should get a total of 50 marks put together for a pass.

Course Code: 19CHMG6201	Course Title: ENVIRONMENTAL SCIENCES (Common to all B.E/B.Tech Programmes)	
Course Category: Mandatory Non-Credit Course	Course Level: Introductory	
L:T:P(Hours/Week): 1: 0: 0	Total Contact Hours:15	Max. Marks:100

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Create awareness for conservation and equitable use of natural resources.
2. Explain the measures of prevention of pollution and disaster management.
3. State the importance of environmental legislation in India.
4. Expose the general environmental issues relevant to human health.
5. Explain the innovative measures for day to day environmental issues.

UNIT I NATURAL RESOURCES 2

Role of individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles.

UNIT II ENVIRONMENTAL POLLUTION AND DISASTER MANAGEMENT 2

Role of an individual in prevention of pollution; Disaster management: floods, earthquake, cyclone and landslides.

UNIT III ENVIRONMENTAL ETHICS AND LEGISLATIONS 2

Environmental ethics : Environment Protection Act; Air Act; Water Act ; Wildlife Protection Act; Forest Conservation Act; Issues involved in enforcement of environmental legislation.

UNIT IV ENVIRONMENTAL ISSUES AND PUBLIC AWARNESS 2

Public awareness - Environment and human health

UNIT V ENVIRONMENTAL ACTIVITIES 7

(a) Awareness Activities*:*

i) Small group meetings about water management, promotion of recycle, reuse, generation of less waste, avoiding electricity waste

ii) Slogan making event

iii) Poster making event

(b) Actual Activities:

i) Plantation

ii) Cleanliness drive

iii) Drive for segregation of waste

iv) To know about the different varieties of plants

v) Shutting down the fans and ACs of the campus for an hour or so

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Create awareness for conservation and equitable use of natural resources.	Understand
CO2: Explain the measures of prevention of pollution and disaster management.	Understand
CO3: State the importance of environmental legislation in India.	Understand
CO4: Expose the general environmental issues relevant to human health.	Understand
CO5: Explain the innovative measures for day to day environmental issues.	Understand

Text Book(s):

T1. Benny Joseph, "Environmental Studies", Tata McGraw Hill, New Delhi, 2006.

T2. Mackenzie Davis and Susan Masten, "Principles of environmental engineering and science", Mc-Graw Hill, 3rd Edition, 2014.

Reference Book(s):

R1. Trivedi R.K. "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol.I and II, Enviro Media.

R2. Cunningham, W.P.Cooper,T.H. Gorhani, "Environmental Encyclopedia", Jaico Publishing House, Mumbai,2001.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	3	3	1	-	1	-	1	-	2
CO2	2	1	-	-	-	3	3	1	-	1	-	1	-	2
CO3	2	1	-	-	-	3	3	1	-	1	-	1	-	2
CO4	2	1	-	-	-	3	3	1	-	1	-	1	-	2
CO5	2	1	-	-	-	3	3	1	-	1	-	1	-	2

High-3; Medium-2; Low-1

Assessment Pattern

- Attendance : 10 Marks
- Knowledge Test : 40 Marks
- Activity(ies) : 50 Marks

Total Marks : 100

RUBRICS FOR ASSESSMENT

Component	Marks	Details
Attendance	10	Minimum 80%, 1 mark for each 5% observed
Knowledge Test	40	40 objective type questions from Induction Program
Activity(ies)	50	Rubrics based assessment

Non-letter Grades

Marks Scored	Performance Level
70 & above	Good
30 – 69	Average
< 30	Fair

END OF SEMESTER- II

SEMESTER- III

Course Code: 19MABC1301	Course Title: NUMERICAL METHODS (Common to AU,ME)		
Course Category: Basic Science		Course Level: Introductory	
L:T:P (Hours/Week) 3: 1: 0	Credits:4	Total Contact Hours:60	Max. Marks:100

Prerequisites

- Matrices and Calculus

Course Objectives

The course is intended to:

1. Solve the system of linear equations and calculate dominant eigenvalue.
2. Solvethenon-linearequationsandapplytheprincipleofleastsquarestofita curve to the given data.
3. Interpolate the given data and calculate the numerical derivatives and integration.
4. Solve the initial value problems using numerical techniques.
5. Solve the boundary value problems using numerical techniques.

UNIT I SOLUTION OF SYSTEM OF LINEAR EQUATIONS AND EIGENVALUE 9+3

Solution of system of linear equations, Gauss elimination method, Crout's method, iterative methods of Gauss Jacobi and Gauss Seidal method, Eigen values of matrix by power method.

UNIT II SOLUTION OF NON-LINEAR EQUATIONS AND CURVE FITTING 9+3

Solution of non-linear equations: Method of false position, Newton Raphson method, order of convergence. Curve fitting: Method of least square fit a straight line, fitting a curve.

UNIT III INTERPOLATION, POLYNOMIAL APPROXIMATION AND NUMERICAL INTEGRATION 9+3

Interpolation with equal intervals, Newton's forward and backward difference formulae, interpolation with unequal interval, Lagrange's interpolation, numerical differentiation, numerical integration, trapezoidal rule, Simpson's rule, double integration using trapezoidal rule.

UNIT IV INITIAL VALUE PROBLEM FOR ORDINARY DIFFERENTIAL EQUATIONS 9+3

Single step methods,Taylor's series method, Euler's method, Modified Euler's method, Fourth order Runge-Kutta method for solving first order equations, Multi step methods, Milne's and Adams method.

UNITV BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 9+3

Solution of two dimensional Laplace's and Poisson's equations, one dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods, one dimensional wave equation by explicit method.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Determine the solution of system of linear equations and also calculate the dominant Eigen value of a matrix.	Apply
CO2: Determine the solution of non-linear equations using numerical techniques.	Apply
CO3: Interpolate the given data and obtain the derivatives and integral at the required points.	Apply
CO4: Determine the solution of initial value problems using numerical techniques.	Apply
CO5: Determine the solution of boundary value problems using numerical techniques.	Apply

Text Book(s):

T1. Erwin Kreyzig, "Advanced Engineering Mathematics", 10th edition, John Wiley & Sons, 2015.

T2. Veerarajan T., "Engineering Mathematics for First Year", Tata McGraw-Hill, New Delhi, 2011.

T3. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw-Hill, New Delhi, 1st edition,2017.

Reference Book(s):

R1. Thomas G.B. and Finney R.L., "Calculus and Analytic Geometry", 9th edition, Pearson,Reprint, 2010.

R2. Bali N.P. and Manish Goyel, "A Text book of Engineering Mathematics", Laxmi Publication, 9th edition, 2010.

R3. B.S.Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, 2014.

Web References:

1. https://onlinecourses.nptel.ac.in/noc16_ma05
2. https://nptel.ac.in/courses/122101003/2

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	1	1	-	1	-	1	1	-
CO2	3	2	1	1	-	-	1	1	-	1	-	1	1	-
CO3	3	2	1	1	-	-	1	1	-	1	-	1	1	-
CO4	3	2	1	1	-	-	1	1	-	1	-	1	1	-
CO5	3	2	1	1	-	-	1	1	-	1	-	1	1	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Assessment	**CCET 1**	**1,2**	**50**	**30**
	CCET 2	**3,4**	**50**	
	Retest	**1,2,3,4**	**50**	
	CCET 3	**5**	**50**	
	Tutorial	**1,2,3,4,5**	**30**	**10**
End Semester Examination	**ESE**	**1,2,3,4,5**	**100**	**60**
				100

Course Code: 19MESC1301	Course Title: ENGINEERING MECHANICS (Common to AU, MC, ME)		
Course Category: Engineering Science		Course Level: Practice	
L:T:P(Hours/Week) 3: 1: 0	Credits: 4	Total Contact Hours:60	Max Marks:100

Prerequisites:

- Physics for Mechanical Sciences

Course Objectives:

The course is intended to:

1. Draw the free body diagram.
2. Determine the magnitude of unknown forces in a given system.
3. Determine the geometric properties of bodies.
4. Determine the degrees of freedom.
5. Determine the kinetic parameters of rigid bodies

UNIT I FREE BODY DIAGRAM 9+3

Fundamental laws of mechanics (Review) – Free body diagram – Statics - Particles and Rigid body (Beams, Frames and Machines) – Types of forces – Action (Point, UDL, UVL and couples) – Reaction (Supports, Friction) – Dynamics – Particles and Rigid body – Linear and Circular planar motions.

UNIT II FORCE ANALYSIS OF BEAMS, FRAMES AND MACHINES 9+3

Governing equations of equilibrium – Equivalent force and couple moment – Types of beams – Determining reactions in statically determinate beams – Bending moment diagram and Shear force diagram of cantilever, simply supported beam and over hanging beams – Analysis of frames – Machines – Laws of dry friction – ladder, belt, wedge and screw frictions.

UNIT III GEOMETRIC PROPERTIES OF LAMINA AND BODIES 9+3

Properties of surfaces – centroid of composite planes such as L, I and T – Moment of Inertia (MI) – Parallel and perpendicular axis theorem – MI of composite sections involving simple geometries such as rectangle, circle and triangle – Centre of gravity and mass moment of inertia of composite solids involving block, cylinder, cone and sphere.

UNIT IV INTRODUCTION TO MECHANISMS 9+3

Mechanism and structure – links – pairs – chains – four bar and slider crank mechanisms – degrees of freedom of linkages – Gruebler's criterion – Grashof's condition of rotatability - transmission angle and mechanical advantage – special lower pair mechanisms: Peucelliar straight line mechanism, Ackermann steering mechanism, pantograph, Geneva mechanism.

UNIT V KINETICS OF RIGID BODY 9+3

Dynamic equilibrium of rigid bodies – Planar kinetics of rigid body – Force and Acceleration, Work and energy, Impulse and momentum

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Develop the free body diagram of particles and rigid bodies such as beams, frames and machines under static and dynamic conditions.	Apply
CO2: Calculate centroids, center of gravity and moment of inertia of simple Shapes.	Apply
CO3: Determine various forces on rigid bodies such as beams, frames and machines under static conditions.	Apply
CO4: Determine the degrees of freedom of given mechanism.	Apply
CO5: Calculate the kinetic parameters of rigid bodies for dynamic equilibrium.	Apply

Text Book(s):

T1. R C Hibbeler, “Engineering mechanics – Statics and Dynamics”, 14th Edition, Pearson, New Delhi, 2017.

T2. F.P. Beer and Jr. E.R. Johnston, “Vector Mechanics for Engineers – Statics and Dynamics”, 10th Edition Tata McGraw Hill publishing company, New Delhi, 2017.

T3. S.S. Rattan, “Theory of Machines”, McGraw Hill Education, 4thEdition.2017.

Reference Book(s):

R1. James L. Meriam and L.GlennKraige, “Engineering mechanics (Statics and Dynamics)” 8th edition. John Wiley & Sons, 2016.

R2. R.S. Khurmi, J.K Gupta, “Theory of Machines” , S.Chand, 14th Edition. 2005.

R3. Irving H. Shames, “Engineering mechanics – Statics and Dynamics”, 14th Edition, Pearson, New Delhi, 2014.

Web References:

1. http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html
2. https://nptel.ac.in/courses/122104015/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	-	1	-	1	1	2
CO2	3	2	1	1	-	-	-	1	-	1	-	1	1	2
CO3	3	2	1	1	-	-	-	1	-	1	-	1	1	2
CO4	3	2	1	1	-	-	-	1	-	1	-	1	1	2
CO5	3	2	1	1	-	-	-	1	-	1	-	1	1	2

High-3; Medium-2; Low-1

Assessment pattern:

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Tutorial	-	30	10
	Quiz	1,2,3,4,5		
	Assignment	1,2,3,4,5		
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19MECC2301	Course Title: FLUID MECHANICS AND HYDRAULIC MACHINERY (Common to AU,MC, ME)		
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week) 3: 0: 2	Credits:4	Total Contact Hours:75	Max Marks:100

Prerequisites

- Physics for Mechanical Sciences

Course Objectives

The course is intended to:

1. Apply mathematical knowledge to predict the properties and characteristics of a fluid.
2. Analyze and calculate major and minor losses associated with pipe flow.
3. Mathematically predict the nature of physical quantities.
4. Select a suitable hydraulic pump for the customer provided site conditions.
5. Select a suitable hydraulic turbine for the given rated parameters.

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS 9

Fluid: definition, classification of fluids, units and dimensions. Properties of fluids: density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, capillarity and surface tension. Flow characteristics, Continuity equation and Bernoulli's equation for 1-D flow, Hydraulic and Energy Gradient. Application of Bernoulli's equation to flow through pipes, Venturimeters, Orificemeters and Pitot tube.

UNIT II FLOW THROUGH CIRCULAR CONDUITS 9

Laminar and Turbulent flow though circular conduits, boundary layer concepts, boundary layer thickness. Darcy-Weisbach equation, Friction factor and Moody diagram, Minor and Major losses, Flow though series pipes, parallel pipes and syphon.

UNIT III DIMENSIONAL ANALYSIS 9

Need for dimensional analysis, methods of dimensional analysis, Buckingham's π theorem. Similitude, types of similitude, Dimensionless parameters, application of dimensionless parameters, Model analysis.

UNIT IV HYDRAULIC PUMPS 9

Centrifugal pump: working principle, velocity triangles, Euler pump equation, various efficiencies and performance curves. Reciprocating pump: classification, working principle, indicator diagram, work saved by air vessels - performance curves.

UNIT V HYDRAULIC TURBINES 9

Classification of turbines, heads and efficiencies, inlet and exit velocity triangles, Euler turbine equation. Pelton, Francis and Kaplan turbines - working principle and construction, work done by water on the runner, Draft tube. Specific speed, unit quantities and performance curves. Governing of turbines.

List of Experiments 30

1. Determination of coefficient of discharge of given Orifice meter(CO1)
2. Determination of coefficient of discharge of given Venturimeter(CO2)
3. Determination of friction factor of given set of pipes(CO2)
4. Performance study of Centrifugal pumps(CO4)
5. Performance study of reciprocating pumps(CO4)
6. Performance characteristics of a Pelton wheel(CO5)
7. Performance test on a Francis Turbine(CO5)
8. Performance test on a Kaplan Turbine(CO5)

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply mathematical knowledge to predict the properties and characteristics of a fluid.	Apply
CO2: Analyze and calculate major and minor losses associated with pipe flow in piping networks.	Apply
CO3: Mathematically predict the nature of physical quantities.	Apply
CO4: Select a suitable hydraulic pump for the customer provided site conditions.	Apply
CO5: Select a suitable hydraulic turbine for the given rated parameters.	Apply

Text Book(s):

T1. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", 5th edition, Laxmi Publications (P) Ltd., New Delhi, 2014.

T2. Vasandani, V.P., "Hydraulic Machines - Theory and Design", Khanna Publishers, 2014.

Reference Book(s):

R1. White, F.M., "Fluid Mechanics", Tata McGraw-Hill, 5th Edition, New Delhi, 2013

R2. Streeter, V.L., and Wylie, E.B., "Fluid Mechanics", McGraw-Hill, 2017.

R3. Kumar, K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd., New Delhi (7th edition), 2014.

Web References:

1. http://nptel.ac.in/courses/112107147/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	3	1	-	2	2	-
CO2	3	2	1	1	-	-	-	1	3	1	-	2	2	-
CO3	3	2	1	1	-	-	-	1	3	1	-	2	2	-
CO4	3	2	1	1	-	-	-	1	3	1	-	2	2	-
CO5	3	2	1	1	-	-	-	1	3	1	-	2	2	-

High-3; Medium-2;Low-1

Assessment pattern:

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	20
	CCET II	3,4	50	
	CCET III	5	50	
	Continuous Assessment – Practical	1,2,4,5	75	10
	Final Assessment – Practical	1,2,4,5	50	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				100

Course Code: 19AUCN1301	Course Title: PRODUCTION PROCESSES		
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max. Marks:100

Prerequisites

- Engineering Materials

Course Objectives:

The course is intended to:

1. Explain operational and procedural steps required in casting process.
2. Describe the procedure of forging process
3. Choose appropriate welding process.
4. Select appropriate metal cutting processes to manufacture a cylindrical part
5. Select appropriate metal cutting processes to manufacture a prismatic a part.

UNIT I CASTING **9**

Sand casting process, Pattern - Types, materials and allowances. Moulding sand – Types and properties. Mould preparation- Tools and equipment's, Core making process. Centrifugal casting processes (True, Semi, Centrifuging), Continuous casting, Lost wax process, Shell mould casting, Die casting (Cold chamber / Hot chamber), Casting defects.

UNIT II METAL FORMING **9**

Hot working and Cold working of metals. Rolling: Rolling mills, Roll passes and sequences, Rolling defects; Forging: Types (Smith, Drop, Press & Machine), Forging operations (Drawing down / Swaging, Upsetting); Forging defects; Extrusion: Types (Direct, Indirect, Impact, Tube).

UNIT III METAL JOINING **9**

Fusion welding processes: Arc welding processes - Manual metal arc welding, GTAW, GMAW, Submerged arc welding, Gas welding process (Oxy-acetylene) - Types of flames, Working principle, Equipment's. Non- fusion welding processes: Electrical resistance welding (ERW), Types (Spot, seam, percussion, projection, flash butt), Thermit welding, Electron beam welding, Laser beam welding, welding defects, Welding symbol.

UNIT IV LATHE, DRILLING AND GRINDING **9**

Center lathe – Operations performed - attachments / accessories, Process parameters, Capstan lathe and Turret lathe. Constructional features of drilling machine, Upright drilling

machine, Radial drilling machine, operations performed in drilling machine and process parameters.

Grinding operation - Grinding wheel – Designation and selection – Grinding Processes : Cylindrical, Surface and Centerless grinding

UNIT V MILLING AND CNC **9**

Milling machines - Types. Milling cutter - Types, nomenclature. Up milling & Down milling, Operations performed in milling machine, Process parameters.

CNC Machines- Types, Machining centre, Part programming fundamentals

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain operational and procedural steps required for manufacturing a cast part.	Understand
CO2: Describe the procedure for manufacturing a part using metal forming processes.	Understand
CO3: Choose appropriate welding process for the required weld joint	Apply
CO4: Select appropriate metal cutting processes to manufacture a cylindrical part which involve lathe, drilling and grinding machines	Apply
CO5: Select appropriate metal cutting processes to manufacture a prismatic part which involve milling machine.	Apply

Text Book(s):

T1. Rao P C, “Manufacturing Technology, Vol 2, Metal Cutting and Machine Tools”, 2nd Edition, Tata McGraw Hill, New Delhi, 13th reprint 2012.

T2. Kalpakjian, Serope, and Schmid, Steven. “Manufacturing Engineering and Technology”, Pearson Education, 2019.

T3. Serope Kalpakjian, Steven R Schmid, “Manufacturing Process for Engineering Materials” Pearson Education, 6th Edition, 2017.

Reference Book(s):

R1. HMT Bangalore, “Production Technology”, McGraw Hill Education Pvt. Ltd., New Delhi, Reprint 2011.

R2. Jain. R.K., “Production Technology”, Khanna Publishers, New Delhi, 2012.

R3. Hajra Choudhury A. K., Nirjhar Roy, Hajra Choudhury S. K., “Elements of Production Technology –Vol. II”, Asia Publishing House, 2008.

Web References:

1. http://nptel.ac.in/courses/112/107/112107144/
2. http://nptel.ac.in/courses/112/107/112107145/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	1	-	-	1	1	-
CO2	2	1	-	-	-	-	-	1	1	-	-	1	1	-
CO3	3	2	1	1	-	-	-	1	1	-	-	1	1	-
CO4	3	2	1	1	-	-	-	1	1	-	-	1	1	-
CO5	3	2	1	1	-	-	-	1	1	-	-	1	1	-

High-3; Medium-2; Low-1

Assessment pattern:

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	40
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19AUSN2301	Course Title: AUTOMOTIVE ENGINES		
Course Category: Engineering Science		Course Level: Introductory	
L:T:P (Hours/Week) 3: 0: 2	Credits: 4	Total Contact Hours:60	Max. Marks:100

Prerequisites

- Physics for Mechanical Sciences

Course Objectives

The course is intended to:

1. Compare the construction and working of IC engines.
2. Explain the induction and ignition system.
3. Infer the influences of combustion chamber geometry.
4. Illustrate the construction and working of engine subsystems
5. Interpret the developments employed in IC engines.

UNIT I IC ENGINES CONSTRUCTION AND WORKING 9

Heat engines, engine components, engine nomenclature, classification, 4 stroke engines, valve timing diagram, SI and CI engines, construction, working and applications, engine performance parameters and emissions.

UNIT II INDUCTION AND IGNITION SYSTEM 9

SI engine: carburetion, air-fuel ratio, importance, requirements, simple carburetor, working, petrol injection, throttle body and multi point injections. CI engine: fuel injection system functional requirements, inline and rotary injection systems, working, feed pump, atomizer, injection pump, injector and nozzles. Ignition system: requirements, ignition timing, spark advance mechanism, centrifugal and vacuum advance mechanism, battery coil, magneto, CDI and distributor-less ignition, spark plug.

UNIT III COMBUSTION AND COMBUSTION CHAMBERS 9

Richard's combustion theory, SI engine, combustion stages, factors affecting SI engine combustion, knocking. SI Engine combustion chamber, Types. CI Engine, combustion stages, abnormal combustion, factors affecting CI engine combustion. CI engine combustion chambers, classification, factors controlling combustion chamber design. Air motion, swirl, squish and turbulence.

UNIT IV COOLING, LUBRICATION AND EXHAUST SYSTEMS 9

Cooling system, importance of cooling, cooling system classification, air cooling system, liquid cooling system, coolant properties, thermostat, thermosyphon, forced circulation cooling. Lubrication system, engine friction fundamentals, influence of engine variable on friction, functions of the lubrication system, mist lubrication, wet sump lubrication, construction and working. Exhaust system, exhaust manifold, exhaust down pipe, resonator, muffler, tailpipe, catalytic converter.

UNIT V DEVELOPMENTS IN IC ENGINES 9

Supercharger and turbocharger, HCCI, Lean burn engine, stratified charge engine, four valve and overhead cam engines, variable valve timing (VVT), variable geometry turbochargers (VGT), electronic engine management, CRDI, GDI, DAQ System – combustion and heat release analysis in engines.

List of Experiments **15**

1. Plot valve timing and port timing diagram (CO1).
2. Dismantle, identify the components and assemble the given petrol engine (CO1).
3. Dismantle, identify the components and assemble the given diesel engine (CO1).
4. Dismantle, identify the components and assemble the given fuel injection system components (CO2).
5. Dismantle, identify the components and assemble the given engine exhaust system components (CO4).
6. Case study on interpretation of vehicle manufacturer's engine specification based on load and speed (CO5).

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Compare the construction and working of IC engines based on working cycle and ignition of the mixture.	Understand
CO2: Explain the induction and ignition system of petrol and diesel engine.	Understand
CO3: Infer the influences of combustion chamber geometry on combustion characteristics of SI and CI engines.	Apply
CO4: Illustrate the construction and working of engine subsystems such as cooling, lubrication and exhaust systems.	Understand
CO5: Interpret the developments employed in IC engines to improve volumetric, thermal efficiencies and emissions.	Apply

Text Book(s):

T1. Mathur M.L. and Sharma R.P., “Internal Combustion Engines”, Dhanpat Rai Publishing Co Pvt Ltd, 7th edition, , 2014.

T2. Ganesan V, “Internal Combustion Engines”, Tata McGraw Hill, 4th edition, 2012.

T3. Ramalingam K.K., “Internal Combustion Engines”, Sci-Tech Publications, 3rd edition, 2015.

Reference Book(s)

R1. John B. Heywood, “Internal Combustion Engines Fundamentals”, McGraw Hill, 1st edition, 2011.

R2. Pundir, B. P., “I. C. Engines: Combustion and Emissions”, Narosa Publishing House, New Delhi, Reprint, 2017.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	1	1	-	3	1	-	1	-	2
CO2	2	1	-	-	-	1	1	-	3	1	-	1	-	2
CO3	3	2	1	1	-	1	1	-	3	1	-	1	-	2
CO4	2	1	-	-	-	1	1	-	3	1	-	1	-	2
CO5	3	2	1	1	-	1	1	-	3	1	-	1	-	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO. No.	Marks	Total
Continuous Assessment	CCET I	1,2	50	20
	CCET II	3,4	50	
	CCET III	5	50	
	Continuous Assessment – Practical	1,2,4,5	75	10
	Final Assessment – Practical	1,2,4,5	50	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19AUCN3301	Course Title : PRODUCTION TECHNOLOGY LABORATORY		
Course Category: Professional Core		Course Level: Practice	
L:T:P (Hours/Week) 0: 0: 3	Credits:1.5	Total Contact Hours:45	Max. Marks:100

Prerequisites:

- NIL

Course Objectives:

The course is intended to:

1. Develop process sequence for manufacturing a machined part
2. Use Lathe, Drilling, Milling, Slotting and grinding machines
3. Produce a sand mould
4. Produce a welded part

List of Experiments:

1. Exercise on Turning of shaft
2. Exercise on Key-way Milling
3. Exercise on Cylindrical Grinding
4. Exercise on Drilling, Reaming and Tapping
5. Exercise on Spur Gear Cutting
6. Exercise on Machining of Key-way in Slotting machine
7. Preparation of Sand mould for split pattern
8. Manual Metal Arc welding of T-joint
9. Manual Metal Arc welding of gear box casing
10. Exercise on Assembly of manufactured components in to a gearbox.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Develop process sequence for manufacturing the given design requirement using the available machine tools	Apply
CO2: Use Lathe, Drilling, Milling, Slotting and grinding machines to manufacture the part as per the given design requirement	Apply
CO3: Make a mould using sand casting process for the given design requirement.	Apply
CO4: Make a welded component using arc welding for the given design requirement	Apply

Reference(s):

R1. Jain. R.K., “Production Technology”, Khanna Publishers, New Delhi, 2012

R2. R2. Hajra Choudhury A. K., Nirjhar Roy, Hajra Choudhury S. K., “Elements of Production Technology –Vol. II”, Asia Publishing House, 2008.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	2	3	2	-	1	-	1
CO2	3	2	2	2	-	-	-	2	3	2	-	1	-	1
CO3	3	2	2	2	-	-	-	2	3	2	-	1	-	1
CO4	3	2	2	2	-	-	-	2	3	2	-	1	-	1

High-3; Medium-2; Low-1

Assessment pattern

	Assessment component	CO. No.	Marks	Total Marks
Continuous Assessment	Each Lab Experiment	1,2,3,4	75	75
	Cycle Test 1	1,2	50	25
	Cycle Test 2	1,3,4	50	
			Total	100

Course Code:19AUCN3302	Course Title: MODELING AND DRAFTING OF AUTOMOTIVE COMPONENTS LABORATORY		
Course Category: Professional Core		Course Level: Practice	
L: T:P (Hours/Week) 0: 0: 3	Credits:1.5	Total Contact Hours:45	Max. Marks:100

Prerequisites

- Engineering Drawing

Course Objectives

The course is intended to:

1. Explain drawing Standards, Limits, Fits and Tolerances
2. Develop part models and Draft
3. Prepare Assembly model, Assembly drawing and Exploded View

UNIT I DRAWING STANDARDS 3

Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, and fasteners – Reference to hand book for the selection of standard components such as bolts, nuts, screws and keys.

UNIT II FITS AND TOLERANCES 6

Definitions, Classifications of Fits, System of Fits, Selection of Fits, Method of Indicating Fits on Drawings, Tolerance Grade, Fundamental of Deviations, Shaft and Hole Basis systems, Method of Placing Limit Dimensions, Surface finish and IT Grades, Tolerance stack up – Interference checking. Geometric tolerance - form and position tolerances, symbols, method of indicating geometric tolerances on part drawings.

UNIT III COMPUTER AIDED ASSEMBLY AND DETAILED DRAWING EXERCISES 36

1. Part Modeling of Universal Coupling
2. Assembly modeling and drawing of Universal coupling
3. Part Modeling of Screw jack
4. Assembly modeling and drawing of Screw jack
5. Part Modeling of Fuel Injector
6. Assembly modeling and drawing of Fuel Injector
7. Part Modeling of Piston and Connecting rod
8. Exploded view of Piston and Connecting rod Assembly

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain drawing Standards, Limits, Fits and Tolerances	Understand
CO2: Develop part models and Draft as per the drawing standards.	Apply
CO3: Prepare assembly drawings of automobile components to understand the assembly process.	Apply

Reference(s):

R1. GopalakrishnaK.R.,"MachineDrawing",22nd Edition, Subhas Stores Books Corner, Bangalore,2013

R2. Bhatt, N.D., "Machine Drawing, Published", Chartstar Book Stall, Anand, India,1999.

R3. Faculty of Mechanical Engineering, PSG College of Technology, "Design Data Book", Kalaikathir Achchagam, Coimbatore, 2012.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	3	-	-	2	3	2	-	1	3	2
CO2	3	2	2	2	3	-	-	2	3	2	-	1	3	2
CO3	3	2	2	2	3	-	-	2	3	2	-	1	3	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment component	CO. No.	Marks	Total Marks
Continuous Assessment	Each Lab Experiment	1,2,3	75	75
	Cycle Test 1	1,2,3	50	25
	Cycle Test 2	1,2,3	50	
			Total	100

END OF SEMESTER - III

SEMESTER- IV

Course Code:19MABG1401	Course Title: PROBABILITY AND STATISTICS (Common to AU, CE, CS. EC, EE, IT, ME)		
Course Category: Basic Science		Course Level: Introductory	
L:T:P(Hours/Week) 3: 1: 0	Credits:4	Total Contact Hours:60	Max Marks:100

Prerequisites

- Nil

Course Objectives

The course is intended to:

1. Calculate expectations and variances of random variables
2. Apply the concepts of standard distributions to solve practical problems
3. Calculate the correlation and regression for two variables
4. Test the samples based on hypothesis
5. Analyze the samples based on variance

UNIT I PROBABILITY AND RANDOM VARIABLES 9+3

Axioms of Probability- Conditional Probability- Total Probability - Baye's Theorem- Random Variables- Probability Mass Function- Probability Density Functions-Properties. Moments- Moment generating functions and their properties.

UNIT II STANDARD DISTRIBUTIONS 9+3

Binomial- Poisson- Uniform –Exponential- Normal Distributions and their properties - Functions of a random variable.

UNIT III TWO DIMENSIONAL RANDOM VARIABLES 9+3

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and regression – Transformation of random variables.

UNIT IV TESTING OF HYPOTHESES 9+3

Sampling Distributions- Testing of hypotheses for mean, variance, proportions and differences using Normal, t, Chi-Square and F distributions – Tests for independence of attributes and Goodness of fit.

UNIT V DESIGN OF EXPERIMENTS 9+3

Analysis of Variance (ANOVA) - One way Classification – Completely Randomized Design (CRD) – Two ways Classification – Randomized Block Design (RBD) – Latin square.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1:Calculate expectations and variances of random variables	Apply
CO2:Apply the concepts of standard distributions to solve practical problems	Apply
CO3:Calculate the correlation and regression for two variables	Apply
CO4:Test the samples based on hypothesis	Apply
CO5:Analyze the samples based on variance	Apply

Text Book(s):

T1. Veerajan T, “Probability, Statistics and Random process”, 2nd Edition, Tata McGraw-Hill, New Delhi, 2009.

T2. Dr. Ravichandran J., “Probability and Statistics for Engineers”, 1st Edition,Wiley India Pvt. Ltd., 2010.

Reference Book(s):

R1. Walpole R.E., Myers R.H., Myers S.L., Ye K., “Probability and Statistics for Engineers and Scientists”, 8'" Edition Pearson Education, Asia, 2007.

R2. M.R. Spiegel, J. Schiller and R.A. Srinivasan, “Schaum's Outlines Probability and Statistics”, Tata McGraw Hill edition, 2004.

R3. Morris DeGroot, Mark Schervish, “Probability and Statistics”, Pearson Educational Ltd, 4th Edition, 2014.

Web References:

1. https://onlinecourses.nptel.ac.in/111105041/
2. https://nptel.ac.in/downloads/111105041/
3. https://nptel.ac.in/courses/111105090**/**

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	1	1	-	1	-	1	3	-
CO2	3	2	1	1	-	-	1	1	-	1	-	1	3	-
CO3	3	2	1	1	-	-	1	1	-	1	-	1	3	-
CO4	3	2	1	1	-	-	1	1	-	1	-	1	3	-
CO5	3	2	1	1	-	-	1	1	-	1	-	1	3	-

High-3; Medium-2; Low-1

Assessment Pattern:

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Assessment	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Tutorial / Quiz / Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code:19MECC2401	Course Title: STRENGTH OF MATERIALS (Common to AU,MC& ME)		
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week) 3: 0: 2	Credits:4	Total Contact Hours:75	Max Marks:100

Prerequisites

- Physics for Mechanical Sciences
- Engineering Mechanics

Course Objectives

The course is intended to:

1. Characterize materials and determine the axial stresses and strains developed.
2. Calculate the principal stresses and planes for 2-D state of stress in bars and thin walled pressure vessels.
3. Compute the stress distribution and slope-deflection in beams.
4. Calculate the shear stress distribution in solid and hollow shafts and design helical springs and leaf springs.
5. Compute the diameter of shafts subjected to combined bending, twisting and axial loads.

UNIT I DEFORMATION OF SOLIDS 9

Mechanical properties of metals - Rigid and deformable bodies. Stress and Strain - tensile, compressive and shear, stress-strain diagram - Hooke's law - Factor of Safety - Poisson's ratio - relationship between elastic constants. Deformation of simple and compound bars under axial load .Strain energy- resilience, proof resilience and modulus of resilience-Strain energy due to axial load. Stresses due to gradual load, sudden load and impact load. Thermal stresses

UNIT II BI-AXIAL STATE OF STRESS 9

Biaxial state of stresses – Principal planes and stresses – Maximum shear stress and planes of maximum shear stress - Mohr’s circle for biaxial stresses. Stresses in thin walled pressure vessels.

UNIT III FLEXURE IN BEAMS AND DEFLECTION OF BEAMS 9

Theory of simple bending – Bending stress and Shear stress variation in beams of standard section like 'I', 'L' and 'T'. Evaluation of beam deflection and slope for cantilever and simply supported beams- Macaulay and Moment-area methods.

UNIT IV TORSION OF SHAFTS AND SPRINGS **9**

Theory of torsion and assumptions - torsion equation- polar moment of inertia and polar modulus - Shear stress distribution in solid and hollow circular shafts. Helical compression springs - terminology, styles of end - stress and deflection equation. Multi- Leaf springs - terminology - stress and deflection equation - Nipping of leaf springs

UNIT V THEORIES OF FAILURE **9**

Introduction to theories of failure - Maximum Principal Stress theory - Maximum Principal Strain theory - Maximum Strain Energy Theory - Maximum Distortion Energy theory - Maximum Shear Stress theory. Stresses in circular shaft with combined bending, axial loading and torsion. Equivalent bending moment and equivalent twisting moment.

List of Experiments **30**

1. Conduct tensile test on Mild Steel rod.
2. Conduct shear test on Mild steel and Aluminum rods by Double shear.
3. Calculate the modulus of rigidity of mild steel rod by Torsion test.
4. Determine the toughness of the given mild steel specimen using IZOD and CHARPY impact test.
5. Determine the Hardness Number of metals by Brinell and Rockwell Hardness tester.
6. Estimate the stiffness and modulus of rigidity of the helical spring by Compression test.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Characterize materials and determine the axial stresses and strains developed due to mechanical and thermal effects	Apply
CO2: Calculate the principal stresses and planes for 2-D state of stress in bars and thin walled pressure vessels using analytical and graphical methods.	Apply
CO3: Compute the stress distribution and slope-deflection in beams subjected to static loads.	Apply
CO4: Calculate the shear stress distribution in solid and hollow shafts subject to pure torsion and design helical springs and leaf springs subject to compressive loads.	Apply
CO5: Compute the diameter of shafts subjected to combined bending, twisting and axial loads using various theories of failure.	Apply

Text Book(s):

T1. Hibbeller RC, “Mechanics of Materials”, 9th Edition Prentice-Hall of India, New Delhi, 2013

T2. James M Gere, “Mechanics of Materials”, 9th Edition Cengage Learning, India 2019.

Reference Book(s):

R1. RattanSS“StrengthofMaterials”TataMcGraw-HillEducationPvtLtd.,NewDelhi, 2017.

R2. Beer F. P. and Johnston R,” Mechanics of Materials”, McGraw-Hill Book Co, Third Edition, 2017.

R3. Egor P. Popov,” Mechanics of Materials”, 2nd Edition, Pearson Co, 2015.

Web References:

1. http://nptel.ac.in/courses/112107147/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	3	1	-	2	1	2
CO2	3	2	1	1	-	-	-	1	3	1	-	2	1	2
CO3	3	2	1	1	-	-	-	1	3	1	-	2	1	2
CO4	3	2	1	1	-	-	-	1	3	1	-	2	1	2
CO5	3	2	1	1	-	-	-	1	3	1	-	2	1	2

High-3; Medium-2; Low-1

Assessment pattern:

	Assessment Component	CO. No.	Marks	Total
Continuous Assessment	CCET I	1,2	50	20
	CCET II	3,4	50	
	CCET III	5	50	
	Continuous Assessment – Practical	1,2,3,4,5	75	10
	Final Assessment – Practical	1,2,3,4,5	50	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code:19AUCN1402	Course Title: MECHANICS OF MACHINES		
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week) 3: 1: 0	Credits:4	Total Contact Hours:60	Max. Marks:100

Prerequisites

- Engineering Mechanics

Course Objectives:

The course is intended to:

1. Calculate Kinematic parameters of simple mechanisms.
2. Develop cam profile for different follower motions
3. Calculate the natural frequency of a free vibrating system
4. Calculate the kinematic parameters of gear trains
5. Calculate the balancing masses required for balancing of rotating systems.

UNIT I VELOCITY AND ACCELERATION IN SIMPLE MECHANISMS **9+3**

Linear and angular velocities - absolute and relative velocities - rubbing velocity - tangential, radial and Coriolis components of acceleration, graphical method for determination of velocity and acceleration of the links in four bar mechanism and single slider crank mechanism.

UNIT II DESIGN OF CAM PROFILE **9+3**

Types of cams, types of followers, radial cam, terminology of radial cam, types of follower motions: uniform velocity motion, simple harmonic motion, constant acceleration/deceleration motion, cycloidal motion, cam profile for knife edge, roller and flat faced follower – Graphical method.

UNIT III VIBRATION **9+3**

Introduction- Terminology- types of vibrations- Types of free vibration- Natural frequency of free longitudinal, transverse and torsional vibrations. Effect of inertia- natural frequency of free transverse vibration due to point load on a simply supported shaft. Critical speed and damping (Theory only). Torsion vibration in single, two and three rotor system- Torsionally equivalent shaft.

UNIT IV KINEMATICS OF GEAR TRAINS **9+3**

Types of gears, spur, Helical, Bevel and worm gear terminologies, law of gearing, Classification of gear trains, calculation of Gear ratio, number of teeth for the gears in the gear trains, velocities of the gears in gear trains such as Simple, Compound, Reverted & Epicyclic

(using tabulation method) gear trains, Differential gear train.

UNIT V BALANCING OF MASSES 9+3

Static and dynamic balancing - Balancing of rotating masses – Balancing of single rotating mass (in single plane and several planes)- Balancing of several masses in single or several planes- Balancing of reciprocating masses (Introduction only)

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Calculate the velocity and acceleration of links in four bar and slider crank chain using graphical method.	Apply
CO2: Develop the radial cam profile for the given type of follower and motion function	Apply
CO3: Determine the natural frequency of a free longitudinal, transverse and torsional vibrating system.	Apply
CO4: Calculate the kinematic parameters of gear trains such as simple, compound and epicyclic gear trains	Apply
CO5: Determine the balancing masses required for balancing of rotating masses in single or several planes.	Apply

Text Book(s):

T1. Rattan SS, “Theory of machines” – Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2009.

T2. Ambekar A.G., “Mechanism and machine Theory”, Prentice Hall of India New Delhi, 2007.

Reference Book(s):

R1. Robert L. Norton, “Kinematics and Dynamics of Machinery”, Tata McGraw-Hill,2009

R2. Uicker, J.J., Pennock G.R and Shigley, J.E., “Theory of Machines and Mechanisms”, 3rd Edition, Oxford University Press,2009.

R3. Ghosh, A, Mallick, A.K., “Theory of Mechanisms and Machines”, Affiliated East-West Pvt. Ltd., New Delhi, 1988.

Web References:

1. http://nptel.ac.in/courses/112104121/1

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	-	1	-	1	1	2
CO2	3	2	1	1	-	-	-	1	-	1	-	1	1	2
CO3	3	2	1	1	-	-	-	1	-	1	-	1	1	2
CO4	3	2	1	1	-	-	-	1	-	1	-	1	1	2
CO5	3	2	1	1	-	-	-	1	-	1	-	1	1	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Tutorial / Quiz / Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code:19AUCN2401	Course Title: AUTOMOTIVE ELECTRICAL AND ELECTRONICS		
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week) 3:0:2	Credits:4	Total Contact Hours:75	Max. Marks:100

Prerequisites

- Nil

Course Objectives:

The course is intended to:

1. Calculate the electrical parameters in the circuit
2. Demonstrate the characteristics of different types of electronic devices and driver circuit used in Automobiles
3. Conduct the test on battery charging system and engine starting system
4. Explain the construction and working of sensors and actuators used in automobile
5. Diagnosis faults in the automobile electronic systems

UNIT I BASIC ELECTRICAL 9

Voltage, current, energy and power. Electrical elements: resistor, inductor and capacitor. Measuring instruments: voltmeter, ammeter and energy meter. Kirchhoff's laws, series and parallel resistor circuits. Voltage and current divider rule. RC and RL circuits. Resistor circuit Mesh analysis.

UNIT II ELECTRONIC DEVICES 9

BJT, FET, SCR and IGBT: Construction and characteristics, Device selection. Driver circuits: Continuous output control, PWM, Relays, H-bridge. Protection circuitry: reverse polarity, short circuit, high voltage protection

UNIT III BATTERY CHARGING AND ENGINE STARTING SYSTEMS 10

Battery: state of health, state of charge. Automobile alternator construction, working and output voltage characteristics. Automobile regulator functions, Nine diode rectifier, IC Voltage Regulator construction and working. DC Motor, Engine Starter Motor and BLDC working and characteristics.

UNIT IV SENSORS AND ACTUATORS 9

Sensors for Modern Vehicles: Speed, Crank and Cam position, Throttle position, Manifold Absolute Pressure, Air intake temperature, Coolant temperature, Exhaust Oxygen level. Piezoelectric and solenoid Injectors: construction, working and control.

UNIT V FUNDAMENTALS OF AUTOMOTIVE ELECTRONIC SYSTEMS 8

Car Electrical system layout, Switches, relays, fuses, lighting system and circuits types. Horns, wipers, defogger, power windows , seat belt, electronic door lock. Electronic dashboard instruments. Electromagnetic interference and suppression, electromagnetic compatibility.

List of Experiments 30

1. Design simple DC power supply for Automobile systems(CO2)
2. Speed control of PMDC Motor using PWM(CO2)
3. Design simple driver circuit using SCR and draw its characteristics(CO2)
4. Conduct No load test on Starter motor(CO3)
5. Conduct load test on three phase induction motor(CO3)
6. Conduct Load test on Alternator(CO3)
7. Design of battery voltage indicator using LM741(CO5)
8. Fault diagnosis in the car electrical system(CO5)

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Calculate electrical parameter such as voltage, current and resistance in a given electrical circuit	Apply
CO2: Demonstrate characteristics of different types of electronic devices and driver circuit used in Automobiles	Apply
CO3: Conduct tests on battery charging system and engine starting system	Apply
CO4: Explain the construction and working of sensors and actuators used in automobiles	Understand
CO5: Diagnose faults in automobile electronic systems	Apply

Text Book(s):

T1. Kohli, P.L., "Automotive Electrical Equipment", Tata McGraw-Hill Co. Ltd., New Delhi, 2014.

T2. Tom Denton, "Automobile Electrical and Electronic systems", 3rd Edition, Elsevier Publications, 2011.

T3. William Ribbens, "Understanding Automotive Electronics", Butterworth-Hienemann, 2012.

Reference Book(s):

R1. Mckenzie Smith I, John Hiley and Keith Brown, “Hughes Electrical and Electronics Technology”, Pearson, 10th Edition,2010.

R2. Cathay J.J., Nasar S A, "Basic Electrical Engineering” 2nd Edition, McGraw-Hill, 2012.

R3. Jegathesan V., Vinoth kumar K., Saravana Kumar R., “Basic Electrical and Electronics Engineering”, Wiley India, 2011.

Web References:

1. https://nptel.ac.in/courses/108/108/108108122/
2. https://nptel.ac.in/courses/108108147/
3. https://nptel.ac.in/courses/108105017/

Course Articulation Matrix:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	3	1	-	1	1	1
CO2	3	2	1	1	-	-	-	-	3	1	-	1	1	1
CO3	3	2	1	1	-	-	-	-	3	1	-	1	1	1
CO4	2	1	-	-	-	-	-	-	3	1	-	1	1	1
CO5	3	2	1	1	-	-	-	-	3	1	-	1	1	1

High-3; Medium-2; Low-1

Assessment pattern:

	Assessment Component	CO. No.	Marks	Total
Continuous Assessment	CCET I	1,2	50	20
	CCET II	3,4	50	
	CCET III	5	50	
	Continuous Assessment – Practical	1,2,3,4,5	75	10
	Final Assessment – Practical	1,2,3,4,5	50	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code:19AUCN3401	Course Title: FUELS, ENGINE PERFORMANCE AND EMISSION TESTING LABORATORY		
Course Category: Professional Core		Course Level: Practice	
L:T:P (Hours/Week) 0: 0: 3	Credits:1.5	Total Contact Hours:45	Max. Marks:100

Prerequisites

- NIL

Course Objectives

The course is intended to:

1. Determine the fuel properties
2. Determine the performance characteristics of IC engines
3. Measure the exhaust emissions

List of Experiments

1. Determine flash and fire points of given fuel.
2. Determine the temperature dependence of viscosity of given fuel.
3. Conduct ASTM distillation test of liquid fuels.
4. Conduct performance test on petrol engine.
5. Conduct performance test on diesel engine.
6. Conduct heat balance test on IC engine.
7. Conduct Morse Test in MPFI engine.
8. Conduct retardation test on single cylinder diesel engine.
9. Plot P-θ and P-V diagrams using EPA software.
10. Conduct emission test on turbocharged engine.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Determine the liquid fuel properties such as flash, fire points, and viscosity and vapor characteristics as per ASTM standard.	Apply
CO2. Determine the performance characteristics of SI and CI engines.	Apply
CO3. Measure the exhaust emissions using five-gas analyzer.	Apply

Reference(s):

R1. “Fuels, engine performance and emission testing laboratory manual”, MCET-Automobile Engineering, 2020.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	3	2	2	2	3	2	-	1	2	1
CO2	3	2	2	2	3	2	2	2	3	2	-	1	2	1
CO3	3	2	2	2	3	2	2	2	3	2	-	1	2	1

High-3; Medium-2; Low-1

Assessment pattern

	Assessment component	**CO. No.**	**Marks**	**Total Marks**
Continuous Assessment	Each Lab Experiment	1,2,3	75	75
	Cycle Test 1	1,2	50	25
	Cycle Test 2	2,3	50	
			Total	100

Course Code: 19PSHG6002	Course Title: UNIVERSAL HUMAN VALUES 2 : UNDERSTANDING HARMONY		
Course Category: Humanities		Course Level: Practice	
L:T:P (Hours/Week) 2:1: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Pre-requisites

- Induction Program (UHV1)

Course Objectives

The course is intended to:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Strengthening of self-reflection
3. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
4. Development of commitment and courage to act

UNIT I INTRODUCTION TO VALUE EDUCATION 6+3

Need for the Value Education; Self -exploration as the process for value education ; Continuous Happiness and Prosperity: A look at basic Human Aspirations; Right understanding: Relationship and Physical Facilities ; Happiness and Prosperity: current scenario ; Method to fulfill the Basic human aspirations

UNIT II HARMONY IN HUMAN BEING 6+3

Human being as a co-existence of self (‘I’) and the material ‘Body’; needs of Self ('I') and 'Body'; The Body as an instrument of 'I'; Harmony in the self(‘I’); Harmony of the self(‘I’) with body; Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Swasthya.

UNIT III HARMONY IN THE FAMILY AND SOCIETY 6+3

Harmony in the Family the basic unit of human interaction; Values in human to human relationship; Trust as the foundational values of relationship; Respect as the right evaluation ;Understanding harmony in the society (society being an extension of family); Vision for the universal human order

UNIT IV HARMONY IN THE NATURE 6+3

Understanding the harmony in the Nature Interconnectedness, self-regulation and mutual fulfillment among the four orders of nature; Existence as Co-existence at all levels; Holistic perception of harmony in existence.

UNITV HARMONY ON PROFESSIONAL ETHICS 6+3

Natural acceptance of human values ;Definitiveness of Ethical Human Conduct; Basic for Humanistic Education, Humanistic Constitution and Humanistic Universal Order; Competence in professional ethics ;Case study: holistic technologies, management models and production systems ;Strategy for transition towards value based life and profession

Course Outcomes	**Affective Level**
At the end of this course, students will be able to:	
CO1: Reflect on values, aspiration, relationships and hence identify strengths and weaknesses.	Responding
CO2: Appraise physical, mental and social well-being of self and practice techniques to promote well-being.	Responding
CO3: Value human relationships in family and society and maintain harmonious relationships.	Valuing
CO4: Respect nature and its existence for survival and sustainable of all life forms and hence practice conservation of nature	Valuing
CO5: Appreciate ethical behavior as a result of value system in personal and professional situations	Receiving

Text Book(s):

T1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010.

Reference Book(s):

R1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.

R2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

R3. The story of stuff, Annie Leonard, Free Press, New York 2010.

Web References:

1. https://aktu.ac.in/hvpe/ResourceVideo.aspx
2. http://hvpenotes.blogspot.com/
3. https://nptel.ac.in/courses/109/104/109104068/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	1	2	2	-	-	2	-	-
CO2	-	-	-	-	-	1	2	2	2	1	-	2	-	-
CO3	-	-	-	-	-	2	2	2	2	1	-	2	-	-
CO4	-	-	-	-	-	2	2	2	2	-	-	2	-	-
CO5	-	-	-	-	-	1	2	2	2	-	-	2	-	-

High-3; Medium-2; Low-1

Assessment Pattern

	Assessment component	**CO No.**	**Marks**	**Total marks weightage**
Continuous assessment	Socially relevant project/Group Activities/ Assignments	1,2,3,4,5	20	75%
	Assessment by faculty mentor		10	
	Self-assessment		10	
	Assessment by peers		10	
End Semester Examination	Part A – Objective type – 20x1 = 20 marks Part B – Short answer questions – 15x 2 = 30 marks Part C – Descriptive Type Questions (Either or Pattern) – 5 x 10 = 50 marks	1,2,3,4,5	100	25%
			Total	100%

Course Code: 19AUPN6401	Course Title: MINI-PROJECT		
Course Category: Project		Course Level: Practice	
L:T:P (Hours/Week) 0: 0: 4	Credits:2	Total Contact Hours:60	Max. Marks:100

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Take up any challenging practical problems and find solution by formulating proper methodology.
2. Work collaboratively on a team to successfully complete a design project
3. Effectively communicate the results of projects in a written and oral format

The objective of Mini-Project is to enable the student to take up investigative study in the broad field of Automobile Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

1. Survey and study of published literature on the assigned topic.
2. Working out a preliminary Approach to the Problem relating to the assigned topic.
3. ConductingpreliminaryAnalysis/Modelling/Simulation/Experiment/Design/Feasibility.
4. Preparing a Written Report on the Study conducted for presentation to the Department.
5. Final Seminar, as oral Presentation before a departmental committee.

Course Outcomes At the end of this course, students will be able to:	Cognitive Level
CO1: Take up any challenging practical problems and find solution by formulating proper methodology.	Apply
CO2: Work collaboratively on a team to successfully complete a design project	Apply
CO3: Effectively communicate the results of projects in a written and oral format	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Course Code: 19AUPN6001	Course Title: INTERNSHIP OR SKILL DEVELOPMENT		
Course Category: Project		Course Level: Practice	
L:T:P (Hours/Week) 2 Weeks	Credits: 1	Total Contact Hours: Nil	Max. Marks:100

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Understand industry-specific terminology and practices
2. Solve simple industrial problems
3. Work collaboratively on a team
4. Effectively communicate the activities of internship in a written and oral format

Minimum of two weeks in an Industry in the area of Automobile Engineering. The summer internship should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to him/her. The outcome of the internship should be presented in the form of a report.

Course Outcomes At the end of this course, students will be able to:	Cognitive Level
CO1: Understand industry-specific terminology and practices	Understand
CO2: Solve simple industrial problems	Apply
CO3: Work collaboratively on a team	Apply
CO4: Effectively communicate the activities of internship in a written and oral format	Understand

Course Articulation Matrix

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

High-3; Medium-2; Low-1

END OF SEMESTER IV

SEMESTER- V

Course Code:19MECC2501	Course Title: PROBLEM SOLVING USING PYTHON FOR MECHANICAL SCIENCES (Common to AU, ME & MC)		
Course Category: Professional Core		**Course Level: Practice**	
L:T:P (Hours/Week) 2: 0: 2	**Credits:3**	**Total Contact Hours:60**	**Max. Marks:100**

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Develop algorithmic solutions to simple computational problems Read, write, execute by hand simple Python programs
2. Structure simple Python programs for solving problems.
3. Decompose a Python program into functions
4. Represent compound data using Python lists, tuples, dictionaries
5. Read and write data from/to files in Python Programs.

UNIT I ALGORITHMIC PROBLEM SOLVING 6

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list.

UNIT II DATA, EXPRESSIONS, STATEMENTS 6

Python interpreter and interactive mode; values and types: int, float, Boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments.

UNIT III CONTROL FLOW, FUNCTIONS 6

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation

UNIT IV LISTS, TUPLES, DICTIONARIES 6

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing – list comprehension; Illustrative programs: selection sort, histogram.

UNIT V FILES, MODULES, PACKAGES 6

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages.

List of Experiments Periods:30

1. Program to calculate the linear stress, strain, Young's modulus & other elastic moduli and strain energy of the bar of user specified dimensions and load.
2. Program to calculate the Thermal efficiency of Otto Engine & COP of the heat engine for the user specified inputs.
3. Program to calculate the diameter of the shaft for the user specified inputs.
4. Program to find the dimensions of a Flexible Flange Coupling
5. Program to plot the equation of the motion of a simple pendulum.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Develop algorithmic solutions to simple computational problems Read, write, execute by hand simple Python programs	Understand
CO2: Structure simple Python programs for solving problems	Understand
CO3: Decompose a Python program into functions	Understand
CO4: Represent compound data using Python lists, tuples, dictionaries	Understand
CO5: Read and write data from/to files in Python Programs.	Understand

Text Book(s):

T1. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist‘‘, 2nd edition, Updated for Python 3, Shroff/O‘Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython).

T2. Guido van Rossum and Fred L. Drake Jr, —An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

Reference Book(s):

R1. John V Guttag, —Introduction to Computation and Programming Using Python‘‘, Revised and expanded Edition, MIT Press, 2013.

R2. Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	1	1	1	1	3	1	-	2	2	**-**
CO2	3	2	1	1	1	1	1	1	3	1	-	2	2	**-**
CO3	2	1	-	-	1	1	1	1	3	1	-	2	2	**-**
CO4	2	1	-	-	1	1	1	1	3	1	-	2	2	**-**
CO5	2	1	-	-	1	1	1	1	3	1	-	2	2	**-**

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	20
	CCET II	3,4	50	
	Retest	1,2,3,4	50	
	CCET III	5	50	
	Continuous Assessment – Practical	1,2,3,4,5	75	10
	Final Assessment – Practical	1,2,3,4,5	50	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				100

Course Code:19AUCN1501	Course Title: DESIGN OF AUTOMOTIVE ELEMENTS		
Course Category: Professional Core		Course Level: Practice	
L:T:P (Hours/Week) 3: 1: 0	Credits:4	Total Contact Hours:60	Max. Marks:100

Pre-requisites:

- Strength of Materials
- Automotive Engines

Course Objectives:

The course is intended to:

1. Design the automotive elements against fluctuating and variable loads.
2. Calculate the design parameters for power transmitting element.
3. Design/Select a suitable bearing.
4. Compute the design parameters of connecting rod and crankshaft.
5. Compute the design parameters of flywheel.

UNIT I DESIGN FOR STEADY AND VARIABLE LOADS **9+3**

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers, fits and tolerances – Direct, Bending and torsional stress equations - Design of straight and curved beams - 'C' Frame and Crane Hook.

Stress Concentration - Stress Concentration Factors - Reduction of Stress Concentration - Fluctuating Stresses - Fatigue Failure - Endurance Limit - Low-cycle and High-cycle Fatigue - Notch Sensitivity - Approximate Estimation of Endurance Limit - Design for Finite and Infinite Life for Reversed Stresses - Soderberg and Goodman Lines - Components subjected to fluctuating stresses - Modified Goodman Diagrams - Gerber Equation.

UNIT II DESIGN OF SHAFTS, KEYS AND COUPLINGS **9+3**

Transmission shaft, categories - Shaft design on strength basis, Equivalent Torsional Moment and Equivalent Bending Moment and Torsional Rigidity - ASME Code for shaft design. Keys, Types - Design of Square and Flat Keys.

Couplings, Types - Design of Unprotected and Protected Rigid Flange couplings, Bushed-PIn Flexible Coupling.

UNIT III BEARINGS 9+3

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, McKee's Investigation - Raimondi and Boyd Method - Sommerfeld Number, Journal Bearing Design. Deep Groove Ball Bearings, Dynamic Load Carrying Capacity, Equivalent Bearing Load, Load-Life relationship, Selection of Deep Groove Ball Bearings from Manufacturers Catalogue.

UNIT IV DESIGN OF CONNECTING ROAD AND CRANKSHAFT 9+3

Connecting Rod - Buckling of Connecting Rod - Cross-Section for Connecting Rod - Big and Small End Bearings - Big End Cap and Bolts -Whipping Stresses.

Crankshaft - Types - Design of Centre Crankshaft and Side Crankshaft when the crank is subjected to maximum bending moment and maximum torsional moment conditions.

UNIT V DESIGN OF FLYWHEELS 9+3

Introduction - Flywheel materials - Coefficient of fluctuation of speed - Fluctuation of energy, Turning Moment Diagram - Maximum fluctuation of energy - coefficient of fluctuation of energy - Energy stored in a flywheel - Stresses in rimmed flywheel - Design of shaft, key and hub for flywheels.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Design the machine elements against fluctuating and variable loads.	Apply
CO2: Calculate the design parameters for power transmitting element such as shaft, key, and coupling.	Apply
CO3: Design/Select a suitable bearing for the given application	Apply
CO4: Compute the design parameters of connecting rod and crankshaft considering the various loads acting on them.	Apply
CO5: Compute the mass and dimensions of flywheel based on the cylinder to cylinder speed fluctuation.	Apply

Text Book(s):

T1. V. B. Bhandari," Design of Machine Elements", Tata McGraw-Hill Education, 2010.

Reference Book(s):

R1. P. C Sharma and A. K Agarwal. “Machine Design” (SI units). S.K. Kataria&

R2. Richard van Basshuysen, “Internal Combustion Engine Handbook”, SAE International, 2004.

R3. Shigley J.E and Mischke C.R., “Mechanical Engineering Design”, Sixth Edition, Tata McGraw Hill, 2012.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	-	1	-	1	-	3
CO2	3	2	1	1	-	-	-	1	-	1	-	1	-	3
CO3	3	2	1	1	-	-	-	1	-	1	-	1	-	3
CO4	3	2	1	1	-	-	-	1	-	1	-	1	-	3
CO5	3	2	1	1	-	-	-	1	-	1	-	1	-	3

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Tutorials / Quiz / Assignments	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code:19AUCN2501	Course Title: ENGINEERING THERMODYNAMICS AND HEAT TRANSFER		
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week) 3: 0: 2	Credits:4	Total Contact Hours:75	Max. Marks:100

Pre-requisites:

- Physics for Mechanical Sciences

Course Objectives:

The course is intended to:

1. Calculate the performance of steady flow devices.
2. Calculate the performance of thermodynamic cycles.
3. Calculate the conduction heat transfer rate.
4. Calculate the convection heat transfer rate.
5. Calculate the effectiveness of heat exchanger and radiation shield.

UNIT I COMPRESSOR, TURBINE, NOZZLE, DIFFUSER **9**

Basic concepts, laws of thermodynamics, steady flow energy equation, and steady flow devices, such as compressor, turbine, diffuser, nozzle,concepts of Entropy, isentropic efficiency, irreversibility concepts , exergy analysis of turbine and nozzle.

UNIT II VAPOR POWER AND AIR STANDARD CYCLES **9**

Vapour power cycles: pure substances, properties, simple Rankine cycle, calculation of cycle efficiencies, methods to improve efficiency (qualitative treatment only). Gas power cycles: Otto cycle, Diesel cycle, dual cycle, air standard efficiency, mean effective pressure, relative efficiency.

UNIT III CONDUCTION **9**

General Differential equation of Heat Conduction– Cartesian and cylindrical Coordinates, Fourier's law, one dimensional steady state conduction, heat conduction through composite walls and cylinder, electrical analogy, extended surface, long fin, short fin , short fin end insulated.

UNIT IV CONVECTION **9**

Convection: Newton's law of cooling, dimensionless numbers, boundary layer concepts, laminar and turbulent flow, forced convection: external flow over plates, Internal Flow.

UNIT V RADIATION AND HEAT EXCHANGER 9

Radiation: Laws of radiation, black body and grey body, shape factor and radiation shield. Heat exchanger: overall heat transfer coefficient, fouling factor, LMTD, effectiveness and NTU methods for parallel and counter flow exchanger.

List of Experiments 30

1. Conduct performance test on reciprocating air compressor / blower (CO1).
2. Determine the thermal conductivity of material/composite wall (CO3).
3. Calculate the fin efficiency and effectiveness using pin-fin apparatus (CO3).
4. Determine the convective heat transfer coefficient and the rate of heat transfer by forced convection (CO4).
5. Calculate the effectiveness of parallel / counter flow heat exchanger (CO5).

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1. Calculate the performance of steady flow devices such as compressor, turbine, nozzle, diffuser and heat exchanger by applying laws of thermodynamics.	Apply
CO2. Calculate the performance of systems operating by vapor power and air standard cycle.	Apply
CO3. Calculate the conduction heat transfer rate in 1D plane wall and fins.	Apply
CO4. Calculate the convection heat transfer rate in forced convection.	Apply
CO5. Calculate the effectiveness of parallel and counter flow heat exchanger and radiation shield using laws of radiation.	Apply

Text Book(s):

T1. Yunus A. Cengel, Michael A. Boles, “Thermodynamics: An Engineering Approach”, McGraw-Hill Education, 8th edition, 2014.

T2. Yunus A. Cengel, Afshin J. Ghajar, “Heat and Mass Transfer”, McGraw-Hill Education, 5th edition, 2014.

Reference Book(s):

R1. P.K. Nag, “Engineering Thermodynamics”, McGraw Hill Education,6thEdition, 2017.

R2. R. C. Sachdeva, “Fundamentals of Engineering Heat and Mass Transfer”, New Age Internationals, 5thedition, 2017.

R3. J. Holman, Souvik Bhattacharyya, “Heat Transfer”, McGraw Hill Education, 10thEdition**,** 2017**.**

Web References:

1. https://www.youtube.com/watch?v=wA7OGkpCC5c

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	3	1	-	1	1	-
CO2	3	2	1	1	-	-	-	1	3	1	-	1	1	-
CO3	3	2	1	1	-	-	-	1	3	1	-	1	1	-
CO4	3	2	1	1	-	-	-	1	3	1	-	1	1	-
CO5	3	2	1	1	-	-	-	1	3	1	-	1	1	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	**CCET I**	**1,2**	**50**	**20**
	CCET II	**3,4**	**50**	
	CCET III	**5**	**50**	
	Continuous Assessment – Practical	**1,2,3,4,5**	**75**	**10**
	Final Assessment – Practical	**1,2,3,4,5**	**50**	**10**
End Semester Examination	**ESE**	**1,2,3,4,5**	**100**	**60**
Total				**100**

Course Code: 19AUCN2502	Course Title: AUTOMOTIVE EMBEDDED SYSTEM		
Course Category: Professional Core		Course Level: Practice	
L:T:P (Hours/Week) 3: 0: 2	Credits:4	Total Contact Hours:75	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- Automotive Electrical and Electronics

Course Objectives:

The course is intended to:

1. Develop Knowledge on program using microcontroller
2. Develop Knowledge to Interface peripherals with microcontroller
3. Develop Knowledge to Interface Automotive sensors and actuator using microcontroller
4. To be aware on Advance concept in power train management system
5. To be aware on Advance concept in chassis electronics systems

UNIT I INTRODUCTION **9+6**

Architecture of Microcontroller- Memory organization in microcontroller, Arithmetical and logical instruction - simple programs using microcontroller- programs using branching instructions- addressing modes, branching instruction

UNIT II PERIPHERAL INTERFACING **9+6**

Analog to Digital converter (ADC) - Interface ADC - Digital to Analog converter (DAC)- Interface DAC- stepper motor- Interface stepper

UNIT III ARDUINO **9+6**

Digital Input and output port interfacing- Analog Input and Output interfacing- Sensor interfacing- Delay generation- Pulse generation- Motor- Head light interfacing- Interrupts – Serial communication

UNIT IV ENGINE AND TRANSMISSION MANAGEMENT SYSTEM **9+6**

SI Engine management system, CI Engine management system including emission control, Transmission management system

UNIT V CHASSIS ELECTRONICS 9+6

Vehicle pitch, roll, yaw - Vehicle Gyro sensor and interfacing- Tyre Slip- ABS- TCS- ESP- EBD. Body electronics system wiper

List of experiments:

1. Perform Arithmetical operation using Microcontroller
2. Data conversion using Microcontroller
3. Interface Ports in the Microcontroller
4. Interfacing of Stepper Motor
5. Generate pulse width modulated signal for automobile Head light application
6. Interfacing of ADC with Throttle position sensor
7. Interfacing of Hall sensor to find speed of wheel
8. Intervene the operation of ABS and ESP in the vehicle using Unitrain kit

Course Outcomes:	**Cognitive Level**
At the end of the course students will be able to:	
CO1: Execute simple program using microcontroller for controlling simple applications	Apply
CO2: Interface the required peripherals with microcontroller for given application	Apply
CO3: Write program to Interface sensors and actuator using microcontroller	Apply
CO4: Explain the working principle of power train management system of an automobile	Understand
CO5: Explain the working principle of chassis electronics systems of an automobile	Understand

Text book(s):

T1. Frank Vahid and Tony Givargis, “Embedded system design A unified Hardware/software Introduction”, Wiley India pvt. Ltd., 2012

T2. Muhammad Ali Mazidi, Janice GillispieMazidi and RolinD.Mckinlay, “The 8051 Microcontroller and Embedded system using Assembly and C” 2nd Edition, Pearson education, 2009.

References book(s):

R1. David E.Simon, “An Embedded software premier”, Pearson education, 2010.

R2. Automotive Handbook” 7th edition, Bosch, 2011.

R3. Halfacree, Gareth, and Upton, Eben. Raspberry Pi User Guide Germany, Wiley 2012.

R4. Hughes, J. M. Arduino: A Technical Reference: A Handbook for Technicians, Engineers, and Makers. United States, O'Reilly Media, 2016.

Website references:

1. https://nptel.ac.in/courses/108/102/108102045/
2. https://www.arduino.cc/en/Tutorial/HomePage

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	-	-	-	3	1	-	1	1	-
CO2	3	2	1	1	2	-	-	-	3	1	-	1	1	-
CO3	3	2	1	1	2	-	-	-	3	1	-	1	1	-
CO4	2	1	-	-	2	-	-	-	3	1	-	1	1	-
CO5	2	1	-	-	2	-	-	-	3	1	-	1	1	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO. No.	Marks	Total
Continuous Assessment	CCET I	1,2	50	20
	CCET II	3,4	50	
	CCET III	5	50	
	Continuous Assessment – Practical	1,2,3,4,5	75	10
	Final Assessment – Practical	1,2,3,4,5	50	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19AUCN3501	Course Title: VEHICLE MAINTENANCE LABORATORY		
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week): 0: 0: 3	Credits:1.5	Total Contact Hours:45	Max Marks:100

Pre-requisites

- Automotive Engines
- Automotive Electrical and Electronics

Course Objectives

The course is intended to

1. Recognize and Overhaul the faults in the vehicle systems.

LIST OF EXPERIMENTS

1. Study and preparation of different statements/records required for the repair and maintenance works.
2. Minor and major tune up of gasoline and diesel engines.
3. Calibration of Fuel injection pump.
4. Fault diagnosis and service of steering system
5. Fault diagnosis and service of transmission system.
6. Fault diagnosis and service of suspension system.
7. Fault diagnosis and service of braking system.
8. Fault diagnosis and service of Electrical systems (battery, starting system, charging system)
9. Study and checking of wheel alignment - checking of camber, caster
10. Practice the following:
    - Adjustment of pedal play in clutch, brake and steering wheel play.
    - Air bleeding from hydraulic brakes, air bleeding of diesel fuel system.
    - Wheel bearings tightening and adjustment.
    - Adjustment of head lights beam.
    - Removal and fitting of tire and tube.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Recognize and Overhaul the faults in the vehicle systems.	Apply

Web Reference:

1. https://www.udemy.com/topic/car-repair/
2. https://www.autotrainingcentre.com/automotive-online-training/auto-mechanics-online-course/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	3	1	-	1	2	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment component	**Marks**	**Total Marks**
Continuous comprehensive Evaluation	Each Lab Experiment	75	100
	Cycle Test 1	50	
	Cycle Test 2	50	

Course Code: 19PSHG6501	Course Title: EMPLOYABILITY SKILLS 1: TEAMNESS AND INTERPERSONAL SKILLS (Common to all B.E/B.Tech Programmes)		
Course Category: Humanities	**Course Level: Introductory**		
L: T:P (Hours/Week): 0:0:2	**Credit :1**	**Total Contact Hours: 30**	**Total Marks: 100**

Pre-requisites:

- NIL

Course objectives:

The course is intended to

1. Demonstrate effective communicative attributes and facilitate presentation and public speaking skills
2. Identify and explore the true self and handle negatives
3. Develop interpersonal skills and to groom as a professional
4. Educate the importance of Nonverbal skill set to attain perfection
5. Build teamness and its ethics to facilitate corporate working

UNIT I EFFECTIVE COMMUNICATION & PRESENTATION SKILLS 6

Barriers of Communication -Fear Of English -Handling Social Factors -Handling Psychological Factors -Handling Practical Problems -Do's & Don't's

Effective Presentation -Presentation - Importance of Presentation Slide orientation – Introduction in a presentation - Styles of a slide - Slide Templates- Font ,color, Background -Graph Diagrammatic representation - Delivery of presentation - Body Language &Gestures - Verbal Attributes - Communication -Handling stammers and breaks - Handling fear of stage - Maintaining Confidence - Content delivery methods- Do's and Don'ts in a presentation- Tips to handle it-Effective Conclusion

UNIT II POSITIVE ATTITUDE & HANDLING REJECTIONS 6

A,B,C's Of Attitude -Influencing Factors -Individual Factors -Character Comparison - Strategies to Handle ourselves-Benefits of Positive Attitude - Do's & Don't's - **Handling Rejections** - Identifying Negativities -Nuances of handling it -Necessary changes -To do List -Creating One's self -Self Qualifiers

UNIT III INTERPERSONAL SKILLS 6

Life skills -Core IP Skills -Importance of IP Skills -Tips to improve IP Skills-Necessity of IP Skills

UNIT IV BODY LANGUAGE, DRESSING & GROOMING 6

Unconscious Physical moments - Metrics of Body Language - Good Posture -Head Motion -Facial Expression - Eye contact –Gestures -Dressing -Grooming & Outlook - Necessity of good Body Language

UNIT V TEAM ETHICS 6

Team Ethics-Necessity of Team Work- Teams Everywhere - Benefits of team culture - Reason for team failure -Conflicts -Handling Conflicts -Being a team player -Work difference from college

Course Outcomes	**Cognitive Level**
At the end of the course students will be able to:	
CO1: Demonstrate effective communicative attributes as part of their skills and facilitate presentation & public speaking skills	Apply
CO2: Identify and explore the true self and handle negatives	Apply
CO3: Develop interpersonal skills and to groom as a professional	Apply
CO4: Explain the importance of Nonverbal skill set to attain perfection	Understand
CO5: Build teamness and its ethics to facilitate corporate working	Apply

Text Book(s)

T1. John C Maxwell, " The 17 Indisputable Laws of Teamwork: Embrace Them and Empower Your Team", Harper Collins Leadership Publishers, 2013

Reference Book(s)

R1. Patrick Lencioni, " The Five Dysfunctions of a Team: A Leadership Fable" Jossey Bass Publishers, 2006

R2. Malcolm Gladwell, "Talking to Strangers: What We Should Know about the People We Don't Know" Penguin Publishers, 2019

R3. Harvey Segler, " Body Language: Discovering & Understanding the Psychological secrets behind reading & Benefiting from Body Language" Kindle Edition, 2016

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	3	-	1	-	-
CO2	-	-	-	-	-	-	-	-	2	-	-	1	-	-
CO3	-	-	-	-	-	-	-	-	2	-	1	1	-	-
CO4	-	-	-	-	-	-	-	-	-	1	-	1	-	-
CO5	-	-	-	-	-	-	-	2	1	-	-	1	-	-

High -3, Medium – 2, Low-1

Assessment Details

Mode of Delivery:

1. Continuous learning and reviews guided by faculty

2. Guided Learning Workshop

Assessment	Details	Weight (%)	Remarks
Continuous Assessment	Diagnostic assessment of a student's communication skills, cognitive abilities, and behavioural traits during the course	25	Continuous
	MCQs/Diagnostic tests and Viva-voce	25	Two per semester - After CCET1 and after CCET2
Final Assessment	MCQs/Diagnostic tests and Viva-voce	50	End of Semester

END OF SEMESTER V

SEMESTER - VI

Course Code: 19MECC1601	Course Title: FINITE ELEMENT ANALYSIS (Common to AU & ME)		
Course Category: Professional Core		Course Level: Mastery	
L:T:P(Hours/Week) 3: 1: 0	Credits:4	Total Contact Hours:60	Max Marks:100

Pre-requisites

- Fluid Mechanics and Hydraulic Machinery
- Strength of Materials
- Engineering Thermodynamics and Heat Transfer

Course Objectives

The course is intended to:

1. Convert physical problems into mathematical model
2. Solve the one dimensional structural problems
3. Solve the 2D vector variable problems
4. Solve the 1D and 2D scalar variable problems
5. Determine the shape function, Jacobean matrix, element stiffness matrix for 2D Quadrilateral element

UNIT I FINITE ELEMENT FORMULATION 9+3

Finite element methods - general applicability of the methods, general finite element procedure, discretization of the domain, degree of freedom, basic element shapes and nodes, numbering of element and nodes, displacement models, local, global coordinates, Spring element - derivation of element stiffness matrices, global stiffness matrix and force vector using minimum potential energy principle, incorporation of boundary conditions, solution of numerical problems.

UNIT II ONE DIMENSIONAL VECTOR VARIABLE PROBLEMS 9+3

Finite element modeling – Natural Coordinates and shape functions - linear bar element, - total potential energy approach - element stiffness matrix and force vector – global stiffness matrix and force vector - boundary condition – problems- quadratic element, Plane Trusses - development of shape function - element equations , element stiffness matrix and force vector – global stiffness matrix and force vector – boundary condition-problems, beam element –finite element formulation – Load vector –boundary condition-problems.

UNIT III TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS 9+3
USING CONSTANT STRAIN TRIANGLES

Finite element modeling – constant strain triangular element – Iso-parametric representation – Potential Energy approach - Element stiffness matrix and force vector – global stiffness matrix and force vector –Boundary condition – Problems, Axisymmetric solids subjected to Axisymmetric loading - axis symmetric formulation - Element stiffness matrix and force vector – global stiffness matrix and force vector –Boundary condition – Problems.

UNIT IV HEAT TRANSFER / SCALAR VARIABLE PROBLEM 1D &2D 9+3

Scalar variable problems- steady state heat transfer- 1D, 2Dconduction & convection – Global stiffness matrix and global thermal load vector - Boundary condition – Problems.

UNIT V TWO DIMENSIONAL VECTOR VARIABLE PROBLEM USING 9+3
QUADRILATERAL ELEMENTS

ISO parametric elements – the four node quadrilateral- derivation of shape function, element stiffness matrix, element force vector- global stiffness matrix and force vector- Boundary condition-problems.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Convert physical problems into mathematical model using finite element procedure and solve simple problem using spring element	Apply
CO2: Solve the one dimensional structural problems such as bar, truss and beam using natural coordinate system.	Apply
CO3: Solve the 2D vector variable problems by applying plane stress, strain and axi-symmetric conditions using CST element.	Apply
CO4: Solve the 1D and 2D scalar variable problems such as conduction and convection.	Apply
CO5: Determine the shape function, Jacobean matrix, and element stiffness matrix for 2D Quadrilateral element and find out the coordinates of a point in an element by applying interpolation technique.	Apply

Text Book(s):

T1 Chandrupatla & Belagundu, “Introduction to Finite Elements in Engineering”, Prentice-Hall of India, 3rd Edition, Eastern Economy Editions, 2011.

T2 Logan D.L., “A first course in Finite Element Method”, Thomson Asia Pvt. Ltd., 2002

Reference Book(s):

R1. David V.Hutton, “Fundamentals of Finite Element Analysis”, Tata McGraw-Hill Edition, 2005.

R2. J.N.Reddy, “An Introduction to the Finite Element Method”, McGraw-Hill International Editions (Engineering Mechanics Series), 2005.

Web References:

1. http://textofvideo.nptel.iitm.ac.in/105106051/lec1.pdf
2. http://nptel.ac.in/courses/112104116/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	1	-	1	-	2	3	3
CO2	3	2	1	1	1	-	-	1	-	1	-	2	3	3
CO3	3	2	1	1	1	-	-	1	-	1	-	2	3	3
CO4	3	2	1	1	1	-	-	1	-	1	-	2	3	3
CO5	3	2	1	1	1	-	-	1	-	1	-	2	3	3

High-3; Medium-2; Low-1

Assessment pattern:

	Assessment Component	CO No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Tutorial	-	30	10
	Quiz	1,2,3,4,5		
	Assignment	1,2,3,4,5		
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				100

Course Code: 19MECC1602	Course Title: DATA SCIENCE FOR ENGINEERS (Common to AU, MC & ME)		
Course Category: Professional Core		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- Problem solving using PYTHON for Mechanical Sciences

Course Objective:

The course is intended to

1. Understand the importance of data science and Python in Engineering
2. Develop algorithmic solutions to simple computational problems
3. Apply basic statistic tools and techniques
4. Perform data analytics process using python
5. Analyze relevant data using basic statistic tools and techniques

UNIT I INTRODUCTION TO DATA SCIENCE AND PYTHON 9

Data, types of data, data sets, data frames, Importance of data applications, Introduction to data science, data science in various fields, anaconda, IDE, Jupyter Notebooks, Microsoft visual studio code, Python-Introduction, Application and Installation procedures. Creation of root path, conda activation, Import sample excel sheet and access using Jupyter Note book. Key steps of the data analysis process.

UNIT II BASICS OF PYTHON PROGRAMMING 9

Ipython, Introduction to NumPy, NumPy Basics: Arrays and Vectorized Computation, Getting started with Pandas, data manipulation with pandas, Perform the entire data analysis process on a dataset, Visualization with Matplotlib, Learn to use NumPy and Pandas to wrangle, explore, analyze, and visualize data

UNIT III ROLE OF STATISTICS AND PROBABILITY IN DATA SCIENCE 9

Central tendency and dispersion, Introduction to probability, Probability distributions, Random variables and expectation, sampling and sampling distribution, Distribution of Sample Means, population, and variance, confidence interval estimation, Hypothesis and Hypothesis testing, Errors, Two sample T test, F test, ANOVA, Pearson correlation, Goodness of Fit, Simple Linear, Multiple and Logistic Regression.

UNIT IV DATA ANALYTICS USING PYTHON 9

Data Loading, Storage, and File Formats, Data Cleaning and Preparation, Data Wrangling, Gathering Data, Assessing Data, Cleaning Data, Join, Combine, and Reshape, Plotting and Visualization, Data Aggregation and Group Operations, Data assembly and Missing data handling, Time Series, Machine Learning.

UNITV DATA ANALYSIS PROCESS 9

Linear Algebra for Data Science, Introduction to Vectors and Matrices using Python, Python demo for distributions and statistics analysis using python, use Seaborn for statistical plots, Use SciKit-Learn for Machine Learning Tasks, Data Visualization in Data Analysis and Data Presentation.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Understand the importance of data science and Python in Engineering.	Understand
CO2: Develop algorithmic solutions to simple computational problems	Understand
CO3: Apply basic statistic tools and techniques	Understand
CO4: Perform data analytics process using python	Understand
CO5: Analyze relevant data using basic statistic tools and techniques	Understand

Text Books:

T1 Jake VanderPlas “Python Data Science Handbook: Essential Tools for Working with Data” O'Reilly Media, Inc, 1st edition, 2017.

T2 Daniel Y. Chen, (2018) “Pandas for Everyone: Python Data Analysis” Pearson Education, 1st edition, 2018.

T3 McKinney, W. “Python for data analysis: Data wrangling with Pandas, NumPy, and IPython” O'Reilly Media, 2017.

T4 Douglas C. Montgomery, George C. Runger “Applied Statistics & Probability for Engineering” John Wiley & Sons, 6th edition, 206.

T5 Jay L. Devore, “Probability and Statistics for Engineering and the Sciences”, Cengage Learning, 9th edition, 2020.

References:

R1. Swaroop, C. H. “A Byte of Python” Python Tutorial, 2003.

R2. Anirban Das Gupta “Probability for Statistics and Machine Learning” Springer link, 2011.

R3. Anderson Sweeney Williams “Statistics for Business and Economics, Cengage Learning, 2011.

Web References:

1. https://jakevdp.github.io/PythonDataScienceHandbook/index.html
2. https://towardsdatascience.com/
3. https://www.practicaldatascience.org/html/pandas_dataframes.html
4. https://hadrienj.github.io

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	1	-	-	1	-	1	-	1	2	-
CO2	2	1	-	-	1	-	-	1	-	1	-	1	2	-
CO3	2	1	-	-	1	-	-	1	-	1	-	1	2	-
CO4	2	1	-	-	1	-	-	1	-	1	-	1	2	-
CO5	2	1	-	-	1	-	-	1	-	1	-	1	2	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	**100**

Course Code:19AUCN2601	Course Title: AUTOMOTIVE CHASSIS AND TRANSMISSION		
Course Category: Professional Core		Course Level: Practice	
L:T:P (Hours/Week) 3: 0: 2	Credits:4	Total Contact Hours:60	Max. Marks:100

Pre-requisites:

- Engineering Mechanics

Course Objectives:

The course is intended to:

1. Compare the different types of frames used in vehicles.
2. Plot a steering system layout.
3. Compare the construction and working principle of friction clutches and gear box.
4. Illustrate the drive line components used in vehicles.
5. Compare the construction and working of various braking system.

UNIT I FRAMES 6

Classification of vehicles, types of chassis layout with reference to power plant locations. Vehicle frames, loads acting on vehicle frames, types of frames – Ladder frame, Integral frame, tubular frame.

UNIT II STEERING AND SUSPENSION SYSTEM 6

Front Axle - Steering system- working mechanism- steering layouts, front wheel geometry. Ackermann and Davis steering system, steering gear boxes and power assisted steering.

Suspension system **-** Need- Types of suspension system-Wishbone & Mc Pherson -. Types of suspension Spring- Leaf spring, Coil Spring. Shock Absorber- types

UNIT III CLUTCH AND GEAR BOX 6

Clutch - types of clutches- single plate clutch-multiple plate clutch-centrifugal clutch.

Gear box –Types of Gear Box. Simple epicyclic gear box- Continuously Variable Transmission (CVT)..

UNIT IV DRIVE LINE 6

Drive Axles - Types, stub axle – types. Drive lines- Hotchkiss drive, torque tube drive.

Final Drive **-** types of final drive. Differential- Types of Differential.

UNIT V BRAKING SYSTEM **6**

Wheels and Tires –Types of wheels. Tire - nomenclature- Types of Tire.

Braking system – Purpose, stopping distance, braking torque, stopping time and braking efficiency. Classifications of brakes- drum brakes and disc brakes-mechanical, hydraulic, pneumatic braking system and Anti-lock braking system

List of Experiments **30**

1. Dismantle, Study and assembly of steering Gearbox
2. Dismantle, Study and assembly of suspension System
3. Dismantle, Study and assembly of single plate clutch
4. Dismantle, Study and assembly of rear Axle
5. Dismantle, Study and assembly of braking system

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Identify the different chassis frames used in the on road and off road vehicles	Understand
CO2: Plot a steering system layout for dependent suspension and independent suspension based on the conditions for true rolling.	Apply
CO3: Compare the construction and working of various types of friction clutches and gear boxes used in vehicles.	Apply
CO4: Illustrate the construction and working of drive line components used in ON road vehicles and OFF road vehicles	Apply
CO5: Compare the construction and working of disc brake and drum brake based on the efficiency and stopping distance.	Apply

Text Book(s):

T1. Heinz heizler, “Advanced Vehicle Technology” – ButterworthHeinemann.2002.

T2. P S. Gill, “Automobile Engineering”, S.K. Kataria & Sons, 2010

T3. Newton, Steeds and Garrot- “Motor Vehicles”- Butterworths, London- 2000.

Reference Book(s):

R1. Heldt.P.M.- “Automotive Chassis”- Literary Licensing, LLC, 2012.

R2. N K Giri “Automobile Mechanics” Khanna Publications,2015.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	3	1	-	1	-	2
CO2	3	2	1	1	-	-	-	-	3	1	-	1	-	2
CO3	3	2	1	1	-	-	-	-	3	1	-	1	-	2
CO4	3	2	1	1	-	-	-	-	3	1	-	1	-	2
CO5	3	2	1	1	-	-	-	-	3	1	-	1	-	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO. No.	Marks	Total
Continuous Assessment	CCET I	1,2	50	20
	CCET II	3,4	50	
	CCET III	5	50	
	Continuous Assessment – Practical	1,2,3,4,5	75	10
	Final Assessment – Practical	1,2,3,4,5	50	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19PSHG6601	Course Title: EMPLOYABILITY SKILLS 2: CAMPUS TO CORPORATE (Common to all B.E / B.Tech Programmes)		
Course Category: Humanities	Course Level: Introductory		
L: T:P (Hours/Week): 0:0:2	Credit :1	Total Contact Hours: 30	Total Marks: 100

Pre-requisites:

- NIL

Course objectives:

The course is intended to:

1. Understand emotions and necessity to handle it to evolve as an effective social animal
2. Build effective resumes to project the positives to be employable
3. Facilitate working in a collaborative work environment and to engage in healthy agreements for building person's professional facet
4. Formulate the growth attribute to outperform, initiate and grow in professional arena
5. Explain time management and impart leadership skills.

UNIT I EMOTIONAL INTELLIGENCE 6

Nature of Emotions - Importance of EI -EQ vs IQ -Behavioral difference between EQ & IQ -Acquiring Emotional Intelligence -Benefits of high EI -Steps to develop EI -Role of EI in Interviews

UNIT II RESUME PREPARATION 6

Importance of Resume - Good Resume -Planning Resume -Organizing Resume - Spell check - Benefits of good resume -Resume Writing

UNIT III GROUP DISCUSSION 6

Purpose of GD -Prerequisites of GD-Benefits of GD-Features of GD-Do's & Don'ts in GD-Accept Criticism &Feedback-Accepting Suggestions-GD Phrases-Effective Introduction& Conclusion-Preferred Etiquette of GD.

UNIT IV INTERVIEW ETIQUETTE (NETIQUETTE) 6

Definition of Interview-Types of Interview -Prior interview-Know the Company - Employer's perspective in interview- Non Verbal etiquette-Dressing -Verbal Communication in Interview-Facing Rejection in Interview-Do's & Don'ts in an Interview-Common Interview Questions - Handling Stress Questions - Handling Telephonic Interviews.

UNIT V LEADERSHIP SKILLS & TIME MANAGEMENT 6

Leadership -Leadership Traits -Leadership styles -Types of Leaders -Qualities of a leader -Developing Perspectives

Time Management -Necessity of Time Management- Types of time -Estimation of time -Process of Time management -Efficient utilization of Time -Time wasting culprits - Tips to manage time -Goal setting in Time Management

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Understand the emotions and necessity to handle them	Understand
CO2: Build effective resumes to project the positives to be employable	Apply
CO3: Facilitate collaborative work environment and to engage in healthy agreements for building person's professional facet	Understand
CO4: Formulate the growth attribute to outperform, initiate and grow in professional arena	Apply
CO5: Explain time management and impart leadership skills	Understand

Text Book(s):

T1. Thea Kelley, "Get That Job! The Quick and Complete Guide to a Winning Interview " Plover crest Press, 2017

Reference Book(s):

R1. Daniel Goleman, " Emotional Intelligence Reader's Guide", BANTAM PUBLISHERS, 1997

R2. Daniel Goleman, Richard Boyatzis & Annie McKee, " Primal Leadership: Unleashing the Power of Emotional Intelligence**"** Harvard Business Review Press; Anniversary edition, 2013

R3. Stephen R Covey, " The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change" Simon & Schuster; Anniversary edition, 2013

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	1	-	1	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	2	-	1	-	-
CO3	-	-	-	-	-	-	-	-	1	1	-	1	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-
CO5	-	-	-	-	-	-	-	1	-	-	1	1	-	-

High -3, Medium – 2, Low-1

Assessment Details

Mode of Delivery:

1. Continuous learning and reviews guided by faculty
2. Guided Learning Workshop

Assessment	Details	Weight (%)	Remarks
Continuous Assessment	Diagnostic assessment of a student's communication skills, cognitive abilities, and behavioural traits during the course	25	Continuous
	MCQs/Diagnostic tests and Viva-voce	25	Two per semester - After CCET1 and after CCET2
Final Assessment	MCQs/Diagnostic tests and Viva-voce	50	End of Semester

Course Code: 19AUPN6601	Course Title: INNOVATIVE AND CREATIVE PROJECT		
Course Category: Project		Course Level: Mastery	
L:T:P (Hours/Week) 0: 0: 4	Credits: 2	Total Contact Hours:60	Max. Marks:100

Pre-requisites:

- Nil

Course Objective:

The course is intended to

1. Take up any challenging practical problems and find solution by formulating proper methodology.
2. Work collaboratively on a team to successfully complete a design project
3. Effectively communicate the results of projects in a written and oral format

The goal of this course is to help students to identify innovative projects that promote creativity to explore the variables that affect creativity and innovation. By the end of the semester, the students should be familiar with current thinking in their field, and able to apply the concepts to relevant research problems or practical applications. The goal of this course is to drive them to learn concepts, models, frameworks, and tools that engineering graduates' need in a world where creativity and innovation is fast becoming a precondition for competitive advantage. Each student will choose a frequently/commonly encountered workplace problem or socially relevant problems that have been difficult for them to "solve." At the end of the semester, each or group of students have to submit a report for evaluation.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Take up any challenging practical problems and find solution by formulating proper methodology.	Apply
CO2: Work collaboratively on a team to successfully complete a design project	Apply
CO3: Effectively communicate the results of projects in a written and oral format	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Course Code: 19AUPN6002	Course Title: INTERNSHIP OR SKILL DEVELOPMENT		
Course Category: Project		Course Level: Practice	
L:T:P (Hours/Week) 2 Weeks	Credits: 1	Total Contact Hours: Nil	Max. Marks:100

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Understand industry-specific terminology and practices
2. Solve simple industrial problems
3. Work collaboratively on a team
4. Effectively communicate the activities of internship in a written and oral format

Minimum of two weeks in an Industry in the area of Automobile Engineering. The summer internship should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to him/her. The outcome of the internship should be presented in the form of a report.

Course Outcomes At the end of this course, students will be able to:	Cognitive Level
CO1: Understand industry-specific terminology and practices	Understand
CO2: Solve simple industrial problems	Apply
CO3: Work collaboratively on a team	Apply
CO4: Effectively communicate the activities of internship in a written and oral format	Understand

Course Articulation Matrix

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

High-3; Medium-2; Low-1

END OF SEMESTER VI

Semester VII

Course Code: 19MECC1701	**Course Title: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING** (Common to AU, ME & MC)		
Course Category: Professional Core		**Course Level: Mastery**	
L:T:P (Hours/Week) 3: 0: 0	**Credits:3**	**Total Contact Hours:45**	**Max. Marks:100**

Prerequisites:

The student should have undergone the courses:

- Nil

Course Objective:

The course is intended to

1. Explain the basics of Artificial Intelligence and applications.
2. Explain search methods to achieve a goal.
3. Explain first-order logic to represent knowledge.
4. Explain the basics of machine learning and applications.
5. Explain the various machine learning techniques.

UNIT I ARTIFICIAL INTELLIGENCE – INTRODUCTION 9

AI - definition. Foundations of AI - History, trends and future. Intelligent Agents - agents and environments, the concept of rationality, the nature of environments, the structure of agents and types-case studies of Artificial Intelligence.

UNIT II PROBLEM SOLVING BY SEARCH 9

Problem solving agents, searching for solutions- Infrastructure for search algorithms, measuring problem-solving performance. Uninformed search strategies- Breadth-first search, Depth-first search, Iterative deepening search, Uniform-cost search, Bidirectional search, Comparing uninformed search strategies. Heuristic functions, Informed (heuristic) search strategies- Best first search.

UNIT III KNOWLEDGE REPRESENTATION 9

Introduction to Knowledge Representation- Hypothesis, Reasoning, Representing Knowledge, Syntax and semantics of Knowledge Representation language, Propositional- Logic. First-order logic: syntax and semantics of first-order logic, knowledge engineering in first-order logic, inference in first-order logic.

UNIT IV INTRODUCTION TO MACHINE LEARNING 9

Introduction: Basic definitions, types of learning, hypothesis, space and inductive bias, evaluation, cross-validation- Linear regression- R programming, Decision trees, over fitting-Instance based learning, Feature reduction, Collaborative filtering based recommendation- Probability and Bayes learning.

UNIT V MACHINE LEARNING TECHNIQUES 9

Introduction: Neural network - Perceptron, multilayer network, back propagation. Introduction to deep neural network- Computational learning theory, PCA learning model, Ensemble learning- Clustering: k-means, adaptive hierarchical clustering.-case studies on Machine Learning.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Explain the basic concept, and application of Artificial Intelligence.	Understand
CO2. Explain uninformed and informed search methods for problem solving.	Understand
CO3. Explain knowledge representation using first order logic.	Understand
CO4. Explain the basic concept, and application of Machine Learning.	Understand
CO5. Explain the classification and clustering techniques for decision making.	Understand

Text Book(s):

T1. Stuart J. Russell and Peter Norvig, “Artificial Intelligence- A Modern Approach”, Fourth Edition, Pearson Series, 2021.

T2. Tom M. Mitchell, “Machine Learning”, McGraw hill, 2013.

Reference Book(s):

R1. George Lugar, .Al-Structures and Strategies for and Strategies for Complex Problem solving, Sixth Edition, 2009, Pearson Educations.

R2. E. Rich and K. Knight, “Artificial intelligence”, McGraw Hill, 3rd ed., 2017.

R3. Robin R Murphy, Introduction to AI Robotics PHI Publication, 2nd edition,2019.

R4. Nils.J. Nilsson, “Principles of AI”, Narosa Publ. House, 2000.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	1	-	-	1	-	1	-	1	2	-
CO2	2	1	-	-	1	-	-	1	-	1	-	1	2	-
CO3	2	1	-	-	1	-	-	1	-	1	-	1	2	-
CO4	2	1	-	-	1	-	-	1	-	1	-	1	2	-
CO5	2	1	-	-	1	-	-	1	-	1	-	1	2	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Tutorials / Quiz / Assignments	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19AUCN1701	Course Title: ELECTRIC, HYBRID AND FUEL CELL VEHICLES		
Course Category: Professional Core		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:

The student should have undergone the courses:

- Automotive Electrical and Electronics

Course Objective:

The course is intended to

1. Explain the construction and working of power sources
2. Explain the performance characteristics and drives of electric vehicles
3. Explain the architecture of various hybrid vehicle designs
4. Explain the operating principle of fuel cells
5. Explain the regenerative braking system

UNIT I ENERGY SOURCES 9

Peaking Power Sources and Energy Storages - Electrochemical Batteries - Electrochemical Reactions, Thermodynamic Voltage, Specific Energy, Specific Power and Energy Efficiency. Battery Technologies – Lead-Acid Battery, Nickel-Cadmium Battery, Nickel-Metal-Hydride (NiMH) Battery, Li-Ion Battery, Zinc-Air Battery. Introduction to battery thermal management system.

UNIT II ELECTRIC VEHICLES 11

Configurations of EVs-Performance of EVs-Traction Motor Characteristics, Tractive Effort and Transmission Requirement and Vehicle Performance. Electric Propulsion Systems - DC Motor Drives-Induction Motor Drives- Induction Motor Drives- SRM Drives, Voltage-Balance Equation, Torque-Speed Characteristics

UNIT III HYBRID VEHICLES 9

Concept of Hybrid Electric Drive Trains-Architectures of Hybrid Electric Drive Trains-Series Hybrid Electric Drive Trains, Parallel Hybrid Electric Drive Trains. Fuel Cell Hybrid Electric Drive Train Design

UNIT IV FUEL CELLS 8

Operating Principles of Fuel Cells - Fuel Cell Technologies - Proton Exchange Membrane Fuel Cells, Alkaline Fuel Cells, Phosphoric Acid Fuel Cells, Molten Carbonate Fuel Cells, Solid Oxide Fuel Cells, and Direct Methanol Fuel Cells. Fuel Supply and reforming techniques.

UNIT V REGENERATIVE BRAKING 8

Braking energy consumption - Brake System of EV, HEV, and FCV - Control strategy for braking performance. Parallel Hybrid Braking System - Fully Controllable Hybrid Brake System.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1. Explain construction and working of power sources with their parameters used for electric vehicles	Understand
CO2. Explain the performance characteristics to improve performance of EV and drives used in electric vehicles	Understand
CO3. Compare the architecture of various hybrid vehicle designs based on their layouts	Apply
CO4. Compare the operating principle of fuel cells with their applications	Apply
CO5. Compare braking performance of EV, HEV and FCV	Apply

Text Book(s):

T1. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay and Ali Emadi, “Modern Electric, Hybrid and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRS Press, 2004.

T2. Ron Hodkinson and John Fenton, “Light Weight Electric/Hybrid Vehicle Design”, Butterworth- Heinemann, 2001

Reference Book(s):

R1. Ronald K Jurgen, “Electric and Hybrid – Electric Vehicles”, SAE, 2002

R2. James Larminie and John Loury, “Electric Vehicle Technology-Explained”, John Wiley &Sons Ltd., 2003.

R3. Iqbal Husain, “Electric and Hybrid Vehicles: Design Fundamentals”, Second Edition, CRC Press, 2011

Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	2	1	-	-	-	2	2	1	-	-	-	1	1	2
CO2	2	1	-	-	-	2	2	1	-	-	-	1	1	2
CO3	3	2	1	1	-	2	2	1	-	-	-	1	1	2
CO4	3	2	1	1	-	2	2	1	-	-	-	1	1	2
CO5	3	2	1	1	-	2	2	1	-	-	-	1	1	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Tutorials / Quiz / Assignments	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19AUCN1702	Course Title: VEHICLE DYNAMICS		
Course Category: Professional Core		Course Level: Mastery	
L:T:P (Hours/Week) 3 : 1 : 0	Credits:4	Total Contact Hours:60	Max. Marks:100

Pre-requisites:

- Automotive Chassis and Transmission
- Engineering Mechanics

Course objective:

Course is intended to:

1. Explain the basic concepts of vibration
2. Analyse the effect of vibrating elements
3. Analyse the ride and cornering characteristics of tyre
4. Analyse vertical dynamic response of suspension on vehicle stability
5. Analyse the vehicle handling characteristics

UNIT I CONCEPTS OF VIBRATION 9

Fundamentals of vibration-importance and sources- vibration terminologies- simple harmonic motion-vibration analysis procedure -parts of vibrating system – vehicle models- methods of vibration analysis- equilibrium method, energy method, Rayleigh method-types of vibration-free and forced vibration, linear and nonlinear vibration, damped and undamped vibration, deterministic and random vibration, torsional vibration

UNIT II SINGLE AND MULTI DEGREE OF FREEDOM 15

Free undamped vibration: differential equation- spring mass system-equivalent stiffness of spring combinations- frequency response of spring mass system. Free damped vibration: differential equation – under damping, critical damping and over damping-frequency response of spring, mass and damper system. Forced vibration: frequency response with external excitation – absolute motion-transmissibility- vibration isolation. Two degree of freedom-vibration response for undamped system-magnification factor

UNIT III TYRE DYNAMICS 12

Tyre terminology- tyre and vehicle axis system-rolling resistance of tyre- force generation mechanism- tractive properties-cornering properties- Slip angle, camber thrust, aligning moment, cornering behavior characteristics- ride properties.

UNIT IV VERTICAL DYNAMICS 12

Forces - side force, lift force, drag force- moments- yaw, roll, pitch and bounce – pitch and bounce frequencies of vehicle – anti squat and anti-dive geometry- roll center analysis- active suspension system – ride control, height control –load transfer- lateral and longitudinal- “g” force for different riding conditions.

UNIT V LATERAL DYNAMICS 12

Steering geometry-steering handling characteristics- under steer, over steer, neutral steer- steady state response – yaw velocity response, lateral acceleration response, curvature response – testing of handling characterizes- constant radius test, constant speed test, constant steering angle test- direction stability- influences on cornering- suspension effects and tractive effects

Course Outcomes:	**Cognitive Level**
At the end of the course students will be able to:	
CO1. Explain the fundamentals of vibration	Understand
CO2. Analyse the effect of vibrating elements (Spring, Mass & Damper) on vibrating systems	Analyze
CO3. Analyse the ride and cornering characteristics of tyre	Analyze
CO4. Analyse the vertical dynamic response of suspension on vehicle stability	Analyze
CO5. Analyse the vehicle handling characteristics based on lateral dynamics	Analyze

Text Book(s):

T1. Singiresu S.Rao, Mechanical Vibrations (5th Edition), Prentice Hall, 2010
T2. Thomas D.Gillespie, Fundamentals of Vehicle Dynamics (Edition 2,revised), Society of Automotive Engineers Inc, 2021.
T3. Dr.N.K.Giri, Automobile Mechanics (8th Edition), Khanna Publications, 2018

Reference Book(s):

R1. G.Nakhaie Jazar, Vehicle Dynamics: Theory and Application (2nd Edition), Springer, 2013
R2. Hans B Packeja, Tyre and Vehicle Dynamics (3rd Edition), SAE International, 2012
R3. J.Y. Wong, Theory of Ground Vehicles (4th Edition), Wiley-Interscience, 2008.

Web References:

1. https://nptel.ac.in/courses/107/106/107106080/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	1	2	3
CO2	3	3	2	2	-	-	-	-	-	-	-	1	2	3
CO3	3	3	2	2	-	-	-	-	-	-	-	1	2	3
CO4	3	3	2	2	-	-	-	-	-	-	-	1	2	3
CO5	3	3	2	2	-	-	-	-	-	-	-	1	2	3

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Assignments	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19MECC3701	Course Title: SIMULATION AND ANALYSIS LABORATORY (Common to AU & ME)		
Course Category: Professional Core		Course Level: Practice	
L:T:P: 0: 0: 3	Credits:1.5	Total Contact Hours: 45	Max Marks:100

Pre-requisites:

The student should have undergone the course(s):

- Numerical Methods
- Strength of Materials
- Mechanics of Machines

Course Objectives:

The course is intended to

1. Apply finite element simulation software
2. Write programs in a mathematical simulation software

Simulation Experiments

1. Simulation of Air conditioning system with condenser temperature and evaporator temperatures as input to get COP using simulation software.
2. Simulation of free vibration characteristics of spring, mass and damper system using simulation software.
3. Simulation of Hydraulic / Pneumatic cylinder using simulation software.
4. Simulation of cam and follower mechanism using simulation software.

Analysis Experiments (Simple Treatment Only)

1. Stress analysis of beams (Cantilever, Simply supported)
2. Stress analysis of rectangular L bracket
3. Stress analysis of an Axi-symmetric component
4. Modal analysis of a 2 D component
5. Modal analysis of beams(Simply supported, Fixed ends)
6. Harmonic analysis of a 2D component
7. Thermal stress analysis of a 2D component
8. Conductive and Convective heat transfer analysis of a 2D component
9. Stress analysis of a 3 D component

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Apply finite element simulation software to solve simple problems such as structural, thermal and vibration problems in Mechanical Engineering.	Apply
CO2. Write programs in a mathematical simulation software to solve mathematical model of mechanical engineering applications	Apply

Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	2	3	-	-	2	3	1	-	1	3	3
CO2	3	2	2	2	3	-	-	2	3	1	-	1	3	3

High-3; Medium-2; Low-1

Assessment pattern

	Assessment component	Marks	Total Marks
Continuous comprehensive Evaluation	Each Lab Experiment	75	100
	Cycle Test 1	50	
	Cycle Test 2	50	

SEMESTER VIII

Course Code: 19AUPN3801	Course Title: PROJECT		
Course Category: Project		Course Level: Mastery	
L:T:P (Hours/Week) 0: 0: 16	Credits:8	Total Contact Hours:240	Max. Marks:100

Pre-requisites:

- Fundamental and advanced courses in Automobile engineering

Course Objectives:

The course is intended to:

1. Take up any challenging practical problems and find solution by formulating proper methodology.
2. Work collaboratively on a team to successfully complete a project
3. Effectively communicate the results of projects in multiple methods

The objective of Project is to enable the student to take up investigative study in the broad field of Automobile Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

1. Survey and study of published literature on the assigned topic.
2. Working out a preliminary Approach to the Problem relating to the assigned topic.
3. Conducting preliminary Analysis/ Modelling/ Simulation/ Experiment/ Design/ Feasibility.
4. Preparing a Written Report on the Study conducted for presentation to the Department.
5. Final Seminar, as oral Presentation before a departmental committee.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Take up any challenging practical problems and find solution by formulating proper methodology.	Apply
CO2: Work collaboratively on a team to successfully complete a design project	Create
CO3: Effectively communicate the results of projects in a written and oral format	Apply

Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	3	3	-	-	-	3	3	3	-
CO2	-	-	3	-	-	-	-	3	3	-	3	3	3	-
CO3	-	-	-	-	-	-	-	-	-	3	-	3	3	-

High-3; Medium-2; Low-1

Course Code: 19AUPN6003	Course Title: INTERNSHIP (Common to all B.E/B.Tech Programmes)		
Course Category: Internship		Course Level: Practice	
L:T:P (Hours/Week) 8/16 Weeks	Credits: 4	Total Contact Hours: 240	Max. Marks:100

Pre-requisites:

- Fundamental and advanced courses in Automobile engineering

Course Objectives:

The course is intended to:

1. Understand industry-specific terminology and practices
2. Solve simple industrial problems
3. Work collaboratively on a team
4. Effectively communicate the activities of internship in a written and oral format

Minimum of 8/16 weeks in an Industry in the area of Automobile Engineering. The summer internship should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to him/her. The outcome of the internship should be presented using multiple methods and formats

Course Outcomes At the end of this course, students will be able to:	Cognitive Level
CO1: Understand industry-specific terminology and practices	Understand
CO2: Solve simple industrial problems	Apply
CO3: Work collaboratively on a team	Create
CO4: Effectively communicate the activities of internship in a written and oral format	Apply

Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1	1	1	1	-	-	3	2	1	1	1	3	-
CO2	3	3	3	3	3	-	-	3	2	1	1	1	3	-
CO3	2	1	1	1	1	-	-	3	2	1	1	1	3	-

High-3; Medium-2; Low-1

End of Semester VIII

ELECTIVES

Course Code: 19AUEN1001	Course Title: MECHANICS OF ROAD VEHICLES		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- Engineering Mechanics
- Mechanics of Machines

Course Objectives:

The course is intended to:

1. Determine the static and dynamic forces
2. Calculate the balancing forces of various masses
3. Analyze the effects of gyroscopic and fuel governing mechanisms
4. Calculate the tractive characteristics of vehicle
5. Analyze the stability characteristics of vehicle

UNIT I FORCE ANALYSIS 9

Applied and Constraint Forces - Free body diagrams - Static Equilibrium conditions - two, three and four force members - Static force analysis in simple mechanisms – Dynamic force analysis – Inertia force and Inertia torque – D'Alemberts principle Dynamic Analysis in Reciprocating Engines Gas Forces - Equivalent masses - Bearing loads - Crank shaft Torque - Turning moment diagrams – Fly wheels - Engine shaking Forces

UNIT II BALANCING 9

Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder Engine Balancing Multi-cylinder Engines Balancing of reciprocating parts Concepts of direct and reverse crank mechanism

UNIT III GYROSCOPIC AND GOVERNING MECHANISM 9

Gyroscopic principle - gyroscopic couple Effect of gyroscopic couple and centrifugal couple on four wheeled vehicle - Gyroscopic forces and Torques – Gyroscopic stabilization - Gyroscopic effects in ships and airplanes. Governors - Types -

Centrifugal governors- Classification of governors- sensitivity of various types of governor- controlling force of governor

UNIT IV VEHICLE PERFORMANCE 9

Power requirement for propulsion, Air, Rolling and Gradient Resistances- Road performance curve for maximum acceleration – Determination of Centre of gravity – Drawbar pull, maximum speed and gradability, Maximum tractive effort calculation - handling and ride characteristics on different road surfaces

UNIT V VEHICLE STABILITY 9

Calculation of equivalent weight- distribution of weight- stability of a vehicle on a slope - reactions for different drive - dynamics of a vehicle running on a banked track – stability of vehicle during cornering

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Determine the static and dynamic forces acting in reciprocating engines	Apply
CO2: Calculate the balancing forces of rotating and reciprocating masses	Apply
CO3: Analyze the effects of gyroscopic and fuel governing mechanisms in automobile	Analyze
CO4: Calculate the tractive characteristics of vehicle for different types of drive (front, rear and four wheel drives)	Apply
CO5: Analyze the stability characteristics of vehicle for various tracks (banked, curved and grade)	Analyze

Text Book(s):

T1. Shigley J.E. and Uicker J J., “Theory of Machines and Mechanisms”. McGraw Hill.Inc., 2002.

T2. N.K. Giri “Automobile Mechanics” Khanna Publishers, 2015.

Reference Book(s):

R1. Thomas Beven, “Theory of Machines”, CBS Publishers and Distributors, 1984.

R2. Rattan SS, “Theory of Machines”, Tata McGraw Hill Publishing company Ltd. New Delhi, 1994

R3. Hans B Packeja, “Tyre and Vehicle Dynamics”, 2nd Edition, SAE International, 2005

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	1	1	-	1	2	3
CO2	3	2	1	1	-	-	-	1	1	1	-	1	2	3
CO3	3	3	2	2	-	-	-	1	1	1	-	1	2	3
CO4	3	2	1	1	-	-	-	1	1	1	-	1	2	3
CO5	3	3	2	2	-	-	-	1	1	1	-	1	2	3

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	**CCET 1**	**1,2**	**50**	**30**
	CCET 2	**3,4**	**50**	
	Retest	**1,2,3,4**	**50**	
	CCET 3	**5**	**50**	
	Assignment	**1,2,3,4,5**	**30**	**10**
End Semester Examination	**ESE**	**1,2,3,4,5**	**100**	**60**
Total				**100**

Course Code: 19AUEN1002	Course Title: VEHICLE SAFETY AND COMFORT SYSTEMS		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- Automotive Chassis and Transmission
- Automotive Electrical and Electronics

Course Objectives:

The course is intended to:

1. Explain the engineering principles that are necessary for the design of an automobile for the safety and comfort of the occupants and other road users.
2. Explain the role and use of safety systems.
3. Explain crashworthiness and failure analysis.
4. Explain the role and use of comfort systems.
5. Explain the importance of ergonomics and NVH.

UNIT I INTRODUCTION TO SAFETY SYSTEMS 9

Vehicle safety system – History, Role of material science in design, Material selection - automotive structure and safety - safety aspects of design for BIW,

UNIT II CONSTRUCTION AND OPERATION OF SAFETY SYSTEMS 9

Construction and operation of safety systems such as: airbags, safety cage, roof crush, crumple zones, seat belts, bumper, bonnet and impact bars.

UNIT III CRASHWORTHINESS AND FAILURE ANALYSIS 9

Crashworthiness legislation, Crash analysis; front crash, rear crash and side crash, The role of HMI Systems in safety aspects of automotive systems, CAE/FEA in analysis of vehicle structure, Fatigue failure analysis for vehicle structure, The role of different vehicle systems in safety aspects

UNIT IV INTRODUCTION TO COMFORT SYSTEMS 9

Embedded Systems (automotive electronics), Interior cabin comfort systems, including seating, lighting, thermal comfort

UNIT V VEHICLE ERGONOMICS AND NVH 9

Vehicle ergonomics and human factors, Human Machine Interface (HMI), automotive sound quality and NVH, Perceived quality, smart driving technologies

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the engineering principles that are necessary for the design of an automobile for the safety and comfort of the occupants and other road users.	Understand
CO2: Explain the role and use of safety systems in vehicle engineering.	Understand
CO3: Explain crashworthiness and failure analysis of a vehicle.	Understand
CO4: Explain the role and use of comfort systems in vehicle engineering.	Understand
CO5: Explain the importance of ergonomics and NVH in vehicle comfort system.	Understand

Text Book(s):

T1. George A. Peters, Barbara J. Peters, “Automotive Vehicle Safety”, Taylor & Francis, 2002

T2. Jack Erjavec, “Automotive Technology: A Systems Approach”, Volume 2, Delmar Cengage Learning, 1992

Reference Book(s):

R1. Ulrich W. Seiffert, Mark Gonter , “Integrated Automotive Safety Handbook”, SAE International,2013

R2. Robert Bosch “Safety, Comfort and Convenience Systems” 3rd Edition, Wiley-Blackwell 2006.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	1	-	1	-	1	-	1	2	3
CO2	2	1	-	-	-	1	-	1	-	1	-	1	2	3
CO3	2	1	-	-	-	1	-	1	-	1	-	1	2	3
CO4	2	1	-	-	-	1	-	1	-	1	-	1	2	3
CO5	2	1	-	-	-	1	-	1	-	1	-	1	2	3

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	**CCET 1**	**1,2**	**50**	**30**
	CCET 2	**3,4**	**50**	
	Retest	**1,2,3,4**	**50**	
	CCET 3	**5**	**50**	
	Assignment	**1,2,3,4,5**	**30**	**10**
End Semester Examination	**ESE**	**1,2,3,4,5**	**100**	**60**
Total				**100**

Course Code: 19AUEN1003	Course Title: HYDRAULIC AND PNEUMATIC SYSTEMS		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- Fluid Mechanics and Hydraulic Machinery
- Mechanics of Machines

Course Objectives:

The course is intended to:

1. Explain different fluid power systems and its applications.
2. Explain various hydraulic system components and applications.
3. Design the hydraulic circuits for desired application.
4. Explain various pneumatic system components and applications
5. Design the pneumatic circuits for desired application.

UNIT I FLUID POWER SYSTEM AND FUNDAMENTALS 9

Introduction to Fluid power - Types of fluid power systems - Hydraulic system components -Pneumatic system components - Application of Pascal's Law in hydraulics-Advantages of fluid power system -Applications of Fluid power system - Properties of hydraulic fluids - Types of fluids.

UNIT II HYDRAULIC SYSTEM AND COMPONENTS 9

Pumping theory - Pump classification - Construction and working of gear pumps, Vane pumps, Piston pumps - Construction and working of linear actuators - Special cylinder - Rotary actuator – Construction and operation of direction control valves (DCV), Pressure control valve, Flow control valve – Construction and operation of accumulators, Intensifiers.

UNIT III DESIGN OF HYDRAULIC CIRCUITS 9

Hydraulic symbols - Hydraulic circuits for linear actuators - Hydraulic circuits using different actuating devices - Speed control circuits - Sequencing circuit - Synchronizing circuit - Regenerative circuit - Accumulator circuit – Application of intensifier - Hydraulic circuit for Milling operation, Grinding Machine - Hydraulic braking in Automobile.

UNIT IV PNEUMATIC SYSTEM AND COMPONENTS 9

Properties of air – Compressor - Types of compressor - Construction and operation of air filter, air regulator, air lubricator - Pneumatic linear actuator - Rotary actuator - Constriction and working of pneumatic direction control valve – Flow control valve - Pneumatic symbols

UNIT V DESIGN OF PNEUMATIC CIRCUITS 9

Pneumatic circuits for single acting cylinder, Double acting cylinder - Pneumatic circuits using manual, mechanical, electrical actuating devices - Cascade method for sequencing: two and three Cylinders - Step counter method- Hydro-Pneumatic circuit - Material handling system circuit - Multiple operation Machining.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the fluid power systems with advantages and applications.	Understand
CO2: Explain construction and working of hydraulic system components.	Understand
CO3: Design hydraulic circuit to perform the desired function.	Apply
CO4: Explain construction and working of pneumatic system components	Understand
CO5: Design pneumatic circuit to perform the desired function.	Apply

Text Book(s):

T1. Esposito Anthony, “Fluid Power with Applications”, Pearson Education Inc., New York, 2008.

T2. Majumdar, S.R., “Oil Hydraulic Systems – Principles and Maintenance”, Tata McGraw-Hill, New Delhi, 2006.

Reference Book(s):

R1. Srinivasan.R, “Hydraulic and Pneumatic controls”, Vijay Nicole, 2006.

R2. Andrew Parr, “Hydraulics and Pneumatics, A technician's and engineer's guide”, Third Edition, Butterworth-Heinemann, 2011.

R3. Majumdar, S.R., “Pneumatic Systems – Principles and Maintenance”, Tata McGraw-Hill, New Delhi, 2006

Web References:

1. http://www.nptel.ac.in/courses/112106175/
2. http://nptel.ac.in/courses/112105046/
3. http://www.nitc.ac.in/dept/me/jagadeesha/mev303/Chapter2_Hydraulics_control_in_machine_tools.pdf
4. http://maysaaiat.weebly.com/uploads/5/8/8/3/5883161/atm1122_hydraulics_module_1.pdf

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO2	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO3	3	2	1	1	-	-	-	1	-	1	-	1	1	2
CO4	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO5	3	2	1	1	-	-	-	1	-	1	-	1	1	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	**100**

Course Code: 19AUEN1004	Course Title: AUTOMOTIVE AERODYNAMICS		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- Fluid Mechanics and Hydraulic Machinery

Course Objectives:

The course is intended to:

1. Describe the Potential of vehicle aerodynamics
2. Calculate the drag coefficient of cars
3. Explain the shape optimization of cabs
4. Calculate forces and moments due to side winds
5. Demonstrate the use of wind tunnel for automotive aerodynamics

UNIT I INTRODUCTION 9

Scope – historical development trends – Fundamentals of fluid mechanics – Flow phenomenon related to vehicles – External & Internal flow problems – Resistance to vehicle motion – Performance – Fuel consumption and performance – Potential of vehicle aerodynamics.

UNIT II AERODYNAMIC DRAG OF CABS 9

Car as a bluff body – Flow field around car – drag force – types of drag force – analysis of aerodynamic drag – drag coefficient of cars – strategies for aerodynamic development – low drag profiles.

UNIT III SHAPE OPTIMIZATION OF CABS 9

Front and modification – front and rear wind shield angle – Boat tailing – Hatch back, fast back and square back – Dust flow patterns at the rear – Effect of gap configuration – effect of fasteners.

UNIT IV VEHICLE HANDLING 9

The origin of force and moments on a vehicle – side wind problems – methods to calculate forces and moments – vehicle dynamics under side winds – the effects of forces and moments – Characteristics of forces and moments – Dirt accumulation on the vehicle – wind noise – drag reduction in commercial vehicles.

UNIT V WIND TUNNELS FOR AUTOMOTIVE AERODYNAMICS 9

Introduction – Principles of wind tunnel technology – Limitation of simulation – Stress with scale models – full scale wind tunnels – measurement techniques – Equipment and transducers – road testing methods – Numerical methods.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Describe the Potential of vehicle aerodynamics	Understand
CO2: Calculate the drag coefficient of cars	Apply
CO3: Explain the shape optimization of cabs	Understand
CO4: Calculate forces and moments due to side winds	Apply
CO5: Demonstrate the use of wind tunnel for automotive aerodynamics	Apply

Text Book(s):

T1. Hucho, W.H., Aerodynamics of Road vehicles, Butterworths Co. Ltd., 1997.

Reference Book(s):

R1. Pope, A, Wind Tunnel Testing, John Wiley & Sons, 2nd Edn., New York, 1994.

R2. Automotive Aerodynamics: Update SP-706, SAE, 1987.

R3. Vehicle Aerodynamics, SP-1145, SAE, 1996.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO2	3	2	1	1	-	-	-	1	-	1	-	1	1	2
CO3	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO4	3	2	1	1	-	-	-	1	-	1	-	1	1	2
CO5	3	2	1	1	-	-	-	1	-	1	-	1	1	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code: 19AUEN1005	Course Title: NOISE, VIBRATION AND HARSHNESS		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- Automotive Electrical and Electronics

Course Objectives:

The course is intended to:

1. Describe the sources of noise and vibration
2. Explain the effects of NVH on people
3. Explain the effects of noise and vibration on external environment
4. Explain the effects of noise and vibration on internal environment
5. Explain the measurement methods of noise and vibration

UNIT I FUNDAMENTALS OF ACOUSTICS AND NOISE, VIBRATION 8

Theory of Sound—Predictions and Measurement, Sound Sources, Sound Propagation in the Atmosphere, Sound Radiation from Structures and Their Response to Sound, General Introduction to Vibration, Vibration of Simple Discrete and Continuous Systems, Random Vibration, Response of Systems to Shock, Passive Damping

UNIT II EFFECTS OF NOISE, BLAST, VIBRATION, AND SHOCK ON PEOPLE 7

General Introduction to Noise and Vibration Effects on People and Hearing Conservation, Sleep Disturbance due to Transportation Noise Exposure, Noise-Induced Annoyance, Effects of Infrasound, Low-Frequency Noise, and Ultrasound on People, Auditory Hazards of Impulse and Impact Noise, Effects of Intense Noise on People and Hearing Loss, Effects of Vibration on People, Effects of Mechanical Shock on People, Rating Measures, Descriptors, Criteria, and Procedures for Determining Human Response to Noise.

UNIT III TRANSPORTATION NOISE AND VIBRATION 10

Introduction to Transportation Noise and Vibration Sources, Internal Combustion Engine Noise Prediction and Control—Diesel, Exhaust and Intake Noise and Acoustical Design of Mufflers, Tire/Road Noise—Generation, Measurement, and Abatement, Aerodynamic Sound Sources in Vehicles—Prediction and Control, Transmission and Gearbox Noise and Vibration Prediction and Control, Brake Noise Prediction and Control.

UNIT IV INTERIOR TRANSPORTATION NOISE AND VIBRATION 10

Introduction to Interior Transportation Noise and Vibration Sources, Automobile, Bus, and Truck Interior Noise and Vibration Prediction and Control, Noise and Vibration in Off-Road Vehicle Interiors- Prediction and Control

UNIT V NOISE AND VIBRATION TRANSDUCERS 10

General Introduction to Noise and Vibration Transducers, Measuring Equipment, Measurements, Signal Acquisition, and Processing, Acoustical Transducer Principles and Types of Microphones, Vibration Transducer Principles and Types of Vibration Transducers, Sound Level Meters, Noise Dosimeters, Analyzers and Signal Generators, Equipment for Data Acquisition, Noise and Vibration Measurements, Determination of Sound Power Level and Emission Sound Pressure Level, Sound Intensity Measurements, Noise and Vibration Data Analysis, Calibration of Measurement Microphones, Calibration of Shock and Vibration Transducers, Metrology and Traceability of Vibration and Shock Measurements.

Course Outcomes **At the end of this course, students will be able to:**	**Cognitive Level**
CO1: Describe the sources of noise and vibration	Understand
CO2: Explain the effects of NVH on people	Understand
CO3: Explain the effects of noise and vibration on external environment	Understand
CO4: Explain the effects of noise and vibration on internal environment	Understand
CO5: Explain the measurement methods of noise and vibration	Understand

Text Book(s):

T1. Clarence W. de Silva , “Vibration Monitoring, Testing, and Instrumentation “,CRC Press, 2007

T2. David A.Bies and Colin H.Hansen “Engineering Noise Control: Theory and Practice“ Spon Press, London, 2009

Reference Book(s):

R1. Munjal M.L., Acoustic Ducts and Mufflers, John Wiley, 1987

R2. Norton M P, Fundamental of Noise and Vibration, Cambridge University Press,1989

R3. Allan G. Piersol ,Thomas L. Paez “Harris’ Shock and Vibration Handbook” , McGraw Hill, New Delhi, 2010

R4. Colin H Hansen “Understanding Active Noise Cancellation“ , Spon Press , London 2003

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	2	2	1	-	1	-	1	1	3
CO2	2	1	-	-	-	2	2	1	-	1	-	1	1	3
CO3	2	1	-	-	-	2	2	1	-	1	-	1	1	3
CO4	2	1	-	-	-	2	2	1	-	1	-	1	1	3
CO5	2	1	-	-	-	2	2	1	-	1	-	1	1	3

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	**100**

Course Code: 19AUEN1006	Course Title: OFF ROAD VEHICLES		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- Automotive Chassis and Transmission

Course Objectives:

The course is intended to:

1. Explain the construction and layout of earth moving equipments
2. Explain the construction and layout of constructional equipments
3. Explain the construction and layout of farm equipments
4. Explain the construction and layout of industrial vehicles
5. Explain the construction and layout of military and combat vehicles

UNIT I EARTH MOVING EQUIPMENTS 9

Construction Layout, Capacity and applications of earth movers like dumpers, Front End loaders, Bull Dozers, Backhoe Loaders, Scrappers, Bucket Conveyors Etc., Selection Criteria of prime mover for dumper and front end loaders based on vehicle performance characteristics

UNITII CONSTRUCTIONAL EQUIPMENTS 9

Layout of constructional equipments, Excavators, Jip Cranes, Hoist motor graders, Mixing machine, Concrete ready mixers, Drillers, Ramming machines for constructions of bridges and working principles, Power generators

UNIT III FARM EQUIPMENTS 9

Classification of tractors - Main components of tractor. Working attachment of tractors- Auxiliary equipment - Trailers and body tipping mechanism- Ploughing - Paddy plantation machine harvesting machines, sugarcane harvesting, and Power trailers.

UNIT IV INDUSTRIAL APPLICATIONS 9

Constructional Features, Capacity and stability of Jib Cranes, Vibratory compactors, Fork Lifts. Towing Vehicles, Case Studies

UNIT V MILITARY AND COMBAT VEHICLES 9

Ride and stability characteristics, Power take off, Special Implementations. Special Features and constructional details of tankers, Gun carriers and transport vehicles, Bridge builders, Communication Vehicles.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the construction and layout of earth moving equipments	Understand
CO2: Explain the construction and layout of constructional equipments	Understand
CO3: Explain the construction and layout of farm equipments	Understand
CO4: Explain the construction and layout of industrial vehicles	Understand
CO5: Explain the construction and layout of military and combat vehicles	Understand

Text Book(s):

T1. Abrosimov.K, Bran Berg A and Katayer K., “Road making machinery”, MIR Publishers, Moscow, 1971.

T2. Wong J T .,”Theory of ground Vehicles”., John wiley& sons,Newyok,1987

Reference Book(s):

R1. Bart H vanderveen, Tanks and transport vehicles, Fresdericwarne and CO ltd., London

R2. Kolchin A and Demidov V “Design of Automotive Engines for Tractor”, MIR Publishers, 1972.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	2	3
CO2	2	1	-	-	-	-	-	1	-	1	-	1	2	3
CO3	2	1	-	-	-	-	-	1	-	1	-	1	2	3
CO4	2	1	-	-	-	-	-	1	-	1	-	1	2	3
CO5	2	1	-	-	-	-	-	1	-	1	-	1	2	3

High-3; Medium-2; Low-1

Assessment pattern

Continuous Comprehensive Evaluation	**Assessment Component**	**CO .No.**	**Marks**	**Total**
	CCET 1	**1,2**	**50**	**30**
	CCET 2	**3,4**	**50**	
	Retest	**1,2,3,4**	**50**	
	CCET 3	**5**	**50**	
	Assignment	**1,2,3,4,5**	**30**	**10**
End Semester Examination	**ESE**	**1,2,3,4,5**	**100**	**60**
Total				**100**

Course Code: 19MEEC1002	Course Title: DESIGN FOR MANUFACTURE, ASSEMBLY AND ENVIRONMENT		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- Design of Automotive Elements

Course Objectives:

The course is intended to:

1. Explain the design principles for manufacturability
2. Describe the factors influencing form design
3. Explain the machining consideration while design
4. Optimize the given casting part.
5. Explain the environmental consideration in design.

UNIT I INTRODUCTION 9

General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances - Geometric tolerances - Assembly limits -Datum features - Tolerance stacks, GD & T

UNIT II FORM DESIGN OF CASTINGS, FORGINGS AND WELDMENTS 9

Working principle, Material, Manufacture, Design- Possible solutions – Materials choice - Influence of materials on form design - form design of welded members, forgings and castings.

UNIT III COMPONENT DESIGN - MACHINING CONSIDERATION 9

Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area- simplification by separation - simplification by amalgamation - Design for machinability - Design for economy - Design for clampability - Design for accessibility - Design for assembly.

UNIT IV COMPONENT DESIGN – CASTING CONSIDERATION 9

Redesign of castings based on Parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores.

Identification of uneconomical design - Modifying the design - group technology - Computer Applications for DFMA

UNIT V DESIGN FOR THE ENVIRONMENT AND DFMA TOOLS 9

Introduction – Environmental objectives – Global issues – Regional and local issues – Basic DFE methods – Design guide lines – Example application – Lifecycle assessment – Basic method – AT&T's environmentally responsible product assessment - Weighted sum assessment method – Lifecycle assessment method – Techniques to reduce environmental impact – Design to minimize material usage – Design for disassembly – Design for recyclability – Design for remanufacture – Design for energy efficiency – Design to regulations and standards.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the design principles for manufacturability considering strength, process capability and tolerances.	Understand
CO2: Describe the factors influencing form design of castings, forgings and welding.	Understand
CO3: Explain the machining consideration while design such as machinability, economy, clampability, accessibility and assembly.	Understand
CO4: Optimize the given casting part by applying design principles.	Understand
CO5: Explain the environmental consideration in design while using DFMA tools.	Understand

Text Book(s):

T1. Geoffrey Boothroyd, Peter Dewhurst, Winston A. Knight , "Product Design for Manufacture and Assembly", Third Edition, T&F INDIA, 2019

T2. Boothroyd, G, "Design for Assembly, Automation and Product Design"., Marcel Dekker, New York 2005

Reference Book(s):

R1 Harry Peck , "Designing for Manufacture", Pitman Publishing, 1973

R2 Dickson, John. R, and Corroda Poly, "Engineering Design and Design for Manufacture and Structural Approach", Field Stone Publisher, USA, 1999

R3 Fixel, J. "Design for the Environment" McGraw hill., 2011.

Web References:

1. http://www.nptel.ac.in/courses/112101005/
2. https://ocw.mit.edu/courses/mechanical-engineering/2-008-design-and-manufacturing-ii-spring-2004/lecture-notes/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	2	2
CO2	2	1	-	-	-	-	-	1	-	1	-	1	2	2
CO3	2	1	-	-	-	-	-	1	-	1	-	1	2	2
CO4	2	1	-	-	-	-	-	1	-	1	-	1	2	2
CO5	2	1	-	-	-	-	-	1	-	1	-	1	2	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	**CCET 1**	**1,2**	**50**	**30**
	CCET 2	**3,4**	**50**	
	Retest	**1,2,3,4**	**50**	
	CCET 3	**5**	**50**	
	Assignment	**1,2,3,4,5**	**30**	**10**
End Semester Examination	**ESE**	**1,2,3,4,5**	**100**	**60**
			Total	**100**

Course Code: 19MEEC1007	Course Title: DESIGN FOR SHEET METAL (Common to AU & ME)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites

The student should have undergone the courses:

- Production Processes
- Strength of materials

Course Objectives

The course is intended to:

1. Calculate the forces involved in bending and drawing operations.
2. Select appropriate press tools.
3. Select appropriate press machines.
4. Suggest a suitable bending process.
5. Estimate the cost required for forming and tube bending.
6. Choose a suitable sequence and tool for forming and tube bending processes.

UNIT I SHEET METAL & FORMING PROCESS 9

Basics of forming, bending & drawing process, Advantages and its Applications in Automotive Parts. Terminology of forming & bending- Bending force & Blank holding force Calculations, Spring Back, Bending defects and remedies. terminology of drawing -Working principle of drawing operations and reverse drawing, Calculation of Draw force, Calculation of cutting force, Blanking & Piercing, Blank holding force (Die cushion), Blank development - No of Draws - Selection of Press tonnage, defects, causes and remedies in drawing operation.

UNIT II PRESS TOOLS 8

Types of forming and press tools, Basis of selection of forming and press tool, Tool steel and merits, demerits and its applications, Tool Design, Tool Maintenance, Punches Types of Punches and Punch tool requirements.

UNIT III PRESS MACHINES 8

Presses - Types of Press machines based on Source of Power, Press tonnage, Slide Actuation & Capacity and its merits & demerits and application of presses and Material handling devices or equipment's and its types- Economic factor & selection of press.

UNIT IV TUBE BENDING PROCESS AND EQUIPMENTS 9

Tube bending process -Types of tube bending operation - Compression Bending, Rotary Draw Bending, Press Bending, Roll Bending, Single or double bend ,3D Bend, Tube on Tube bend, Tube bending related to shapes & size-Round, Rectangular & Square, Materials used Tube bending parts. Equipment's of Tube bending – Conventional type pipe bending machine - clamp - wiper shoe - Bend form – Mandrel, Single axis pipe bending machine, 3 axis & 5 axis pipe bending machine.

UNIT V TOOL COSTING AND SELECTIONS 11

Cost drivers for formed part – Tool cost estimation - Trial & Inspection cost overhead cost & profit. Determination of Sequence and Tool selection - Sequence of operation available in the given part - Blanking tool & Piercing tool design - Draw the component drawing & Strip layout - stripping force - Draw the assembly of tool drawing & BOM - Draw the individual tool elements part drawing for Manufacturing. Prepare the process planning chart. Inspection, trials and Troubleshooting - checklist for tool in static condition - checklist for tool in Dynamic condition - general inspection methods. Specific inspection methods (Panel checker/acceptance gauge).

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Calculate the forces involved in bending and drawing operations such as bending force, drawing force and blank holding forces.	Apply
CO2: Select appropriate press tools for forming processes based on the geometry and material of the given part.	Apply
CO3: Select appropriate press machines for forming processes based on the geometry and material of the given part.	Apply
CO4: Suggest a suitable bending process based given part geometry and material.	Apply
CO5: Estimate the cost required for forming and bending for the given part.	Apply

Text Book(s):

T1. SeropeKalpakjian and Steven R. Schmid, “Manufacturing Engineering and Technology”, Addition Wesley Longman Pvt. Ltd., First Indian reprint, 2000.

T2. S.K. HajraChoudhury and A.K. HajraChoudhury, “Elements of Work shop Technology”, Vol – I Manufacturing Processes, Media Promoters and Publishers Pvt. Ltd, 1986.

Reference Book(s):

R1. S.L. Semiatin “ASM Handbook Volume 14B: Metalworking: Sheet Forming”, 2006.

R2. Schuler “Metal Forming Handbook”, Springer-Verlag Berlin Heidelberg 1998

R3. Kurt Lange, "Handbook of Metal Forming", Society of Manufacturing Engineers,1985

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	-	1	-	1	1	2
CO2	3	2	1	1	-	-	-	1	-	1	-	1	1	2
CO3	3	2	1	1	-	-	-	1	-	1	-	1	1	2
CO4	3	2	1	1	-	-	-	1	-	1	-	1	1	2
CO5	3	2	1	1	-	-	-	1	-	1	-	1	1	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	**CCET 1**	**1,2**	**50**	**30**
	CCET 2	**3,4**	**50**	
	Retest	**1,2,3,4**	**50**	
	CCET 3	**5**	**50**	
	Assignment	**1,2,3,4,5**	**30**	**10**
End Semester Examination	**ESE**	**1,2,3,4,5**	**100**	**60**
Total				**100**

Course Code: 19AUEN1007	Course Title: COMPUTER INTEGRATED MANUFACTURING		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- Production processes

Course Objectives:

The course is intended to:

1. Explain NC, DNC and CNC used in CIM.
2. Apply the features of CAD System in design and modeling and understanding the integration of CAE
3. Explain the role of AGVs, AS/RS and Robots in material handling and Storage System.
4. Describe Group Technology and Classification of Coding system.
5. Explain Artificial Intelligent system, Expert system and FMS.

UNIT I INTRODUCTION 9

Automated Manufacturing system – Needs, Types. CIM - CIM wheel - Components, Evolution, needs, Benefits. NC system - Components, NC motion control system, application, advantages and disadvantages. Computer Numerical control System – Components, functions, advantages. Direct Numerical Control System – Components, functions, advantages.

UNIT II COMPUTER AIDED DESIGN, COMPUTER AIDED ENGINEERING 9

Concept of CAD as drafting and designing facility, desirable features of CAD package, drawing features in CAD - typical CAD command structure - Types CAD modeling - wire frame modeling, surface modeling and solid modeling-Reverse engineering - Modeling of geometry of parts -Modeling of assemblies and disassemblies – Sustainable engineering –Different modeling packages -Data exchange standards between different software -Use of analysis software (FEA)-Use of CAE software – Case studies

UNIT III MATERIAL HANDLING AND STORAGE SYSTEMS 9

Materials handling and Storage Systems - Automated storage and retrieval systems, carousel storage systems - Interfacing of Handling and Storage with Manufacturing system. AGVs - types, advantages and application. Robot – Basic concepts, applications.

UNIT IV GROUP TECHNOLOGY 9

Group Technology– Role of G.T in CAD/CAM Integration, Part families, Part Classification and coding – DCLASS and MICLASS and OPITZ coding systems - facility design using G.T, benefits of G.T - Cellular Manufacturing.

UNIT V ARTIFICIAL INTELLIGENT SYSTEM, EXPERT SYSTEM AND FMS 9

Artificial Intelligence System, Basic concepts of Artificial intelligence, intelligent systems and expert systems. Flexible manufacturing systems – Configurations, workstations, planning, applications and benefits – Automated inspection and testing - Machine vision.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain NC, DNC and CNC used in CIM.	Understand
CO2: Apply the features of CAD System in design and modeling.	Apply
CO3: Explain the role of AGVs, AS/RS and Robots in material handling and Storage System.	Understand
CO4: Describe Group Technology and Classification of Coding system.	Understand
CO5: Explain Artificial Intelligent system, Expert system and FMS.	Understand

Text Book(s):

T1. Mikell. P. Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Pearson Education 2001.

T2. Mikell. P. Groover and Emory ZimmersJr.,“CAD/CAM”, Prentice hall of India Pvt. Ltd., 1998.

Reference Book(s):

R1. James A. Regh and Henry W. Kreabber, “Computer Integrated Manufacturing”, Pearson Education second edition, 2005.

R2. Chris McMahon and Jimmie Browne, “CAD CAM Principles, Practice and Manufacturing Management”, Pearson Education second edition, 2005.

R3. Ranky, Paul G., “Computer Integrated Manufacturing”, Prentice hall of India Pvt. Ltd., 2005.

Web References:

1. https://en.wikipedia.org/wiki/Computer-integrated_manufacturing
2. https://en.wikipedia.org/wiki/Integrated_Computer-Aided_Manufacturing

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO2	3	2	1	1	-	-	-	1	-	1	-	1	1	2
CO3	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO4	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO5	2	1	-	-	-	-	-	1	-	1	-	1	1	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				100

Course Code: 19AUEN1008	Course Title: PRODUCTION OF AUTOMOTIVE ELECTRICAL COMPONENTS		
Course Category: Professional Elective		Course Level: Introductory	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- Nil

Course Objectives

The course is intended to:

1. Explain the characteristics and effects of components on circuit board.
2. Explain the parameters and methods involved in integration of electrical and electronics parts
3. Explain the steps involved in fabrication of Electrical parts
4. Explain the steps involved in fabrication of Electronic parts
5. Explain the process involved in manufacturing of lighting system

UNIT I BASICS OF ELECTRICAL AND ELECTRONICS 6

Introduction of Resistor capacitor inductor and characteristics under AC & DC, Power dissipation, Fuse and fuse selection. Electromagnetic compatibility (EMC), Interference

UNIT II INTEGRATION OF ELECTRICAL & ELECTRONIC PARTS ON VEHICLE 10

Overview of Advanced Product Quality Planning (APQP) /New Product Development, Vehicle Integration- Mounting methods, Routing methods, Fastening, Clearance/Interference fit.

UNIT III MANUFACTURING OF AUTOMOTIVE ELECTRICAL PARTS 10

Process flow, process specifications and Inspection methodologies for Starter motor, Relay, Horn, Switches, Magneto and Wiring Harness.

UNIT IV MANUFACTURING OF AUTOMOTIVE ELECTRONIC PARTS 10

Process flow, Manufacture of PCB, PCB assembly and Testing, Electronic Packaging.

UNIT V MANUFACTURING OF AUTOMOTIVE LIGHTING SYSTEM 9

Basic principles and working of lighting system, Process flow and process specifications for automotive lighting system

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the characteristics and effects of components on circuit board that are used in a motorcycle	Understand
CO2: Explain the parameters and methods involved in integration of electrical and electronics parts in a motorcycle	Understand
CO3: Explain the steps involved in fabrication of Electrical parts used in a motorcycle	Understand
CO4: Explain the steps involved in fabrication of Electronic parts in a motorcycle	Understand
CO5: Explain the process involved in manufacturing of lighting system used in a motorcycle	Understand

Text Book(s):

T1. Raymond H. Clark, “Handbook of Printed Circuit Manufacturing” Springer 1st edition, 1985.

T2. H. Richard Stillwell, “Electronic Product Design for Automated Manufacturing” CRC Press, 1st edition, 1988.

Reference Book(s):

R1. V K Mehta Rohit Mehta, “Principles of Electrical and Electronics” 3rd edition S Chand Publishers, 2014.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO2	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO3	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO4	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO5	2	1	-	-	-	-	-	1	-	1	-	1	1	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				100

Course Code: 19AUEN1009	Course Title: JIGS AND FIXTURES		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3:0:0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites

The student should have undergone the courses:

- Production Processes
- Design of Automotive Elements

Course Objectives

The course is intended to:

1. Apply the basic locating and clamping principles in designing general jigs and fixtures.
2. Design a jig for a simple components
3. Design a fixtures for the milling , turning ,welding and grinding operations
4. Design progressive, compound and combination dies for simple components.
5. Design dies for bending, forming and drawing operations

UNIT I LOCATING AND CLAMPING PRINCIPLES 9

Objectives of Tool design – Function and advantages of Jigs and fixtures - Materials used in Jigs and Fixtures – principles of location – Locating methods and devices - Principles of clamping- Mechanical actuation-pneumatic and hydraulic actuation-Analysis of clamping force-Tolerance and error analysis.

UNIT II JIGS 9

Different types of jigs-plate latch, channel, box, post, angle plate, angular post, turnover, pot jigs-Indexing jigs ,Drill bushes, Automatic drill jigs-Rack and pinion operated, Air operated Jigs components. Design and development of Jigs for given components.

UNIT III FIXTURES 9

General principles of boring, lathe, milling and broaching fixtures- Grinding, planning and shaping fixtures, assembly, Inspection and welding fixtures- Modular fixtures- Quick change fixtures. Design and development of fixtures for given component.

UNIT IV PRESS WORKING AND ELEMENTS OF CUTTING DIES 9

Press working terminology-Operations-Types of Presses and press accessories-Computation of capacities and tonnage requirements. Elements of progressive and compound dies: Die block, die shoe. Bolster plate-punch plate - punch holder-guide pins and bushes – strippers –knockouts-stops – pilots-Selection of standard die sets, Design and development of progressive and compound dies for Blanking and piercing operations ,strip lay out-strip lay out calculations

UNIT V BENDING, FORMING AND DRAWING DIES 9

Bending ,forming and drawing operations –Blank development for above operations-Types of Bending dies – Press capacity – Spring back – knockouts – direct and indirect - pressure pads – Ejectors – Variables affecting Metal flow in drawing operations – draw die inserts – draw beads- ironing – Design and development of bending, forming, drawing and combination dies – Blank development for axi-symmetric, rectangular and elliptic parts – Single and double action dies. Design considerations in forging, extrusion, casting and plastic dies

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply the basic locating and clamping principles in designing general jigs and fixtures.	Apply
CO2: Design a jig for a simple components	Apply
CO3: Design a fixtures for the milling , turning ,welding and grinding operations	Apply
CO4: Design progressive, compound and combination dies for simple components.	Apply
CO5: Design dies for bending, forming and drawing operations	Apply

Text Book(s):

T1. Edward G Hoffman, “Jigs & Fixture Design”, Thomson – Delmar Learning, 2004

T2. Donaldson.C,“ToolDesign”,TataMcGraw-Hill,1986

Reference Book(s):

R1. Kempster, “Jigs & Fixtures Design”, The English Language Book Society, 1978

R2. Joshi, P.H., “Jigs & Fixtures”, Second Edition, Tata McGraw-Hill Publishing Company Limited, 2004

R3. Hiram E Grant, “Jigs and Fixture”, Tata McGraw-Hill, 2003

R4. Fundamentals of Tool Design”, CEEE Edition, ASTME, 1983

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	-	1	-	1	1	2
CO2	3	2	1	1	-	-	-	1	-	1	-	1	1	2
CO3	3	2	1	1	-	-	-	1	-	1	-	1	1	2
CO4	3	2	1	1	-	-	-	1	-	1	-	1	1	2
CO5	3	2	1	1	-	-	-	1	-	1	-	1	1	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19AUEN1010	Course Title: WELDING AND JOINING TECHNOLOGIES		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3:0:0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites

The student should have undergone the courses:

- Production Processes.
- Engineering Materials

Course Objectives

The course is intended to:

1. Choose a suitable welding process.
2. Identify the potential failure modes of a weld joint.
3. Explain the types of fixtures used in welding processes.
4. Design a suitable welding fixture.
5. Explain inspection, maintenance and calibration procedure.

UNIT I INTRODUCTION 9

Fundamentals of welding Process - Arc welding processes - Principle and operation - Advantages and limitations of welding processes - Power sources of arc welding process and their influence on the process behavior - MIG / MAG Welding - Metal transfer in MIG welding processes-Process requirements of GMAW process - Impact of Process parameters - Defects of GMAW, Causes and their remedies - Resistance Welding Processes - Various types of Resistance welding process and its applications - Process requirements of Resistance Welding process - Impact of Process parameters – Resistance welding defects, causes and their remedies.

UNIT II DESIGN OF WELD JOINTS 9

Types of Weld Joints and their applications - Styles and practices of Edge preparation - Representation of Weld symbols - Loads acting on the Weld Joints - Calculation of Stresses in Weld Joints - Determination of Weld size for Fatigue Applications -Effect of Temperature on Metallurgical properties - Causes of Distortion - Causes for Residual Stresses - Quality requirement for Welders - Qualification Tests for welder - Optimization of Weld Process - Estimation of Welding Costs for a given application.

UNIT III INTRODUCTION TO WELDING FIXTURES 9

Fixtures and its types - Datum and its importance of the Part - Location and its importance of the Part - Orientation and its importance of the Part - Resting & Clamping and its importance of the Part - Elements of the welding fixture - Different fixture accessories used for welding fixture assembly - Different types of welding fixtures for Resistance welding Process- Different types of welding fixtures for Arc welding Process. [SMAW & MIG].

UNIT IV DESIGN OF FIXTURES FOR WELD PARTS 9

Critical & Major dimension of the fixture part - Datum and its classifications - Location, orientation & clamping for the weld part - Design of fixture elements for the given weld joint - Design of FMEA for the pre designed concept fixture -Welding distortion control by using fixture clamping - Design of welding fixture drawing for a given part.

UNIT V INSPECTION AND VALIDATION OF WELDING FIXTURES 9

Inspection procedure for welding fixtures - Critical fit function of fixture hold part – Need of tolerance in fixture assembly-Possible failure modes while inspection of fixtures –Need of Fixture Maintenance and Calibration-Fixture maintenance procedure - Different fixture maintenance tools - Fixture calibration procedure.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Choose suitable welding processes.	Apply
CO2: Identify the potential failure modes of a weld joint.	Apply
CO3: Explain the types of Fixtures used in welding process	Understand
CO4: Design the welding fixtures for the given weld parts.	Apply
CO5: Explain the inspection, maintenance and calibration procedure of welding fixtures	Understand

Text Book(s):

T1. O.P Khanna “A Textbook of Welding Technology”, Dhanpat Rai & Sons, Twentieth Reprint, 2011.

T2. Omer. W.Blodgett, James F. Lincoln, “Design of Welded Structures, RC Welding Foundation”, 1st Edition 1996.

T3. Prakash Hiralal Joshi, “Welding and Assembly Fixtures”, McGraw-Hill Professional, 2010.

Reference Book(s):

R1. S.J Maddox, “Fatigue Strength of Welded Structures”, Woodhead Publishing, 1991.

R2. T.R Gurney, Tim Gurney, “Fatigue Strength of Transverse Fillet Welded Joints: A Study of the Influence of Joint Geometry”, Woodhead Publishing, 1991.

Web References:

1. https://ocw.mit.edu/courses/materials-science-and-engineering/3-37-welding-and-joining-processes-fall-2002/lecture-notes/
2. http://www.esabna.com/euweb/awtc/lesson1_1.htm

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	-	1	-	1	1	2
CO2	3	2	1	1	-	-	-	1	-	1	-	1	1	2
CO3	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO4	3	2	1	1	-	-	-	1	-	1	-	1	1	2
CO5	2	1	-	-	-	-	-	1	-	1	-	1	1	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19AUEC1001	Course Title: UNCONVENTIONAL MACHINING PROCESSES (Common to AU & MC)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- Production Processes

Course Objectives:

The course is intended to:

1. Explain the Classification of UCM
2. Describe the mechanical energy based UCM
3. Explain electrical energy based unconventional machining processes
4. Explain Chemical & Electro chemical energy based UCM
5. Describe Thermal energy based unconventional UCM

UNIT I INTRODUCTION 9

Need for unconventional machining process-Advantages of UCM - Disadvantages of UCM - Comparison of conventional and unconventional machining processes - Process parameters - Processes based on type of energy required to shape the material- Processes based on mechanism of material removal- Processes based on transfer media- Processes based on source of energy

UNIT II MECHANICAL ENERGY BASED UCM PROCESSES 9

Principle of Mechanical energy based UCM Processes - Mechanical energy based unconventional machining processes: Ultrasonic machining process, Abrasive Jet machining process, Water Jet Machining process - Principle, Working of various elements, Mechanism of metal removal, Applications, Advantages and Disadvantages. Comparison of Mechanical energy based unconventional machining processes

UNIT III ELECTRICAL ENERGY BASED UCM PROCESSES 9

Principle of Electrical energy based UCM Processes - Electrical energy based unconventional machining processes: Electric Discharge machining - Principle, Layout of EDM process, Functions and types of dielectric fluid, Properties of different tool materials, Working of R-C (Relaxation) circuit, R-C-L circuit, rotary pulse

generator circuit, controlled pulse generator circuit, Process parameters in EDM Process, Mechanism of metal removal, Applications, Advantages and Disadvantages. Wire cut EDM (WCEDM) process: Layout, Construction and working of various elements, Applications, Advantages and Disadvantages. Drilling and Die sinking by EDM process. Comparison of Electrical energy based unconventional machining processes

UNIT IV CHEMICAL & ELECTRO CHEMICAL ENERGY BASED UCM PROCESSES 9

Principle of Chemical & Electro chemical energy based UCM Processes - Chemical & Electro chemical energy based unconventional machining processes: Chemical machining, Electro chemical machining, Electro chemical grinding, Electro chemical honing processes - Principle, Working of various elements, Mechanism of metal removal, Applications, Advantages and Disadvantages. Comparison of Chemical & Electro chemical energy based unconventional machining processes

UNIT V THERMAL ENERGY BASED UCM PROCESSES 9

Principle of Thermal energy based UCM Processes - Thermal energy based unconventional machining processes: Electron Beam machining (EBM), Laser Beam machining (LBM), Plasma Arc machining (PAM) processes - Principle, Working of various elements, Mechanism of metal removal, Applications, Advantages and Disadvantages. Comparison of Thermal energy based unconventional machining processes.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the various methods of Unconventional Machining Processes based on type of energy required, mechanism of material removal, transfer media and source of energy.	Understand
CO2: Select mechanical energy based unconventional machining processes such as Ultrasonic machining process, Abrasive Jet machining process and water jet machining process based on machining requirements for a product.	Apply
CO3: Choose Electrical energy based unconventional machining processes such as EDM based on machining requirements for a product.	Analyse

CO4: Select Chemical & Electro chemical energy based unconventional machining processes such as Chemical machining, Electro chemical machining and Electro chemical grinding based on machining requirements for a product..	Apply
CO5: Choose Thermal energy based unconventional machining processes such as Electron Beam machining (EBM), Laser Beam machining (LBM), Plasma Arc machining (PAM) processes for special applications.	Analyse

Text Book(s):

T1. Vijay.K. Jain "Advanced Machining Processes" Allied Publishers Pvt. Ltd., New Delhi, 2007

T2. 2. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill, New Delhi (2007).

Reference Book(s):

R1. Benedict.G.F."Nontraditional Manufacturing Processes" Marcel Dekker Inc., New York (1987).

R2. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, "Material and Processes in manufacturing" Prentice Hall of India Pvt. Ltd., New Delhi ,8th Edition, 2001.

R3. Ghosh and Malik, "Manufacturing Science", 1st ed., EWP Private Ltd., 2008.

Web References:

1. https://en.wikipedia.org/wiki/Machining
2. https://en.wikipedia.org/wiki/Laser_beam_machining

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	**1**	**2**
CO2	3	2	1	1	-	-	-	1	-	1	-	1	**1**	**2**
CO3	3	3	2	2	-	-	-	1	-	1	-	1	**1**	**2**
CO4	3	2	1	1	-	-	-	1	-	1	-	1	**1**	**2**
CO5	3	3	2	2	-	-	-	1	-	1	-	1	**1**	**2**

High-3; Medium-2; Low-1

Assessment pattern

Continuous Comprehensive Evaluation	**Assessment Component**	**CO .No.**	**Marks**	**Total**
	CCET 1	**1,2**	**50**	**30**
	CCET 2	**3,4**	**50**	
	Retest	**1,2,3,4**	**50**	
	CCET 3	**5**	**50**	
	Assignment	**1,2,3,4,5**	**30**	**10**
End Semester Examination	**ESE**	**1,2,3,4,5**	**100**	**60**
Total				**100**

Course Code: 19MEEC1008	Course Title: COMPOSITE MATERIALS (Common to AU, MC & ME)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max. Marks:100

Prerequisites:

The student should have undergone the courses:

- Engineering Materials
- Strength of Materials

Course Objectives:

The course is intended to:

1. Explain the properties of matrices and reinforcements.
2. Explain the various types of composite materials.
3. Explain the fabrication and testing of composites.
4. Explain the mechanics and lamination theory of fiber reinforced composites.
5. Explain the load bearing behaviour of composite and composite structures.

UNIT I MATRICES AND REINFORCEMENTS 9

Definition – Functions of a Matrix, desired Properties of a Matrix, Classifications of Matrix - Polymer Matrix (Thermosets and Thermoplastics), Metal matrix, Ceramic matrix, Carbon Matrix, Glass Matrix etc.: Role and selection of reinforcement materials, Classifications of Reinforcements/Fibers - Glass fibers, Carbon fibers, Aramid fibers , Metal fibers, Alumina fibers, Boron Fibers, Silicon carbide fibers etc., Mechanical properties of fibres.

UNIT II TYPES OF COMPOSITES 9

Various types of composites: Classification based on Matrix Material: Organic Matrix composites, Polymer matrix composites (PMC), Carbon matrix Composites or Carbon-Carbon Composites, Metal matrix composites (MMC), Ceramic matrix composites (CMC); Classification based on reinforcements: Fiber Reinforced Composites, Fiber Reinforced Polymer (FRP) Composites, Laminar Composites, Particulate Composites, Comparison with Metals, Advantages & limitations of Composites

UNIT III FABRICATION AND TESTING OF COMPOSITES 9

Fabrication methods: hand layup, Autoclave, filament welding, compression molding, resin-transplant method, pultrusion, pre-peg layer. Mechanical testing of composites - tensile testing, Compressive testing, Flexural testing, Shear testing and Impact testing.

UNIT IV MECHANICS AND LAMINATION THEORY OF COMPOSITES 9

Rule of mixture -volume and mass fractions – density - void content, Evaluation of four elastic moduli based on strength of materials approach and Semi - Empirical model - Longitudinal Young's modulus-transverse Young's modulus – major Poisson's ratio-In- plane shear modulus, Ultimate strengths of a unidirectional lamina. Characteristics of Fiber-reinforced lamina – laminates – lamination theory, Maximum stress and strain criterion- Tsai-Hill, Tsai-Wu, Inter laminar stresses- Impact resistance- Fracture resistance- Fatigue resistance.

UNIT V COMPOSITE STRUCTURES 9

Fatigue – S-N curves – Fatigue behaviors of CMCs – Fatigue of particle and whisker reinforced composites. Introduction to structures - selection of material, manufacturing and laminate configuration -design of joints - bonded joints - bolted joints - bonded and bolted. Case studies in design and development of composite parts, boats, pressure vessels, automotive parts, aerospace parts, electronics parts and composites for space vehicles.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the properties of matrices and reinforcements	Understand
CO2: Explain the various types of composite materials	Understand
CO3: Explain the fabrication and testing of composites.	Understand
CO4: Explain the mechanics and lamination theory of fiber reinforced composites.	Understand
CO5: Explain the load bearing behavior of composite and composite Structures	Understand

Text Book(s):

T1. Krishnan K.Chawla, “Composite Materials Science and Engineering”, Springer-Verlag New York, 3rd Edition, 2012.

T2. Mallick, P.K., “Fiber Reinforced Composites: Materials, Manufacturing and Design”, CRC Press; 3rd edition, 2007.

Reference Book(s):

R1. Agarwal, B.D., and Broutman L.J., “Analysis and Performance of Fiber Composites”, John Wiley and Sons, New York, 2012.

R2. Gibson, R.F., “Principles of Composite Material Mechanics”, McGraw-Hill, 2011.

R3. Srinivasan K , “Composite Material” Narosa Publication , 2009.

Web References:

1. http://nptel.ac.in/courses/101104010/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	1	1
CO2	2	1	-	-	-	-	-	1	-	1	-	1	1	1
CO3	2	1	-	-	-	-	-	1	-	1	-	1	1	1
CO4	2	1	-	-	-	-	-	1	-	1	-	1	1	1
CO5	2	1	-	-	-	-	-	1	-	1	-	1	1	1

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				100

Course Code: 19MEEC1011	Course Title: NON-DESTRUCTIVE TESTING METHODS (Common to AU, ME & MC)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- Engineering Materials.

Course Objectives:

The course is intended to:

1. Explain the testing procedure for Visual Inspection and Eddy Current Testing Method.
2. Explain testing procedure for Magnetic Particle Testing Method.
3. Explain testing procedure for Liquid Penetrant Testing Method.
4. Plan inspection sequence for Ultrasonic Testing Method.
5. Plan inspection sequence for Radiographic Testing Method.

UNIT I VISUAL INSPECTION AND EDDY CURRENT TESTING METHOD 9

Scope and advantages of NDT-Compare NDT with DT-Principle of Visual Inspection theory- Optical aids used for Visual Inspection-Microscope, Boroscope, Endoscope, Flexi scope, Telescope and Hollography- Principles of Eddy Current Theory-surface mounted coils-Encircling coils-types of Probes-Eddy current sensing Probes-Flux leakage sensing Probes-Eddy Current Techniques, Advanced Eddy Current Techniques-applications, Limitations and standards.

UNIT II MAGNETIC PARTICLE TESTING METHOD 9

Basic Principle of magnetic particle testing(MPT)-induced magnetic fields-circular and longitudinal fields-Hysteresis curve-magnetic flux strips and coils-residual fields and demagnetization-MPT techniques-magnetization using a permanent magnet, magnetization using a Electro magnet, contact current flow method, wet and dry particle inspection methods, remote magnetic particle inspection, probe power inspection, light weight UV lamps inspection, semi-automatic inspection, applications and limitations of MPT.

UNIT III LIQUID PENETRANT TESTING METHOD 9

Physical properties of liquid penetrant-penetrant testing materials-penetrants, cleaners, emulsifiers developers, lint free cloth-Basic Principle, applications and

limitations of liquid penetrant testing(LPT)-different LPT methods-Post-Emulsification Fluorescent penetrant process, Reverse Fluorescent Dye penetrant process, Visible Dye penetrant process, Water-Emulsification visible Dye penetrant process, solvent clean visible Dye penetrant process.

UNIT IV ULTRASONIC TESTING METHOD 9

Basic properties of sound beam-sound waves-velocity of ultrasonic waves, Acoustic Impedance behavior of ultrasonic waves-ultrasonic transducers-characteristics of ultrasonic beam, Flaw sensitivity, Beam divergence, Attenuation-Principle of ultrasonic testing methods, applications and limitations-Ultrasonic testing method-normal incident pulse echo inspection method, normal incident through transmission testing method, angle beam pulse echo inspection method.

UNIT V RADIOGRAPHIC TESTING METHOD 9

Basic Principle of Radiography-Electromagnetic radiation sources-X ray source, Gamma ray source-properties of X and Gamma rays-Radiographic Imaging-Geometrical factors- radiographic film-film density-Radiographic sensitivity-Penetrometer-Radiographic Inspection Techniques-single wall single image technique, wall penetration technique, Latitude technique-Applications and Limitations of Radiographic Inspection Techniques.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the testing procedure for Visual Inspection and Eddy Current Testing Method in Quality Assurance.	Understand
CO2: Explain testing procedure for Magnetic Particle Testing Method for quality Assurance.	Understand
CO3: Explain testing procedure for Liquid Reentrant Testing Method for Quality Assurance.	Understand
CO4: Plan inspection sequence for Ultrasonic Testing Method for Quality Assurance.	Understand
CO5: Plan inspection sequence for Radiographic Testing Method for Quality Assurance.	Understand

Text Book(s):

T1. Baldev Raj, T.Jayakumar, M.Thavasimuthu,“Practical Non-Destructive Testing”, Narosa Publishing House, 2009.

T2. J Prasad, C G K Nair, “Non-Destructive Testing and Evaluation of Materials”, Tata McGraw-HillEducation Private Limited, 2003.

Reference Book(s):

R1. Ravi Prakash, “Non-Destructive Testing Techniques”, 1st revised edition, New Age International Publishers, 2010.

R2. American Metals Society, “Non-Destructive Examination and Quality Control”, Metals Hand Book, Vol.17, 9th Edition, Metals Park, 1989.

R3. Paul Mix, “Introduction to Non-destructive testing: a training guide”, Wiley, 2nd Edition,New Jersey,2005.

Web References:

1. https://www.nde-ed.org/index_flash.htm
2. http://117.55.241.6/library/E-Books/NDT%20Notes.pdf

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	1	1
CO2	2	1	-	-	-	-	-	1	-	1	-	1	1	1
CO3	2	1	-	-	-	-	-	1	-	1	-	1	1	1
CO4	2	1	-	-	-	-	-	1	-	1	-	1	1	1
CO5	2	1	-	-	-	-	-	1	-	1	-	1	1	1

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				100

Course Code: 19MEEC1012	Course Title: LEAN MANUFACTURING (Common to AU & ME)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- Nil

Course Objectives:

The course is intended to:

1. Understand the Lean Manufacturing principles.
2. Apply various Lean tools.
3. Apply value stream management.
4. Apply the lean principles in manufacturing and service industries.
5. Evaluate various lean metrics.

UNIT I INTRODUCTION TO LEAN MANUFACTURING 7

Manufacturing systems-Types-Ford Production System, Lean Manufacturing Paradigm-History of Lean Manufacturing-Traditional Vs Lean Manufacturing, TQM vs. Lean, Toyota Production System. Lean Principles-Value Added Activities-Non-Value Added Activities-Necessary Non-Value added Activities- 3Ms-Muda, Mura and Muri-Types of wastes, Lean objectives-Need for lean manufacturing.

UNIT II LEAN TOOLS AND METHODOLOGIES 9

Problem solving tools-Cause and Effect Diagram, Pareto analysis, FMEA, Work cell and equipment management tools- Process Mapping, Spaghetti diagram, U shaped Layout, Poke Yoke, Kanban , Andon, SMED, One Piece Flow , Genchi, Genbutsu, Milk run , Visual workplace, Quality at the source Methodologies-Pillars of Lean Manufacturing-Just in Time, Jidoka, 5S, TPM, Six sigma, DFMA, Kaizen.

UNIT III VALUE STREAM MANAGEMENT 10

Value stream Mapping-Value stream icons-Road map-Current State, Future State-Demand stage-Market Dynamics, Customer Demand; PQ Analysis; PR Analysis; Takt Time; Pitch; Finished Goods Stock, Cycle Stock Buffer Stock; Safety Stock-Flow Stage-Continuous flow, work cells, Line balancing, Standardized work, Quick change over, Autonomous maintenance, In process Super markets, Kanban systems, FIFO Lanes, Production Scheduling, Leveling Stage-Paced Withdrawal, Heijunka(Load Leveling), Heijunka Box, The Runner-a Case Study.

UNIT IV LEAN IMPLEMENTATION 10

Training Stage-Management Commitment, Identify the value stream manager/Champion and core Implementation team Members, Training of team members, Planning stage-Customer Focus, Go to the floor, Hosin Planning, Brain storming, Prepare Tree Diagram, Select the cross functional team, Prepare project plan, Improvement stage-Production and Productivity-Operator, Process, Machinery and Equipment, Work place Organization, Inventory management, Planning and Procurement of Materials, A case study on Lean implementation in manufacturing and service industries.

UNIT V LEAN METRICS 9

Lean Metrics-the fundamentals, steps in identifying Lean Metrics, WIP inventory, Total Product cycle time, Total value stream lead time, On time delivery, Defective PPM, Uptime, OEE, Throughput rate, Through put yield, Utilization rate, Lean Manufacturing assessment-Radar Chart- a case study.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the Lean Manufacturing principles such as -Value Added Activities-Non-Value Added Activities-Necessary Non-Value added Activities- 3Ms-Muda, Mura and Muri to eliminate the waste	Understand
CO2: Design manufacturing solutions based on various Lean tools and methodologies such as Process Mapping, Spaghetti diagram, U shaped Layout, Poke Yoke, Kanban , Andon, SMED, One Piece Flow .	Apply
CO3: Prepare value stream maps such Current state, Future state mapping, Standardized work, Quick change over, Autonomous maintenance to eliminate the non value added activities.	Understand
CO4: Design manufacturing solutions for manufacturing and service industries based on Hosin Planning.	Apply
CO5: Compare various lean metrics such as Lead time, Cycle Time, through put time, PPM, Uptime, OEE, Throughput rate, through put yield for Lean assessment.	Understand

Text Book(s):

T1. Don Tapping, Tom Luyster, and Tom Shuker, Value stream Management Eight steps to planning, Mapping and sustaining Lean Improvements,2002, Productivity Press,New York.

T2. N.Gopalakrishnan, Simplified Lean Manufacture Elements, Rules, Tools and Implementation, 2010, PHI Learning, New Delhi.

Reference Book(s):

R1. James P. Womack, Daniel T Jones, Daniel Ross The Machine That Change the world,2007, Free Press trade paperback edition, U.S.A.

R2. Ronald G. Askin& Jeffrey B.Goldberg, Design and Analysis of Lean Production Systems,2003, John Wiley & Sons.

R3. Rother M. and Shook J, 'Learning to See: Value Stream Mapping to Add Value and Eliminate Muda' , Lean Enterprise Institute, 1999, Brookline, MA.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO2	3	2	1	1	-	-	-	1	-	1	-	1	1	2
CO3	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO4	3	2	1	1	-	-	-	1	-	1	-	1	1	2
CO5	2	1	-	-	-	-	-	1	-	1	-	1	1	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				100

Course Code: 19MEEC1013	Course Title: LOGISTICS ENGINEERING (Common to AU & ME)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- Nil

Course Objectives:

The course is intended to:

1. Assess the potential failure modes in material storage and handling between POM/POS to POC.
2. Apply REBA/RULA tools and techniques in storage and material handling design.
3. Verify produced part quality is delivered to the point of consumption.
4. Design material storage and handling system to prevent potential failure modes.
5. Develop standardized storage and handling work procedures.

UNIT I MATERIAL HANDLING - SYSTEMS AND FACILITIES 9

Material Handling System - Need, scope, definitions and terminologies, types, elements, Organization for logistics management and control. Introduction Process flow charting/mapping techniques.

Material Handling Facilities - Types of Material Handling Equipments (AGVs, Fork lift, prime movers, stackers, lifts etc), selection criteria for MHES. Design considerations, selection of materials. Estimation of number of facilities required; cost estimation and control. Introduction to thermoforming/injection molded crate design and manufacturing for kitting of the parts.

UNIT II ERGONOMICS IN DESIGN 9

Application of RULA & REBA in MHF design, MHF design considerations for plastic parts, painted Parts, machined parts, fragile parts, c class parts, inter-plant material movement, and in-direct areas.

UNIT III MEASURES OF MATERIAL HANDLING SYSTEM 9

Reliability, maintainability, serviceability, availability factors, Supply supports, TPM for MHF, manufacturing consideration: processes, methods and tools, assembly and dismantling of MHF, system feasibility analysis, system operational requirements, Supportability analysis, functional analysis, MTBF and MTTR for MHFs, flexibility in MHFs, traceability of MHFs and MHEs, salvaging of MHFs and MHEs

UNIT IV STORAGE SYSTEMS 9

Creation of modern stores and storage systems: concept of stores, types of stores, storage facilities, considerations for creation of stores, estimation of docks, truck turn-around time, truck window time, inventory and types, WIP, material retention point, model store concept

UNIT V ANALYSIS OF MATERIAL TRANSPORT SYSTEMS 9

Analysis of Vehicle based system- determination of number of vehicles in AGVs and determination of delivery distance. Conveyor analysis – single direction, continuous loop and re-circulating conveyors.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Identify the potential failure modes in material storage and handling between POM/POS to POC.	Understand
CO2: Use REBA/RULA tools and techniques to study ergonomics in storage and material handling design.	Understand
CO3: Verify produced part quality is delivered to the point of consumption.	Understand
CO4: Design material storage and handling system to prevent potential failure modes.	Apply
CO5: Develop standardized storage and handling work procedures.	Apply

Text Book(s):

T1. Mikel P. Groover, “Automation, Production Systems, and Computer-Integrated Manufacturing”, PHI Publishers, 3rd Edition 2016.

T2. Blanchard and Benjamin S, “Logistics Engineering and Management”, 6th International Edition, Prentice Hall Inc, 2015.

Reference Book(s):

R1. Christopher M, “Logistics and Supply Chain Management - Creating Value Adding Networks”, Prentice Hall, 2010.

R2. PraussL,“The Green Multiplier - a Study of Environmental Protection and Supply Chain”, Antonn Rauss Limited, Palgrave Macmillan, 2005.

R3. Taylor G.D, “Logistics Engineering handbook”, CRC Press, 2008.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO2	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO3	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO4	3	2	1	1	-	-	-	1	-	1	-	1	1	2
CO5	3	2	1	1	-	-	-	1	-	1	-	1	1	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	**CCET 1**	**1,2**	**50**	**30**
	CCET 2	**3,4**	**50**	
	Retest	**1,2,3,4**	**50**	
	CCET 3	**5**	**50**	
	Assignment	**1,2,3,4,5**	**30**	**10**
End Semester Examination	**ESE**	**1,2,3,4,5**	**100**	**60**
Total				**100**

Course Code:19MEEC1024		Course Title: NEW PRODUCT DEVELOPMENT (Common to AU & ME)	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max. Marks:100

Prerequisites

The student should have undergone the courses:

- Manufacturing Technology
- Design of Machine Elements

Course Objectives

The course is intended to:

1. Understand the need of product development.
2. Identify the customer needs.
3. Select appropriate materials for a new product.
4. Select appropriate processes for a new product.
5. Understand the value analysis in costing.
6. Understand the Product Teardown.

UNIT I PRODUCT DEVELOPMENT 9

Need for developing products, the importance of engineering design, types of design, the design process. product lifecycle- relevance of product lifecycle issues in design, design using codes and standards. societal considerations in engineering design, fisher product classification, generic product development process, various phases of product development, planning for products, establishing markets, market segments, relevance of market research- market requirement specification and product requirement specification.

UNIT II PRODUCT MORPHOLOGY METHODS AND ANALYSIS 9

Identifying customer needs –voice of customer –customer populations- hierarchy of human needs-need gathering methods – affinity diagrams – needs importance-identify the technical requirement of customer need - establishing engineering characteristics. competitive benchmarking- quality function deployment- house of quality. product design specification- generating design concepts -systematic methods for design–functional decomposition – physical decomposition –functional representation. morphological methods and analysis -TRIZ- axiomatic design.

Unit III MATERIAL, AND MANUFACTURING PROCESS SELECTION 9

Selection of material for mechanical properties- Strength, toughness and fatigue- Material selection for durability, surface wear and Corrosion resistance- Functional relation between materials and processing. Manufacturing Processes - advantages and limitations. Selection of Processes- Process Capabilities - Design Guidelines. Product Design- Manufacturing Perspective.

UNIT IV VALUE ENGINEERING 9

Value Engineering Function- Approach of Function, Evaluation of Function, Determining Function, Classifying Function. Evaluation of costs- Evaluation of Worth, Evaluation of Value, FAST Diagram, categories of cost – overhead costs – activity based costing –methods of developing cost estimates – manufacturing cost –value analysis in costing.

UNIT V PRODUCT TEARDOWN 9

Teardown Process- List Design Issues-Prepare for Product Teardowns, Examine the Distribution and Installation-Disassemble, Measure and Analyse Data by Assemblies, Form a Bill of Materials. Teardown methods-Subtract and Operate Procedure, Force Flow (Energy Flow Field) Diagrams, Measurement and Experimentation, product verification and validation, Case studies.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Design the various phases of product development based on the relevance of market research	Apply
CO2: Design the House of Quality to identify the customer needs and product design specification for a new product development.	Apply
CO3: Identify the appropriate materials and manufacturing process for a new product development based on manufacturing perspective.	Apply
CO4: Integrate the various functions of value engineering in new product development.	Apply
CO5: Examine the types Teardown process and methods using in new product development.	Apply

Text Book(s):

T1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, Product Design and Development, 6th Edition, 2019, Tata McGraw-Hill Education.

T2. Kevin Otto, Kristin Wood, Product Design, Indian Reprint 2018, Pearson Education.

T3. Anil Kumar Mukhopadhyaya, “Value Engineering: Concepts Techniques and applications”, SAGE Publications 2020.

Reference Book(s):

R1. Clive L.Dym, Patrick Little, Engineering Design: A Project-based Introduction, 3rd Edition, John Wiley and Sons, 2019.

R2. George E.Dieter, Linda C.Schmidt, Engineering Design, McGraw-Hill International Edition, 4th Edition, 2009.

R3. YousefHaik, T. M. M. Shahin, Engineering Design Process, 2nd Edition Reprint, Cengage Learning, 2010.

Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO 1	3	2	1	1	1	1	1	1	-	1	-	2	2	1
CO 2	3	2	1	1	1	1	1	1	-	1	-	2	2	1
CO 3	3	2	1	1	1	1	1	1	-	1	-	2	2	1
CO 4	3	2	1	1	1	1	1	1	-	1	-	2	2	1
CO 5	3	2	1	1	1	-	-	1	-	1	-	2	2	1

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				100

Course Code:19MEEC1025		Course Title: SYSTEMS ENGINEERING (Common to AU & ME)	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max. Marks:100

Prerequisites

The student should have undergone the courses:

- Nil

Course Objectives

The course is intended to:

1. Understand the systems engineering.
2. Explain the various Technical processes in Systems Engineering.
3. Explain the various Management processes in Systems Engineering.
4. Understand the Project Enabling Processes in Systems Engineering.
5. Understand the Systems Engineering Methods.

UNIT I SYSTEMS ENGINEERING OVERVIEW 9

Definitions and Concepts of a System-The Hierarchy within a System, Definition of Systems of Systems, Definition of Systems Engineering. Origins and Evolution of Systems Engineering, Use and Value of Systems Engineering, Systems Engineering Effectiveness, Systems Science and Systems Thinking, interdependency in systems, sub systems and processes, Life Cycle Stages-Life Cycle Approaches.

UNIT II TECHNICAL PROCESSES 9

Business or Mission Analysis Processes-Stakeholder Needs, Requirements Definition Process, System Requirements Definition Process, Architecture Definition Process, Design Definition Process, System Analysis Process-Integration Process, Verification Process, Validation Process, Operation Process-Maintenance Process and Disposal Process.

UNIT III MANAGEMENT PROCESSES 9

Project Planning Processes- Project Assessment and Control Process, Decision Management Process, Risk Management Process, Configuration Management Process, Information Management Process, Measurement Process and Quality Assurance Process.

UNIT IV PROJECT ENABLING PROCESSES 9

Life Cycle Model Management Process, Infrastructure Management Process, Portfolio Management Process, Human Resource Management Process, Quality Management Process, Knowledge Management Process, Acquisition Process and Supply Process.

UNIT V CROSS CUTTING SYSTEMS ENGINEERING METHODS 9

Modelling and Simulation – Model Based Systems Engineering, Functions based Systems Engineering Method, Object Oriented Systems Engineering Method, Prototyping, Interface Management, Integrated Product and Process Development. Lean Systems Engineering and Agile Systems Engineering.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain the overview of Systems Engineering, its goals and value of using Systems Engineering throughout the system life cycle.	Understand
CO2: Break down the various stages of Technical processes are used to define the requirements for a system, to transform the requirements into an effective product.	Apply
CO3: Implement the processes like planning, assessment, decision making, configuration, information, measurement and quality assurance for Technical management.	Apply
CO4: Evaluate the project enabling processes and their interfaces to meet specific strategic and provide support of the system projects.	Apply
CO5: Choose the different methods that can apply across all processes, reflecting various aspects of the iterative and recursive nature of System Engineering.	Apply

Text Book(s):

T1. Garry J. Roedler, Kevin J. Forsberg,R. Douglas Hamelin,Thomas M. Shortell, “Systems Engineering Handbook”, 4th Edition,WILEY,2015.

T2. James N Martin, “Systems Engineering Guidebook”, 1th Edition, CRC Press, 2020.

Reference Book(s):

R1. Alexander Kossiakoff, William N. Sweet and Samuel J. Seymour , “Systems Engineering Principles and Practice”, WILEY,2011

R2. .Benjamin S. Blanchard and John E. Blyler,"System Engineering Management", WILEY,2016.

Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO 1	2	1	-	-	1	-	-	1	-	1	-	1	-	-
CO 2	3	2	1	1	1	-	-	1	-	1	-	1	-	-
CO 3	3	2	1	1	1	-	-	1	-	1	-	1	-	-
CO 4	3	2	1	1	1	-	-	1	-	1	-	1	-	-
CO 5	3	2	1	1	1	-	-	1	-	1	-	1	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				100

Course Code: 19AUEN1011	Course Title: ALTERNATIVE FUELS FOR IC ENGINES		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3:0:0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:
The student should have undergone the course(s):

- Automotive Engines

Course Objectives
The course is intended to:

1. Explain the performance and emission characteristics of alcoholic fuels
2. Explain the performance and emission characteristics of vegetable oils
3. Explain the performance and emission characteristics of Biogas, CNG, and LPG
4. Explain the performance and emission characteristics of hydrogen
5. Explain the performance and emission characteristics of synthetic fuels.

UNIT I ALCOHOLS 9

Introduction to alternative fuels. - Need for alternative fuels - Availability of different alternative fuels for SI and CI engines. Alcohols as fuels. Production methods of alcohols. Properties of alcohols as fuels. Methods of using alcohols in CI and SI engines. Blending, dual fuel operation, oxygenated additives. Performance and emission characteristics alcohols as fuels in CI and SI engines.

UNIT II VEGETABLE OILS 9

Various vegetable oils and their properties. Different methods of using Straight vegetable oils in engines -Blending, preheating, Problems of using SVO. Biodiesel production- trans esterification of vegetable oils - advantages of biodiesel Performance and Emission Characteristics of biodiesel in diesel engines.

UNIT III BIOGAS, NATURAL GAS AND LPG 9

Production methods of biogas- and its characteristics- compressed natural gas and LPG. Properties of gaseous fuels - modification required to use gaseous fuels in SI and CI engines- performance and emission characteristics of CNG and LPG in SI and CI engines.

UNIT IV HYDROGEN 9

Production methods of hydrogen. Properties of hydrogen- different methods of using hydrogen in SI and CI engines. performance and emission characteristics of hydrogen in engines. Hydrogen storage - safety aspects of hydrogen- Problems associated with hydrogen as fuel

UNIT V SYNTHETIC ALTERNATIVE FUELS 9

Properties of Di-Methyl Ether (DME) - Diethyl Ether (DEE) – Performance and emission characteristics in CI and SI engines. Biomass to Liquid (BTL) - Gas to Liquid (GTL) - Synthesis methods – Pyrolysis, Fischer-Tropsch (FT) - Wood Pyrolysis Oil (WPO) - Tyre Pyrolysis Oil (TPO)- Plastic Fuel

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Describe the performance and emission characteristics of IC engines with pure and blended alcoholic fuels	Understand
CO2: Explain the trans esterification of vegetable oils and their performance and emission characteristics while used as fuel in of IC engines.	Understand
CO3: Explain the modification required in engines, performance and emission characteristics while using biogas, CNG, and LPG in SI and CI Engines	Understand
CO4: Explain the safety aspects, performance and emission characteristics of hydrogen used as IC engine fuel	Understand
CO5: Explain the performance and emission characteristics of different synthetic fuels used in IC engines.	Understand

Text Book(s):

T1. A S Ramadhas," Alternative Fuels for Transportation ", CRC Press, 2010.

T2. S.S. Thipse, “Alternative Fuels Concepts, Technologies and Developments”, Jaico Publishing House, 2010.

Reference Book(s):

R1. James Speight, " Synthetic Fuels Handbook: Properties, Process, and Performance ", McGraw Hill Professional, 2008.

R2. "The properties and performance of modern alternate fuels” - SAE PaperNo.841210.

R3. Keith owen and Trever Coley, “Automotive Fuels Reference Book”, SAE 1995.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	2	2	1	-	1	-	1	1	2
CO2	2	1	-	-	-	2	2	1	-	1	-	1	1	2
CO3	2	1	-	-	-	2	2	1	-	1	-	1	1	2
CO4	2	1	-	-	-	2	2	1	-	1	-	1	1	2
CO5	2	1	-	-	-	2	2	1	-	1	-	1	1	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19AUEN1012	Course Title: AUTOMOTIVE FUELS AND LUBRICANTS		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3:0:0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- Chemistry for Mechanical Sciences

Course Objectives

The course is intended to:

1. Describe the petroleum oil refining process and manufacturing process of lubricants.
2. Demonstrate the testing of fuel properties.
3. Demonstrate the testing procedures of lubricants.
4. Illustrate the working principle of engine lubrication system
5. Explain the properties of additives and alternate fuels

UNIT I INTRODUCTION 9

Requirements of automotive fuels – manufacturing of fuels and lubricants – crude petroleum – structure – constituents – refining process – thermal cracking, catalytic cracking, polymerisation, alkylation, isomerisation, reforming, blending – products of refining process.

Lubricant – base stocks – classification – grades of base stocks – viscosity – properties of base stock –base oil processes – manufacturing process of lubricants.

UNIT II PROPERTIES AND TESTING OF FUELS 9

Fuel standard – ASTM testing – octane number – self ignition temperature – cetane number – distillation temperature measurement – viscosity measurement – flash point & fire point measurement – calorific value measurement – aniline point measurement – effects of fuel properties on engine performance.

UNIT III PROPERTIES AND TESTING OF LUBRICANTS 9

Lubricants – Classification – components of lubricants – functions – selection of lubricating oils –properties – nomenclature and specifications – SAE Rating – synthetic lubricants – grease – properties– NLGI Numbers – ASTM testing – viscosity

measurement – flash point & fire point measurement –pour point & cloud point measurement – effects of lubricant properties on engine performance.

UNIT IV LUBRICATION 9

Engine friction fundamentals – influence of engine variable on friction – hydrodynamic and elasto-hydrodynamic lubrication – boundary lubrication – bearing lubrication – functions of the lubrication system – mist lubrication – dry sump lubrication – wet sump lubrication – working. Introduction to automotive tribology – crankshaft bearing lubrication.

UNIT V ADDITIVES AND ALTERNATIVE FUELS 9

Need of additives – gasoline additives –diesel additives –lubricant additives – properties.

Alternative Fuels – need – classification – alcohols – gaseous fuels – biofuels – properties.

Course Outcomes **At the end of this course, students will be able to:**	**Cognitive Level**
CO1: Describe the petroleum oil refining process and the manufacturing process of lubricants.	Understand
CO2: Demonstrate the testing procedures of fuels as per ASTM standard.	Apply
CO3: Demonstrate the testing of procedures of lubricants as per ASTM standard.	Apply
CO4: Explain the fundamentals of lubrication and the automotive lubrication system.	Understand
CO5: Explain the properties of additives and alternative fuels	Understand

Text Book(s):

T1. V. Ganesan, “Internal Combustion Engines”, Tata McGraw Hill, New Delhi, 2007.

T2. P.L.Mathur and Sharma, “Internal Combustion Engines”, Dhanpat Rai and Sons, 2010.

Reference Book(s):

R1. John B. Heywood, “Internal Combustion Engines Fundamentals”, McGraw Hill, New York, 2011

R2. George E. Totten, “Fuels and Lubricants Handbook: Technology, Properties, Performance, and Testing”, ASTM International, 2003

R3. Surinder Parkash, “Petroleum Fuels Manufacturing Handbook”, McGraw-Hill, New York, 2010

Web References:

1. http://nptel.ac.in/courses/103105110/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	2	2	1	-	1	-	1	1	2
CO2	3	2	1	1	-	2	2	1	-	1	-	1	1	2
CO3	3	2	1	1	-	2	2	1	-	1	-	1	1	2
CO4	2	1	-	-	-	2	2	1	-	1	-	1	1	2
CO5	2	1	-	-	-	2	2	1	-	1	-	1	1	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19AUEN1013	Course Title: AUTOMOTIVE POLLUTION CONTROL		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3:0:0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:
The student should have undergone the course(s):

- Automotive engines

Course Objectives:
The course is intended to:

1. Apply the standards for emission control
2. Analyse the emissions in SI engines
3. Analyse the emissions in CI engines
4. Apply various emission control techniques
5. Demonstrate emission measurements and tests

UNIT I INTRODUCTION 6

Pollutants – sources – formation – effects of pollution on environment - human – transient operational effects on pollution – Regulated – Unregulated emissions - Emission Standards.

UNIT II EMISSIONS IN SI ENGINES 10

Chemistry of SI engine combustion – HC and CO formation in SI engines – NO formation in SI engines – Smoke emissions from SI engines – Effect of operating variables on emission formation.

UNIT III EMISSIONS IN CI ENGINES 10

Basics of diesel combustion – Smoke emission and its types in diesel engines – NOx emission and its types from diesel engines – Particulate emission in diesel engines. Odour, sulphur and Aldehyde emissions from diesel engines - effect of operating variables on emission formation

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UNITIV EMISSION CONTROL TECHNIQUES 10

Design modifications – Optimization of operating factors – Fuel modification – Evaporative emission control - Exhaust gas recirculation – SCR – Fumigation – Secondary Air injection – PCV system – Particulate Trap – CCS. Exhaust treatment in SI engines –Thermal reactors – Catalytic converters – Catalysts.

UNIT V EMISSION MEASUREMENTS AND TESTS 9

NDIR analyser – Flame ionization detectors – Chemiluminescent analyser – Dilution tunnel – Gas chromatograph Smoke meters. Test procedures CVS1, CVS3 – Test cycles – IDC – ECE Test cycle – FTP Test cycle –SHED test.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply the standards for emission control	Apply
CO2: Analyse the emissions in SI engines	Analyse
CO3: Analyse the emissions in CI engines	Analyse
CO4: Apply various emission control techniques	Apply
CO5: Demonstrate emission measurements and tests	Apply

Text Book(s):

T1. Heywood,J.B., “Internal Combustion Engine Fundamentals”, McGraw Hill Book Co., 2011.

T2. B.P.Pundir, “ IC Engines Combustion and Emissions”, Narosa Publishers, 2010

Reference Book(s):

R1. Ramalingam. K.K., “Internal Combustion Engines”, Scitech Publications, Chennai, 2003.

R2. Ganesan,V., “Internal Combustion Engines”, Tata McGraw Hill Co., 2008.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	2	2	1	-	1	-	1	2	3
CO2	3	3	2	2	-	2	2	1	-	1	-	1	2	3
CO3	3	3	2	2	-	2	2	1	-	1	-	1	2	3
CO4	3	2	1	1	-	2	2	1	-	1	-	1	2	3
CO5	3	2	1	1	-	2	2	1	-	1	-	1	2	3

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19AUEN1014	Course Title: AUTOMOTIVE AIR CONDITIONING SYSTEMS		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3:0:0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites

The student should have undergone the course(s):

- Engineering Thermodynamicsand Heat Transfer

Course Objectives:

The course is intended to:

1. Calculate the performance of vapour compression refrigeration systems.
2. Explain the major components in vapour compression refrigeration systems.
3. Estimate the heating and cooling loads in air-conditioning systems.
4. Explain the various applications of refrigeration and air conditioning systems.
5. Explain the installation and servicing methods used in refrigeration and air conditioning systems.

UNIT I REFRIGERATION 9

Thermodynamic principles of refrigeration – Types of Refrigeration Systems – Vapour compression refrigeration cycle, use of Ts and P-H diagrams, Performance calculation – Refrigerants: Primary& secondary refrigerants, Nomenclature of Refrigerants, properties and selection – Environment friendly alternatives.

UNIT II COMPONENTS OF REFRIGERATION SYSTEM 9

Refrigerant Compressors- Different Types, Performance, Capacity Control – Evaporators, Evaporators Circuitry, Different Types and application – Condensers- Types-air cooled- water cooled - evaporative condensers- Optimum Cooling Water Rate and Velocity – Expansion Devices.

UNIT III AIR CONDITIONING SYSTEM AND ITS COMPONENTS 9

Characteristics of Human comfort condition – Different types of Air Conditioner , Construction Details of Room Air Conditioner , Window Type, Package Type, Split Type Central Units – Automotive Heater –Air conditioning Equipments , air filters , humidifiers & dehumidifiers, fans & blowers , control system – Thermal insulation and Ventilation in air conditioning system – Types of load - Cooling Load Calculations, Air Distribution Patterns.

UNIT IV APPLICATION OF REFRIGERATION AND AIR CONDITIONING SYSTEMS 9

General layout, Working Principle, Advantages & Disadvantages - Food Preservation, Food Storage & Distribution - Beverage Coolers, LNG – Ice Manufacturing – Solar Air Conditioning, Solar dehumidifier – Automobile air conditioning, Refrigerated trucks, Aircraft air conditioning, Railway Refrigerator Cars, Marine Air conditioning

UNIT V INSTALLATION AND SERVICING 9

Duct installation - Charging of refrigerant - Servicing of central, packaged, split air-conditioning, – Safety procedures, Leak detection procedures- safety controls, trouble shooting. – Basic Elements of Control systems - temperature control, Bimetal thermostat, Electric resistance thermostat, Electronic thermostat- Humidity control elements- Automatic Dew point recorder - Energy conservation methods.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the concepts of refrigeration system and evaluate the performance of vapor compression refrigeration cycles	Understand
CO2: Explain the various components of vapor compression refrigeration system viz. evaporator, compressor, condenser and expansion valve.	Understand
CO3: Calculate the heating and cooling loads in an air conditioning system using psychrometric concepts.	Apply
CO4: Discuss the applications of refrigeration and air conditioning systems viz. food preservation, automobile air conditioning, aircraft air conditioning and marine air conditioning.	Analyse
CO5: Explain the refrigerant charging procedure, leakage detection and various temperature and humidity control methods	Understand

Text Book(s):

T1. Manohar Prasad, "Refrigeration and Air Conditioning", New Age International, 2004

T2. Arora. C.P., "Refrigeration and Air conditioning", 2nd edition. Tata McGraw-Hill, 2000.

Reference Book(s):

R1. Dossat, R.J. "Principles of Refrigeration", Prentice-Hall, 1997.

R2. Stoecker N.F and Jones, "Refrigeration and Air Conditioning", McGraw Hill Education (Asia) 2nd Edition 2001

R3. ASHRAE 2012 Hand book (Fundamentals & Equipments)

Web References:

1. http://nptel.ac.in/courses/112105128/
2. https://www.ashrae.org/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	1	1	1	-	1	-	1	1	2
CO2	2	1	-	-	-	1	1	1	-	1	-	1	1	2
CO3	3	2	1	1	-	1	1	1	-	1	-	1	1	2
CO4	3	3	2	2	-	1	1	1	-	1	-	1	1	2
CO5	2	1	-	-	-	1	1	1	-	1	-	1	1	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19AUEN1015	Course Title: VEHICLE BODY ENGINEERING		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3:0:0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- Automotive Chassis andTransmission

Course Objectives:

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

1. Illustrate the various types of car body.
2. Classify the different constructions of bus body
3. Classify the type of commercial vehicles.
4. Describe the aerodynamic effect.
5. Describe the various materials used for body construction

UNIT I CAR BODY 9

Car body terminology- Types of car: sedan limousine, convertible, hatch back car, station wagon, racing car- Visibility regulations- Tests for visibility, Methods to improve visibility, Safety regulations, Factors considering the safety design- Crumple zone- Safety features in car.

UNIT II BUS BODY 9

Bus body terminology- Types of bus based on size: minibus, town, mofussil, luxury bus- Types of bus based on shape: single deck, double deck, articulated bus- body on frame construction-integral type of construction- double skin bus body construction- Bus body layout: entrance and exit location, engine location, bus floor height- bus body building process.

UNIT III COMMERCIAL VEHICLE BODY 9

Types of LCV: pickup van, auto rickshaw cargo truck- Types of MCV: drop side, box van- Types of HCV: flat platform, tipper, tanker, draw bar trailer- Design factors of driver cab and seat- Types of driver cab: normal control, forward control, semi forward control

UNIT IV VEHICLE AERODYNAMICS 9

Objective of aerodynamics- Types of aerodynamic forces and moments- Effect of forces and moments on vehicle body- Types of aerodynamic drag- drag reduction methods- closed circuit wind tunnel test- flow visualization methods

UNIT V BODY MATERIALS, RECONSTRUCTION AND TRIMS 9

Types and properties of body materials: steel sheet, timber, polymers, FRP- body collision reconstruction- panel replacement reconstruction-types of paints-body painting process- anti corrosion coating methods- body trims

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Illustrate the various types of car body and ergonomic design aspects.	Understand
CO2: Classify the different constructions of bus body based on size and shape of body.	Understand
CO3: Classify the type of commercial vehicles based on body structure.	Understand
CO4: Describe the aerodynamic effect of forces on vehicle body.	Understand
CO5: Describe the various materials used for body construction and body repairing methods.	Understand

Text Book(s):

T1. John Fenton, Vehicle Body layout and analysis, Mechanical Engg. Publication Ltd., London., London.

T2. James E Dufly, Body Repair Technology for 4-Wheelers, Cengage learning, 2009.

Reference Book(s):

R1. Powloski J. Vehicle Body Engineering, Business Books Ltd., 1998.

R2. Giles, G J., Body construction and design, Illiffe Books Butterworth & Co.,1991.

R3. Dieler Anselm., The Passenger car body, SAE International, 2000.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	2	3
CO2	2	1	-	-	-	-	-	1	-	1	-	1	2	3
CO3	2	1	-	-	-	-	-	1	-	1	-	1	2	3
CO4	2	1	-	-	-	-	-	1	-	1	-	1	2	3
CO5	2	1	-	-	-	-	-	1	-	1	-	1	2	3

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19AUEN1016	Course Title: VEHICLE MAINTENANCE		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3:0:0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:
The student should have undergone the course(s):

- Automotive Engines
- Automotive Chassis andTransmission

Course Objectives:
At the end of the course students will be able to:

1. Explain the maintenance practices, safety and tools used
2. Explain the engine and engine subsystem maintenance
3. Explain the transmission and driveline maintenance
4. Explain the steering, brake, suspension and wheel maintenance
5. Explain the electrical and air conditioning maintenance

UNIT I MAINTENANCE WORKSHOP PRACTICES SAFETY AND TOOLS 9

Maintenance- Need, Importance, Primary and secondary functions, Policies,- Classifications of maintenance work - Vehicle Insurance - basic Problem Diagnosis. Automotive Service procedures- Work shop operations - Workshopmanual- Vehicle identification.Safety- Personnel, Machines, and equipment, vehicles, fire safety- Firstaid. Basic tools - Special service tools- Mesuring instruments- Conditionchecking of seals, gaskets and sealants. Scheduldedmaintenance services- service intervals - towing and recovering.

UNIT II ENGINE AND ENGINE SUBSYSTEM MAINTENANCE 9

General Engine service- Dismantling of Engine components- Engine repair - Working on the underside, front,top, ancillaries- serviceof basic engine parts, cooling and lubricating system, Fuel system, Intake and exhaust system, Electrical system- Electronic fuel injection and engine management service - Fault diagnosis -servicing emission controls

UNIT III TRANSMISSION AND DRIVELINE MAINTENANCE 9

Clutch- general checks, adjustment and service -Dismantling, Identifying, Checking and reassembling of transmission, transaxle- road testing -removing and replacing propeller shaft, servicing of cross and yoke joint and constant velocity joint - Rear axle service points -Removing axle shaft and bearings- servicing differential assemblies- fault diagnosis

UNIT IV STEERING, BRAKE, SUSPENSION & WHEEL MAINTENANCE 9

Inspection, maintenance and service of hydraulic brake, drum brake,disc brake, parkingbrake, bleeding of brakes. Inspection, Maintenance and service of Mc Pherson strut, coilspring, leaf spring, shock absorber,Dismantling and assembly procedures.

Wheel alignment and balance, Removingand fitting of tyres,tyre wear and tyre rotation.

Inspection, Maintenance and service of steering linkage, steering column, rack and pinion steering, recirculating ball steering service- worm type steering, power steering system

UNIT V ELECTRICAL AND AIR CONDITIONING MAINTENANCE 9

Maintenance of batteries, starting system, charging system and body electrical- Fault Diagnosis using scan tools. Maintenance of Air conditioning parts like compressor, condensor, expansion valve, evaporato- replacement of hoses- leak detection - AC Charging - Fault Diagnosis. Vehicle Body repair like panel beating, tinkering,soldering,polishing, painting.

Course Outcomes **At the end of this course, students will be able to:**	**Cognitive Level**
CO1. Explain the maintenance practices, safety and tools used in workshop	Understand
CO2. Explain the engine and engine subsystem maintenance procedure	Understand
CO3. Explain the transmission and driveline maintenance procedure	Understand
CO4. Explain the steering, brake, suspension and wheel maintenance maintenance procedure	Understand
CO5. Explain the electrical and air conditioning maintenance procedure	Understand

Text Book(s):

T1. Ed May, Autmobile Mechanics Volume one, Mc Graw Hill Publications, 2003

T2. Crouse W H, "Automotive Transmissions and Power Trains", McGraw Hill Book Co.,5th edition, 1976

Reference Book(s):

R1. Bosch automotive handbook , Sixth Edition,2004.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	2	3
CO2	2	1	-	-	-	-	-	1	-	1	-	1	2	3
CO3	2	1	-	-	-	-	-	1	-	1	-	1	2	3
CO4	2	1	-	-	-	-	-	1	-	1	-	1	2	3
CO5	2	1	-	-	-	-	-	1	-	1	-	1	2	3

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19AUEN1017	Course Title: TRANSPORT MANAGEMENT		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3:0:0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:

- NIL

Course Outcomes

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

1. Explain the legislative laws
2. Explain the types of vehicle insurance
3. Explain the operation of passenger transport system
4. Explain the operation of goods transport system
5. Describe taxation and traffic management

UNIT I MOTOR VEHICLE ACT 9

Motor Vehicle Act: Short titles & definitions, Laws governing to use of motor vehicle & vehicle transport, Licensing of drivers & conductors, Registration of vehicle, State & interstate permits, Traffic rules, Signals & controls, Offences, penalties & procedures, Different types of forms. Government administration structure, Personnel, Authorities & duties, Rules regarding construction of motor vehicles

UNIT II INSURANCE AND ROAD SAFETY 9

Insurance types & significance, Comprehensive, Third party insurance, Furnishing of particulars of vehicles involved in accident, MACT (Motor Accident Claims Tribunal), Solatium Fund, Hit & Run case, Duty of driver in case of accident, Surveyor & Surveyor's report

UNIT III PASSENGER TRANSPORT OPERATION 9

Structure of passenger transport organizations, typical depot layouts, requirements, Fleet maintenance - Scheduling operation & control.Propaganda, passenger amenities, Parcel traffic. Theory of fares, Basic principles of fare charging , Needs, straight and tapered scales, Differential rates for different types of services, Depreciation & debt charges, operation cost, Economics & records.

UNIT IV GOODS TRANSPORT OPERATION 9

Structure of goods transport organizations, Typical depot layouts, requirements ,scheduling of goods transport, materials Handling equipments in the goods transport operation, , storage & transportation of petroleum products

UNIT V TAXATION AND TRAFFIC MANAGEMENT 9

Objectives, Structure & methods of laving taxation, One-time tax, Tax Exemption & tax renewal, Global positioning system- Traffic navigation, advanced traffic control devices.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the legislative laws governing the use of motor vehicle	Understand
CO2: Explain the types of vehicle insurance and the importance of road safety	Understand
CO3: Explain the operation of passenger transport system	Understand
CO4: Explain the operation of goods transport system	Understand
CO5: Describe taxation and traffic management	Understand

Text Book(s):

T1. Motor Vehicle Act - Govt. of India Publications.

T2. Santosh Sharma, “Productivity in Road Transport”, 2nd Edition, Association of State Road Transport Undertakings, New Delhi.

Reference Book(s):

R1. P.G. Patankar, “Road Passenger Transport in India”, CIRT, Pune.

R2. Transport Development in India”, S. Chand & Co. Pvt. Ltd., New Delhi.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	2	2	1	-	1	-	1	1	2
CO2	2	1	-	-	-	2	2	1	-	1	-	1	1	2
CO3	2	1	-	-	-	2	2	1	-	1	-	1	1	2
CO4	2	1	-	-	-	2	2	1	-	1	-	1	1	2
CO5	2	1	-	-	-	2	2	1	-	1	-	1	1	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19AUEN1018	Course Title: RELIABILITY AND MAINTENANCE ENGINEERING		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3:0:0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:
The student should have undergone the course(s):

- Engineering Practices Laboratory
- Engineering Materials
- Production Processes

Course Objectives:
The course is intended to:

1. Explain the principle involved in reliability and maintainability
2. Improve reliability of system by applying redundancy techniques.
3. Evaluate system reliability from reliability of sub systems.
4. Implement maintenance policies for the successful management of maintenance activities.
5. Conduct hazard and safety analysis for material handling equipments

UNIT I BASIC CONCEPTS OF RELIABILITY MAINTENANCE AND AVAILABILITY 9

Reliability –Definition, Reliability vs quality, Failure and failure modes, Bath tub curve, causes of failures and unreliability. Maintainability, Availability- Concepts, Definition. System down time, uptime – MTBF,MTTR,MTBM. Types of availability- Inherent availability, Achieved availability and Operation availability. Reliability and Maintainability trade off.

UNIT II DESIGN FOR RELIABILITY 9

Reliability analysis, Mathematical models and numerical evaluation. Designing for higher reliability. Redundancy Techniques, Application. Various forms of redundancy.

UNIT III SYSTEM RELIABILITY 9

Determination of system reliability from subsystems. Series configuration, Parallel configuration, Mixed configuration, R out of N structure. Component redundancy vs Unit redundancy, Stand by redundancy, Mixed redundancy- Simple problems to calculate system reliability. Reliability cost trade off.

UNIT IV MAINTENANCE POLICIES – PREVENTIVE MAINTENANCE 9

Maintenance categories – comparative merits of each category – preventive maintenance, maintenance schedules, repair cycle – Principles and methods of lubrication – TPM.

UNIT V SAFETY AND OTHER ASPECTS OF MAINTENANCE 9

Repair methods for material handling equipment – Equipment records – Job order systems – use of computer in maintenance.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the principle involved in reliability and maintainability	Understand
CO2: Improve reliability of system by applying redundancy techniques	Understand
CO3: Evaluate system reliability from reliability of sub systems.	Analyse
CO4: Implement maintenance policies for the successful management of maintenance activities.	Apply
CO5: Conduct hazard and safety analysis for material handling equipments in line with industrial standards.	Apply

Text Book(s):

T1. Srivastava S.K., “Industrial Maintenance Management”, - S. Chand and Co., 1981

T2. Bhattacharya S.N., “Installation, Servicing and Maintenance”, S. Chand and Co., 1995

Reference Book(s):

R1. White E.N., “Maintenance Planning”, I Documentation, Gower Press, 1979.

R2. Mishra R.C. and Pathak K. “Maintenance Engineering and Management” Prentice Hall of India Pvt. Ltd. 2007. 3 Garg M.R., “Industrial Maintenance”, S. Chand & Co., 1986.

R3. Higgins L.R., “Maintenance Engineering Hand book”, McGraw Hill, 5th Edition, 1988

Web References:

1. http://catalog.flatworldknowledge.com/bookhub/reader/5?cid=41991&e=carpenter-ch01
2. http://www.nios.ac.in/media/documents/VocInsServices/m1-4f.pdf
3. http://discovery.bits-pilani.ac.in/dlpd/courses/coursecontent/courseMaterial/mgtszc211.pdf
4. http://faculty.mercer.edu/jackson_r/Ownership/chap02.pdf

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	1	1	1	-	1	-	1	2	3
CO2	2	1	-	-	-	1	1	1	-	1	-	1	2	3
CO3	3	3	2	2	-	1	1	1	-	1	-	1	2	3
CO4	3	2	1	1	-	1	1	1	-	1	-	1	2	3
CO5	3	2	1	1	-	1	1	1	-	1	-	1	2	3

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19MEEC1014	Course Title: ENGINEERING ECONOMICS AND COST ANALYSIS (Common to AU & ME)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3:0:0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites

The student should have undergone the course(s):

- Production Processes

Course Objectives:

The course is intended to:

1. Calculate the breakeven point.
2. Application of interest formula.
3. Comparison of economic alternatives.
4. Replacement analysis of equipment.
5. Calculate depreciation of equipment.

UNIT I INTRODUCTION TO ECONOMICS 8

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics - Elements of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis- V ratio, Elementary economic Analysis

UNIT II VALUE ENGINEERING 10

Make or buy decision, Value engineering – Function, aims, and Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor-Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods with problems.

UNIT III CASH FLOW 9

Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated

cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

UNIT IV REPLACEMENT AND MAINTENANCE ANALYSIS 9

Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

UNIT V DEPRECIATION 9

Depreciation- Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-Evaluation of public alternatives- introduction, Examples, Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset. Case study

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Categorize different cost and calculate the breakeven point for a given business situation	Apply
CO2: Apply different interest formulae and their application in decision making process.	Apply
CO3: Evaluate present value, future value and annual worth analysis on one or more economic alternatives.	Apply
CO4: Determine the economic value of an asset and develop a better replacement policy for given equipment.	Apply
CO5: Evaluate the depreciation of equipment per period.	Apply

Text Book(s):

T1. Panneerselvam R, “Engineering Economics”, Prentice Hall of India Ltd, New Delhi, 2014

T2. Chan S. Park, “Contemporary Engineering Economics”, Prentice Hall of India, 2010.

Reference Book(s):

R1. Donald.G. Newman, Jerome.P.Lavelle, “Engineering Economics and analysis” Engg. Press, Texas, 2010.

R2. Degarmo, E.P., Sullivan, W.G and Canada, J.R, “Engineering Economy”, Macmillan, New York, 2010.

R3. Grant.E.L., Ireson.W.G., and Leavenworth, R.S, “Principles of Engineering Economy”, Ronald Press, New York,1990.

Web References:

1. https://en.wikipedia.org/wiki/Engineering_economics
2. https://en.wikipedia.org/wiki/Cost%E2%80%93benefit_analysis

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	-	1	3	1	1	2
CO2	3	2	1	1	-	-	-	1	-	1	3	1	1	2
CO3	3	2	1	1	-	-	-	1	-	1	3	1	1	2
CO4	3	2	1	1	-	-	-	1	-	1	3	1	1	2
CO5	3	2	1	1	-	-	-	1	-	1	3	1	1	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19MEEC1016	Course Title: QUALITY ENGINEERING (Common to AU, ME & MC)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3:0:0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites

The student should have undergone the course(s):

- Production Processes.

Course Objectives

The course is intended to:

1. Explain the need of quality and customer satisfaction.
2. Explain the basics of Quality cost with classification
3. Explain the concept of total quality management relevant to both manufacturing and service industry.
4. Explain the various tools used in Quality Engineering and Management.
5. Explain the steps used for Designing for Quality.

UNIT I INTRODUCTION 9

Introduction – Need for quality – Evolution of quality – Different Definitions and Dimensions of Quality– Concepts of Product and Service Quality– Contributions of Deming, Juran and Crosby – Barriers to Quality – Quality statements – Customer focus – Customer orientation, Customer satisfaction, Customer complaints, and Customer retention – Costs of Poor quality.

UNIT II QUALITY COSTS 9

Basic Concept Quality Costs: Fitness for Use, Quality Characteristics, Parameters of Fitness for use-Quality functions, Concept of Quality assurance and Quality control, Quality costs concept, Quality cost categories, Examples of Quality cost studies, Securing the Cost figures, Pareto Analysis, Cost reduction Programs and economics of quality.

UNIT III TOTAL QUALITY MANAGEMENT 9

Total quality Management- Basic concepts of TQM, historical review, leadership, concepts, role of senior management, quality statements, plans for process parameters, Modern Quality Management Techniques-Benchmarking, QFD, Taguchi quality loss function TPM, Lean Manufacturing continuous improvement techniques,

JIT systems, Cause and effect diagrams, Scatter diagram, Run charts, Affinity diagrams, Inter-relationship diagram, Process decision program charts, PDCA Concept

UNIT IV QUALITY ENGINEERING AND MANAGEMENT TOOLS 9

Quality Engineering and Management Tools, Techniques & Standards: 7 QC tools, 7 New Quality Management Tools, 5S Technique, Kaizen, Poka-Yoke, SMED, Quality Circle, Cost of Quality Technique, Introduction to Quality Management Standards – ISO 9000, IATF 16949, ISO 14001, ISO 45001, ISO 50001 (Concept, Scope, Implementation Requirements & Barriers, and Benefits), Introduction to National and International Quality Awards.

UNIT V DESIGNING FOR QUALITY 9

Introduction to Concurrent Engineering, Quality Function Deployment (QFD) and Failure Mode and Effect Analysis (FMEA) – Concept, Methodology and Application (with case studies).Six Sigma - Basic Concept, Principle, Methodology, Implementation, Scope, Advantages and Limitations – DOE

Course Outcomes **At the end of this course, students will be able to:**	**Cognitive Level**
CO1: Explain the need of quality and customer satisfaction.	Understand
CO2: Explain the basics of Quality cost with classification	Understand
CO3: Explain the concept of total quality management relevant to both manufacturing and service industry.	Understand
CO4: Explain the various tools used in Quality Engineering and Management.	Understand
CO5: Explain the steps used for Designing for Quality.	Understand

Text Book(s):

T1. Quality Assurance and Total Quality Management (ISO 9000, QS 9000 ISO 14000) by K C Jain and A K Chitale, Khanna Publishers.

T2. Total Quality Management by Dale H. Besterfield, Carol Besterfield-Michna, Glen H. Besterfield and Mary Besterfield-Sacre, Pearson Education .

Reference Book(s):

R1. Quality planning and Analysis, Juran and Gryna, TMH, New Delhi

R2. Quality Control & Application by B. L. Hanson & P. M. Ghare, Prentice Hall of India

Web References:

1. http://www.nptel.ac.in
2. http://www.ocw.mit.edu

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	-	1
CO2	2	1	-	-	-	-	-	1	-	1	-	1	-	1
CO3	2	1	-	-	-	-	-	1	-	1	-	1	-	1
CO4	2	1	-	-	-	-	-	1	-	1	-	1	-	1
CO5	2	1	-	-	-	-	-	1	-	1	-	1	-	1

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19MEEC1017	Course Title: INDUSTRIAL SAFETY MANAGEMENT (Common to AU , ME & MC)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3:0:0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- Production Processes

Course Objectives:

The course is intended to:

1. Explain the importance of safety management
2. Explain the measurement and monitoring techniques
3. Explain the roles and responsibilities of Safety department
4. Describe the importance of Industrial safety acts
5. Explain the classes of fires and controlling techniques.

UNIT I INTRODUCTION TO SAFETY MANAGEMENT 9

Principles of Safety Management, Need of safety in organisation, Occupational Health & hygiene, modern safety concept-Safe operating procedure (SOP's), Safety permits, Social and physiological effects, Behavioural based safety- aim, benefits, law and rules, Accident - Near Miss, injury, Cost of accident, Unsafe act , Unsafe condition, Environmental safety - air pollution, water pollution ,industrial noise & vibration control ,physical hazards - chemical hazards , biological hazards, electrical hazards.

UNIT II SAFETY PERFORMANCE MONITORING 9

Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, Components of safety audit, types of audit, audit methodology, permanent total disabilities, permanent partial disabilities, temporary total disabilities - Concept of an accident, reportable and non-reportable accidents, unsafe act and condition – principles of accident prevention incident rate, accident rate, safety “t” score, safety activity rate Records of accidents, accident reports.

UNIT III SAFETY ORGANISATION 9

Role and responsibilities of management and line staffs Supervisors and Employees, Safety committee, Motivation, budgeting for safety, safety policy, Safety Education and Training, Importance of training-identification of training needs- Training

methods –programme, seminars, conferences, role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training, Personal Protective Equipment (PPE) - Requirements of PPE, Selection and Usage of PPE, Importance of IS Standard, Types of PPE.

UNIT IV INDUSTRIAL ACTS 9

Indian Factories act 1948, Tamilnadu Factories rule 1950 – Environmental protection act 1986- Indian electricity act 1910, Indian electricity rule 1956 – Indian boiler act 1923 – Workmen's compensation act 1923 – Explosive act1983 - Noise pollution rules 2000

UNIT V DISASTER MANAGEMENT AND EMERGENCY PREPAREDNESS 9

Fire properties of solid, liquid and gases - fire spread - toxicity of products of Combustion - sources of ignition – fire triangle – principles of fire extinguishing – active and passive fire protection systems – various classes of fires – a, b, c, d, e – fire extinguishing agents - fire stoppers, Emergency preparedness and responsibilities, On site and off site emergency plan, Mock drill Bhopal Gas tragedy - faulty handling of equipment's, failure of hoist, crane.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the importance of safety management to control the accidents, pollution and hazards.	Understand
CO2: Explain the measurement and monitoring techniques to report the safety performance.	Understand
CO3: Explain the roles and responsibilities of Safety department in an organization to eliminate the unsafe act and conditions.	Understand
CO4: Describe the importance of Industrial safety acts related to safety environment pollution in India.	Understand
CO5: Explain the classes of fires and controlling techniques and plan for an onsite and offsite emergency.	Understand

Text Book(s):

T1. Deshmukh .L.M “Industrial Safety Management” McGraw-Hill 2006.

T2. C.RayAsfahl “Industrial Safety and Health management” Pearson Prentice Hall,2003

Reference Book(s):

R1. John V. Grimaldi and Rollin H. Simonds, “Safety Management”, All India Travellers bookseller, New Delhi-1989.

R2. Heinrich H.W. “Industrial Accident Prevention” McGraw-Hill Company, New York, 1980

R3. Subramanian.V., “The Factories Act 1948 with Tamilnadu factories rules 1950”, Madras Book Agency, 21st ed., Chennai, 2000.

Web References:

1. http://www.icebookshop.com
2. http://nptel.ac.in/courses/112107143/40

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	1	-	-	1	-	1	-	1	1	-
CO2	2	1	-	-	1	-	-	1	-	1	-	1	1	-
CO3	2	1	-	-	1	-	-	1	-	1	-	1	1	-
CO4	2	1	-	-	1	-	-	1	-	1	-	1	1	-
CO5	2	1	-	-	1	-	-	1	-	1	-	1	1	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO. No.	Marks	Total
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19AUEN1021	Course Title: ELECTRIC VEHICLE POWERTRAINS		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3 : 1 : 0	Credits: 3	Total Contact Hours: 45	Max. Marks: 100

Pre-requisites:

- Understanding of concepts of vehicle dynamics, operation of AC/DC motors, functions of basic power electronics components

Course objective:

Course is intended to:

1. Calculate battery and pack parameters for electric vehicles
2. Select traction machines for electric vehicles
3. Select converters and controllers for electric vehicles
4. Select sensors for electric vehicles
5. Perform cost benefit analysis of electric vehicles

UNIT I ELECTRIC VEHICLE AND BATTERY PACKS 9

Longitudinal vehicle dynamics: vehicle load forces, vehicle acceleration, drive cycle. Electric vehicle architecture: subsystems, BEV, PHEV, HEV, FCEV.

Energy source: introduction to batteries, lifetime and sizing considerations, battery charging, management and protection systems, battery chemistries and models. Battery pack design: parameters, configuration, capacity, range, C-rates, SoC, SoH, SoF.

UNIT II TRACTION MACHINES 9

Introduction to traction machines: propulsion machine, machine specifications, characteristic curves, conversion factors for machine units. Machine structure, operation, specifications, characteristic curves, using machine for EV powertrain, thermal characteristics of Brushed DC machine, Brushless DC machine, Induction machine, PMSM machine.

UNIT III CONVERTERS AND CONTROLLERS 9

DC DC converters: power conversion basic principles, buck converter, boost converter, power semiconductors, passive components, interleaving. Inverters: three phase inverters, modulation schemes, sinusoidal modulation, inverter power losses.

Controller: introduction to control of traction machines, control of DC machines, control of induction machines, control of PMSM, BLDC, DC machines.

UNIT IV BMS, SENSORS AND COMMUNICATION 9

BMS: significance, cell balancing, architecture, types. Sensors: current, voltage, temperature, pressure and position. SoC, SoH and SoF measurement. ASICs. Communication: protocols, CAN, CANOpen, FlexRay.

UNIT V COST ANALYSIS 9

Market trends: batteries, traction motors, converters, controllers, BMS, sensors and communication. Technology updates in electric vehicles. System component layout: design of mechanical structures, optimization of space and layout. Renewable energy: charging infrastructure, types, GHG reduction potential.

Course Outcomes:	**Cognitive Level**
At the end of the course students will be able to:	
CO1. Calculate parameters associated with electric vehicle batteries and packs for various two, three, four wheeler, and special applications.	Apply
CO2. Select traction machines based on the requirements using machine characteristic curves, specifications and performance.	Evaluate
CO3. Select converters and controllers based on the technical specifications and electric vehicle system requirements.	Evaluate
CO4. Select sensors for measurement as part of management of the vehicle performance.	Evaluate
CO5. Perform cost benefit analysis of electric vehicle powertrains based on market trends, technology, environment, and sustainability.	Apply

Text Book(s):

T1. John G. Hayes and G. Abas Goodarzi, “Electric Powertrain”, First Edition, John Wiley and Sons, 2018. ISBN:9781119063667

T2. Luis Romeral Martinez and Miguel Delgado Prieto, “ New Trends in Electrical Vehicle Powertrains, Intechopen, 2019. ISBN:9781838816988.

T3. Sam Davis, “Managing Electric Vehicle Power”, SAE International, 2020. ISBN:9781468601442

Reference Book(s):

R1. Xudong Zhang, “Modeling and Dynamics Control for Distributed Drive Electric Vehicles”, Springer, 2021.

R2. Sang-Hoon Kim, “Electric Motor Control: DC, AC, and BLDC Motors”, Elsevier, 2017.

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Web References:

1. https://nptel.ac.in/courses/108/106/108106182/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	1	1	3	1	2	-	1	1	1
CO2	3	3	2	2	3	1	1	3	1	2	-	1	1	1
CO3	3	3	2	2	3	1	1	3	1	2	-	1	1	1
CO4	3	3	2	2	3	1	1	3	1	2	-	1	1	1
CO5	3	2	1	1	1	1	1	3	1	2	-	1	1	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Assignments	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19AUEN1022	Course Title: ELECTRIC VEHICLE BATTERY TECHNOLOGY		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Chemistry for Mechanical Sciences

Course Objectives

The course is intended to:

1. Select suitable Li-Ion battery cells
2. Prepare mechanical assembly drawings of battery systems
3. Design battery management systems
4. Prepare vehicle layout for sub-systems
5. Perform cost benefit analysis of battery sub systems

UNIT I LI-ION BATTERY 7

Significance of Li-ion batteries - Classification of Li-Ion batteries - Construction of Li-Ion batteries - Energy density - Charging and discharging profiles - influence of temperature - life and ageing issues - Safety aspects and thermal runaway.

UNIT II LI-ION BATTERY SYSTEMS 8

Battery systems and subsystems - Battery modules - Cells in series and parallel configurations - Battery cooling systems - Battery management systems - Cell balancing - Battery housing - Assembly of battery systems - Production aspects - Regulations on battery systems

UNIT III BATTERY MANAGEMENT SYSTEM

10

Battery management systems: functions and architecture, performance parameter measurement, equalization management circuit, data communication, logic and safety control, testing stability.

UNIT IV BATTERY AND OTHER SUB-SYSTEMS **10**

Expectations from an electric vehicle - Vehicle design, body styles - Vehicle layout - Vehicle's subsystems - Vehicle concepts - Longitudinal dynamics of an electric vehicle, torque demand - Crash requirements and vehicle's safety requirements. Traction motors, controllers and transmission systems.

UNIT V TRENDS AND OUTLOOK **10**

Study of battery systems in electric passenger vehicles (Bus, Car and Two Wheeler) - Production and cost analysis - Mass production demands - Cell manufacturing - Demands on cooling systems - Fast charging and charging stations - Second life use for battery packs - Solid state batteries - Ecosystem for electric vehicles

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Select suitable Li-Ion battery cells for use in electric vehicles based on the calculation of various cell parameters	Evaluate
CO2: Prepare mechanical assembly drawings of battery systems for electric vehicles using available CAD software	Apply
CO3: Design battery management system for various battery systems to obtain peak performance by monitoring and charge equalization.	Create
CO4: Prepare vehicle layout for sub-systems in TWO and FOUR wheelers using available CAD software	Create
CO5: Perform cost benefit analysis of battery sub systems based on market conditions and manufacturability	Apply

Text book(s):

T1: Reiner Korthauer, "Lithium-Ion Batteries: Basics and Applications", Springer, August 2018 ISBN 978-3-662-53069-6

Reference book(s):

R1. Jiuchun Jiang and Caiping Zhang, “Fundamentals and Applications of Lithium-Ion Batteries in Electric Drive Vehicles”, John Wiley and Sons, 2015 ISBN 978-1-118-41478-1

R2. John G. Hayes and G. Abas Goodarzi, “Electric Powertrain”, First Edition, John Wiley and Sons, 2018. ISBN:9781119063667

R3. James Larminie and John Lowry, “Electric Vehicle Technology Explained”, John Wiley and Sons, 2018 ISBN 978-81-265-5670-8

Web Reference(s):

1. http://batteryuniversity.com/

Course Articulation Matrix

CO Vs PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	3	3	-	-	1	-	1	-	-	1	2
CO2	2	1	1	1	1	1	1	3	2		1	1	1	2
CO3	3	3	3	3	3	-	-	1	-	1	-	-	1	2
CO4	3	3	3	3	3	1	1	3	2	-	1	1	1	2
CO5	2	1	1	1	1	-	-	1	-	1	-	-	1	2

High -3, Medium – 2, Low-1

Assessment pattern

	Assessment Component	CO. No.	Marks	Total
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19AUEN1019	Course Title: SENSORS FOR AUTOMOTIVE APPLICATION		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:
The student should have undergone the course(s):

- Nil

Course Objectives:
The course is intended to:

1. Explain the evolution of automotive sensors.
2. Describe about pressure sensors.
3. Describe about speed and position sensors.
4. Describe about temperature sensors.
5. Describe about sensors for after-treatment.

UNIT 1 INTRODUCTION TO AUTOMOTIVE SENSORS 9

The evolution of automotive sensors, sensor applications in the vehicle, active and passive sensors, power supply, ratio-metric output, automotive systems and electromagnetic compatibility (EMC), importance of EMC in the automotive industry, the EMC model as applied to the automotive systems

UNIT II PRESSURE SENSORS 9

Manifold absolute pressure (MAP) sensor, TMAP sensor, BAP sensor, fuel tank pressure sensor, oil pressure sensor, common rail pressure sensors, tyre pressure monitoring sensor (TPMS), brake fluid pressure sensor – construction, working principle and performance characteristics.

UNIT III SPEED AND POSITION SENSORS 9

Engine rpm sensor, crankshaft position sensor, and camshaft position sensor, throttle position sensor, pedal position sensor, steering position sensor – construction, working principle and performance characteristics.

UNIT IV TEMPERATURE SENSORS 9

Inlet air temperature sensor, coolant temperature sensor, engine oil temperature sensor, exhaust gas temperature sensor - construction, working principle and performance characteristics

UNIT V SENSORS FOR AFTER TREATMENT 9

O_2 sensor, NO_X sensor, ammonia sensor, differential pressure sensor, soot sensor - construction, working principle and performance characteristics.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1. Explain the evolution of automotive sensors and their application in automobiles.	Understand
CO2. Describe about pressure sensors, their construction, working principle and performance characteristics.	Understand
CO3. Describe about speed and position sensors, their construction, working principle and performance characteristics.	Understand
CO4. Describe about temperature sensors, their construction, working principle and performance characteristics.	Understand
CO5. Describe about sensors for after treatment with their construction, working principle and performance characteristics.	Understand

Text Book(s):

T1. Tom Denton, “Automotive Electrical and Electronics”, Butterworth Heinemenn, 2014.

Reference Book(s):

R1. Jacob Fraden, “Handbook of Modern Sensors: Physics, Designs, and Applications”, Springer International Publishing, Switzerland 2016.

R2. Eric Chowanietz, "Automobile Electronics" SAE Publications, 2014.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	1	1	1	-	1	-	1	1	2
CO2	2	1	-	-	-	1	1	1	-	1	-	1	1	2
CO3	2	1	-	-	-	1	1	1	-	1	-	1	1	2
CO4	2	1	-	-	-	1	1	1	-	1	-	1	1	2
CO5	2	1	-	-	-	1	1	1	-	1	-	1	1	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Assignments	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19AUEN1020	Course Title: AUTOMATED AND CONNECTED VEHICLES		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites:

- Automotive Engines

Course Objectives:

The course is intended to:

1. Explain operational and procedural steps Automated Vehicles
2. Describe the working procedure of connected vehicles
3. Describe the working procedure of Pilot Deployment program
4. Explain the trials and test drives of modern vehicles.
5. Explain the artificial intelligence and machine learning Applications for automotive.

UNIT I AUTOMATED VEHICLES 9

Sensing and Perception, Machine learning and User Interface, Driver Complacency, Driver monitoring, Event Data Recorder, Physical Infrastructure, vehicle and capability prototyping. Driver Assistance Systems- Driver information, driver perception, driver convenience, driver monitoring, general vehicle control, longitudinal and lateral control, collision avoidance, vehicle monitoring.

UNIT II CONNECTED VEHICLES 9

Connected Assist and Safety, Cyber security and Connectivity, DSRC Based Connectivity, Cellular Based connectivity, Manual Override.

UNIT III CONNECTED VEHICLES- PILOT DEPLOYMENT PROGRAM 9

Testing facilities-Planet M , M City – Technology Development – Artificial Intelligence and machine learning -Evolution of Neural Networks- Cyber security – Cameras- Thermal Camera for smarter cars and safer roads

UNIT IV TRIALS AND TEST DRIVES **9**

Autonomous Driving- Tesla ,Bolt, Hyundai Landscape of test driving cars

UNIT V ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING FOR AUTOMOTIVE APPLICATIONS **9**

Automotive Sales Prediction- Predictive maintenance – Smart Cruise Control(SCC)- Smart Production -Visual Inspection- Advantages - Opportunities-Challenges of AI and ML.

Course Outcomes:	**Cognitive Level**
At the end of the course students will be able to:	
CO1. Explain the importance of Automated Vehicles	Understand
CO2. Explain the importance of Connected Vehicles	Understand
CO3. Explain the importance of Pilot Deployment Program	Understand
CO4. Explain the Trails and Test Drives of Latest Cars	Understand
CO5. Explain the importance of Artificial Intelligence and Machine Learning using automotive case studies.	Understand

Text Book(s):

T1. Stephen Underwood, Automated, Connected and Electric vehicles systems, Institute of Advanced vehicle systems, Expert forecast and Roadmap for sustainable transportation report, University of Michigan-Dearborn, Pg 1-154.

T2. Ronald K Jurgen, “Navigation and Intelligent Transportation Systems – Progress in Technology”, Automotive Electronics Series. SAE, USA, 1998.

T3. Robert Bosch GmbH, "Safety, Comfort and Convenience Systems", Wiley, 2007.

Reference Book(s):

R1. Robert Bosch, “Automotive Hand Book”, SAE, 2000.

R2. Hong Cheng, “Autonomous Intelligent Vehicles: Theory, Algorithms & Implementation”, Springer, 2011.

R3. Robert Bosch GmbH,, Bosch Automotive Handbook", Bentley Publishers, 2011.

Web References:

1. http://graham.umich.edu/media/files/LC-IA-ACE-Roadmap-Expert-Forecast-Underwood.pdf

2. http://autocaat.org/Technologies/Automated_and_Connected_Vehicles/
3. http://autocaat.org/Technologies/Connected_and_Automated_Vehicles/The_Road_to_Autonomous_Vehicles/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO2	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO3	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO4	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO5	2	1	-	-	-	-	-	1	-	1	-	1	1	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Assignments	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19AUEC1002	Course Title: FLEET MANAGEMENT (Common to AU & ME)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites:

- Nil

Course objective:

Course is intended to:

1. Develop knowledge on Fleet Management
2. Develop knowledge on the Fleet Analysis
3. Develop knowledge on the Fleet Policy Management
4. Develop knowledge on the Fleet Life Cycle & Optimization
5. Develop knowledge on the Current Technologies & Systems used in Fleet

UNIT I INTRODUCTION TO FLEET MANAGEMENT 9

Overview of Fleet Management – Origins of Fleet Management –Main functions of Fleet Management – Fleet Manager- Roles and Responsibilities

UNIT II FLEET ANALYSIS 9

Fleet Analysis and Operations Survey – Fleet Audits – Conditions and Location of the Fleet Vehicle- Fleet Scheduling- Driver Management

UNIT III FLEET POLICY MANAGEMENT 9

Formulate a Fleet Policy - critical policy issues - critical expenses- Discover risk issues facing your fleet operation- perform critical expense control calculations for fuel, maintenance, depreciation, tyres

UNIT IV FLEET LIFE CYCLE & OPTIMIZATION 9

Route optimization- ergonomic user interfaces- Intelligent maps- Dispatch Management and GPS Tracking- Open and robust IT architecture- Fleet life cycle- Discover different methods of financing fleet - calculate total fleet costing, insurance premium calculations and optimization – Fleet Life Cycle & Optimization Case Studies

UNIT V INTELLIGENT TRANSPORT SYSTEMS 9

Developer Platforms : Google and Apple Technologies - Vehicle Hacking using Arduino and CAN Bus shield –Design Wireless Smart City ecosystem , Design Vehicle Tracking Systems - Advanced fleet management software solutions- Case Studies

Course Outcomes:	**Cognitive Level**
At the end of the course students will be able to:	
CO1: Explain the fundamental concepts of Fleet management	Understand
CO2: Explain the various fleet management and analysis technique	Understand
CO3: Describe the components Fleet Policy Management	Understand
CO4: Explain the concept on Fleet Life Cycle & Optimization	Understand
CO5: Explain the concept of Intelligent Transport Systems	Understand

Text Book(s):

T4. Asvin Goel, Fleet Telematics: Real-time Management and Planning of Commercial Vehicle Operations , Springer, 2017.

T5. John Dolce, Analytical Fleet Maintenance Management, 3rd Edition, SAE International , 2009.

Reference Book(s):

R1. Fleet Telematics: Real-time management and planning of commercial vehicle operations,Springer, 2007

Web References:

1. https://www.udemy.com/course/introduction-to-fleet-management/
2. https://blogsyear.com/learn-about-telematics-and-its-impact-on-fleet-management/
3. https://www.descartes.com/resources/knowledge-center/5-critical-features-fleet-solutions-route-optimization-dispatch

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	1	-
CO2	2	1	-	-	-	-	-	1	-	1	-	1	1	-
CO3	2	1	-	-	-	-	-	1	-	1	-	1	1	-
CO4	2	1	-	-	-	-	-	1	-	1	-	1	1	-
CO5	2	1	-	-	-	-	-	1	-	1	-	1	1	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Assignments	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19AUEC1003	Course Title: IN-VEHICULAR NETWORKS (Common to AU & ME)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Develop knowledge on The CAN protocol and its Woking
2. Develop knowledge on The LIN protocol and its Woking
3. Develop knowledge on of MOST , FlexRay protocol and its Woking
4. Develop knowledge on The PCI, I2C, RS232 and SPI protocol and its Woking
5. Develop knowledge on The GPS and GSM Systems Woking and automobile application

UNIT I ELECTRONIC SIGNAL ACQUISITION AND CONDITIONING **9**

Overview of vehicular Data communication and networking - Types of Bus- need of vehicle networking-CAN Protocol: frame formats, message transmission - bit encoding - bit timing and synchronization - types of errors – Error handling -data rate Vs bus length

UNIT II LOCAL INTERCONNECTED NETWORK **9**

Introduction to LIN- standard overview – applications – LIN Communication real time data transmission – message frame formats, bit encoding- timing and synchronization – data rate and bus length- network topology- bus access – physical layer standards

UNIT III MOST AND FLEXRAY **9**

MOST and FlexRay: MOST review - data rates - data types – topology- application areas- FlexRay Introduction- network topology - ECUs and Bus interfaces - Controller host interface and protocol operation controls - media access control and frame and symbol processing - coding/decoding unit - FlexRay scheduling - message processing - Wakeup/startup -applications.

UNIT IV OTHER PHYSICAL LAYER COMMUNICATION PROTOCOLS **9**

Peripheral component interface (PCI)- Inter-Integrated Circuit(I^2C)- RS232- Serial Peripheral Interface (SPI) -Ethernet

UNIT V WAN, SATELLITE NETWORKS AND GSM **9**

Introduction to WAN Networks-GPS - setting receivers - Positioning - activating the navigation function -Concept of latitude and longitude grid system - Mapping and location technologies – application- GSM

Course Outcomes:	**Cognitive Level**
At the end of the course students will be able to:	
CO1: Demonstrate Woking of The CAN protocol	Understand
CO2: Demonstrate Woking of The LIN protocol	Understand
CO3: Explain the construction and working of MOST and FlexRay protocol	Understand
CO4: Explain the construction and working of PCI, I2C, RS232 and SPI	Understand
CO5: Demonstrate Woking of The GPS and GSM systems	Understand

Text Book(s):

T1. Bosch, Robet. Bosch Automotive Networking: Expert Know-How on Automotive Technology. Germany, Bentley Publishers, 2007.

T2. Kukushkin, Alexander. Introduction to Mobile Network Engineering: GSM, 3G-WCDMA, LTE and the Road to 5G. Germany, Wiley, 2018.

T3. Mohinder S. Grewal, Angus P. Andrews, Chris G. Bartone, Global Navigation Satellite Systems, Inertial Navigation, and Integration, 3rd Edition

Reference Book(s):

R1. Dressler, Falko, and Sommer, Christoph. Vehicular Networking. United Kingdom, Cambridge University Press, 2014.

R2. Elliott D. Kaplan, Christopher J. Hegarty (eds.), Understanding GPS/GNSS. Principles and Applications, Third Edition, Artech House

Web References:

1. https://nptel.ac.in/courses/117/102/117102062/
2. https://nptel.ac.in/courses/117/105/117105131/
3. https://nptel.ac.in/courses/108/102/108102045/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	1	-
CO2	2	1	-	-	-	-	-	1	-	1	-	1	1	-
CO3	2	1	-	-	-	-	-	1	-	1	-	1	1	-
CO4	2	1	-	-	-	-	-	1	-	1	-	1	1	-
CO5	2	1	-	-	-	-	-	1	-	1	-	1	1	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19AUEC1004	Course Title: AUTOMOTIVE INFOTRONICS (Common to AU & ME)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites:

- Automotive Embedded system

Course Objectives: The course is intended to:

1. Develop knowledge on general construction and working of Driver information system
2. Develop knowledge on Lateral/Side Sensing and Control Systems
3. Develop knowledge on Longitudinal Sensing and Control Systems
4. Develop knowledge on Integrated Lateral and Longitudinal Control and Sensing Systems
5. Develop knowledge on Security systems and its Woking used in automobile application

UNIT I INTRODUCTION 8

Driver information system: Architecture of Driver information system, Vehicular Sensors Datas, data types, Bus types and Gateway, interfacing devices, indication systems, data storage, Display devices

UNIT II LATERAL/SIDE SENSING AND CONTROL SYSTEMS 10

Lane Departure Warning System, Road Departure Warning Systems, Lane Keeping Assist Systems, Parallel Parking Assist, Side Sensing: Blind Spot Monitoring and Lane Change Assistance, Comprehensive Lateral Control Assistance, Rollover Collision Avoidance (RCA) for Heavy Trucks

UNIT III LONGITUDINAL SENSING AND CONTROL SYSTEMS 9

Rear Sensing for Parking-Night Vision-Adaptive Front Lighting-Adaptive Cruise Control-Safe Gap Advisory-Forward Collision Warning-Rear Impact Countermeasures-Forward Crash Mitigation (FCM) and Avoidance—Active Braking-Pedestrian Detection and Avoidance-Next Generation Sensors

UNIT IV INTEGRATED LATERAL AND LONGITUDINAL CONTROL, SENSING SYSTEMS **9**

Sensor Fusion: CARSENSE for Urban Environments, INVENT Data Fusion Approach - Autonomous Intersection Collision Avoidance, Bus Transit Integrated Collision Warning System, Integrated Vehicle-Based Safety System (IVBSS) Program, PReVENT Integrated Systems

UNIT V SECURITY SYSTEMS **9**

Anti-theft technologies – mechanical, electromechanical and electronic immobilizers, alarm system, stolen vehicle tracking system, remote keyless entry, number plate coding and recognition system , Automotive cyber security – Car Hacking

Course Outcomes:

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1. Describe general construction and working of Driver information system	Understand
CO2. . Explain the working of Lateral/Side Sensing and Control Systems	Understand
CO3. Explain the working of Longitudinal Sensing and Control Systems	Understand
CO4. Explain the working of Integrated Lateral and Longitudinal Control and Sensing Systems	Understand
CO5. Explain about security systems usage in vehicle automobile	Understand

Text Book(s):

T1. Bosch, Robet. Bosch Automotive Networking: Expert Know-How on Automotive Technology. Germany, Bentley Publishers, 2007.

T2. Kukushkin, Alexander. Introduction to Mobile Network Engineering: GSM, 3G-WCDMA, LTE and the Road to 5G. Germany, Wiley, 2018.

T3. Mohinder S. Grewal, Angus P. Andrews, Chris G. Bartone, Global Navigation Satellite Systems, Inertial Navigation, and Integration, 3rd Edition

Reference Book(s):

R1. Dressler, Falko, and Sommer, Christoph. Vehicular Networking. United Kingdom, Cambridge University Press, 2014.

R2. Elliott D. Kaplan, Christopher J. Hegarty (eds.), Understanding GPS/GNSS. Principles and Applications, Third Edition, Artech House

Web References:

1. https://nptel.ac.in/courses/117/102/117102062/
2. https://nptel.ac.in/courses/117/105/117105131/
3. https://nptel.ac.in/courses/108/102/108102045/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	1	-
CO2	2	1	-	-	-	-	-	1	-	1	-	1	1	-
CO3	2	1	-	-	-	-	-	1	-	1	-	1	1	-
CO4	2	1	-	-	-	-	-	1	-	1	-	1	1	-
CO5	2	1	-	-	-	-	-	1	-	1	-	1	1	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19MEEC1019	Course Title: INDUSTRIAL IOT (Common to AU, MC & ME)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Explain the basic concepts of IIoT.
2. Explain the various Architectures of IIoT.
3. Explain the sensors available in IIoT based on application requirement.
4. Explain the basics of Big Data and IoT Analytics.
5. Explain the various applications of IoT .

UNIT I INTRODUCTION 9

Introduction to IoT, IoT Vs. IIoT, History of IIoT, Components of IIoT -Sensors, Interface, Networks, Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories, Role of IIoT in Manufacturing Processes, Sustainability through Business excellence tools Challenges & Benefits in implementing IIoT.

UNIT II ARCHITECTURES 9

Overview of IOT components, various architectures of IOT and IIOT, Advantages & Disadvantages, IIOT System components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers and its integration, WSN, WSN network design for IoT, IIoT Business Model and Reference Architectures, Industrial IoT- Sensing, IIoT - Processing and Communication, IIoT Networking.

UNIT III SENSOR AND INTERFACING 9

Introduction to sensors, Transducers, Classification, Roles of sensors in IIOT, Various types of sensors, special requirements for IIOT sensors, Role of actuators, types of actuators. Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel, Ethernet and BACNet.

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UNIT IV BIG DATA AND IOT ANALYTICS 9

Big Data, Characteristics of Big Data, Types of Big Data, Analysing of Data, Applications, Big Data tools, Introduction to Machine Learning and Data Science, R and Julia Programming, IOT Analytics, Role of Analytics in IOT, Data visualization Techniques.

UNIT V IoT APPLICATIONS 9

Internet of Things Applications : City Automation, Automotive Applications, Home Automation, Smart Cards, Plant Automation, Real life examples of IIoT in Manufacturing Sector, Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the basic concepts of IIoT.	Understand
CO2: Explain the various Architectures of IIoT.	Understand
CO3: Explain the sensors available in IIoT based on application requirement.	Understand
CO4: Explain the basics of Big Data and IoT Analytics.	Understand
CO5: Explain the various applications of IoT.	Understand

Text Book(s):

T1. Sudip Misra, Chandana Roy, Anandarup Mukherjee " Introduction to Industrial Internet of Things and Industry 4.0" CRC Press,1st edition 2020.

T2. Adrian McEwen, Hakim Cassimally "Designing the Internet of Things", John Wiley & Sons, 1st edition, 2013.

T3. Perry Lea, "Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security", Packt Publishing Ltd., 2018.

T4. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on Approach)", Orient Blackswan Private Limited - New Delhi, 1st edition 2015.

Reference(s):

R1. Qusay F. Hassan, "Internet of Things A to Z: Technologies and Applications", John Wiley & Sons,2018.

R2. Joe Biron and Jonathan Follett “Foundational Elements of an IoT Solution: The Edge, The Cloud, and Application Development”, Cisco Press, First Edition, 2017.

R3. Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, Apress; 1st edition 2017.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	1	-
CO2	2	1	-	-	-	-	-	1	-	1	-	1	1	-
CO3	2	1	-	-	-	-	-	1	-	1	-	1	1	-
CO4	2	1	-	-	-	-	-	1	-	1	-	1	1	-
CO5	2	1	-	-	-	-	-	1	-	1	-	1	1	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				100

Course Code: 19MEEC1009		Course Title: ADDITIVE MANUFACTURING (Common to AU, ME & MC)	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites:

- Manufacturing Processes

Course Objectives:

The course is intended to:

1. Apply the concept of design and process optimization.
2. Select suitable materials for additive manufacturing.
3. Explain the concept of photo polymerization and extrusion process system.
4. Explain the concept of Powder bed fusion and direct energy system.
5. Apply the architecture of IoT in additive manufacturing.

UNIT I DESIGN FOR ADDITIVE MANUFACTURING 9

Introduction of AM – Basic principle-Generic AM process – DFAM concepts and objectives-AM unique capabilities –Exploring design freedoms – Design tools for AM- Guidelines for process selection.

UNIT II MATERIALS FOR ADDITIVE MANUFACTURING 9

Classification of polymer and metallic materials –Properties of AM materials – Application of AM material – Atomic structure and bonding-ceramics – polymer-powdered materials- composites- Multiple materials in AM – Multiple – discrete – porous – blended.

UNIT III PHOTOPOLYMERIZATION PROCESSES AND EXTRUSION BASED SYSTEM 9

Photopolymerization materials – Reaction Rates – Vector scan SL - SL Resin Curing Process - SL Scan Patterns - Vector Scan Microstereolithography - Mask Projection Photopolymerization Technologies and Processes - Two-Photon SL - Extrusion-Based Systems – Basic Principles - Plotting and Path Control - Fused Deposition Modeling – Materials – Limitation – Bio extrusion - FDM of Ceramics.

UNIT IV POWDER BED FUSION AND DIRECT ENERGY SYSTEM 9

SLS process - Powder Fusion Mechanisms - Powder Handling – Process parameters – Materials – Application – SLM Process – Process parameters – Materials – Application – DMLS process – Process parameters – materials – application – EBM process – process parameters – materials – application – LENS process – process parameters – materials – application.

UNIT V ARTIFICIAL INTELLIGENT ADDITIVE MANUFACTURING 9

Overview of AI – Types of intelligent agents – AI model – AI enabled AM - AM-based product development - Intelligent agents for product design - Intelligent agents for process design - Intelligent agents for production - Global methods - Framework of smart AM - Artificial Intelligence Applications in 3D Printing.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply the concept of design and process optimization for Additive manufacturing	Apply
CO2: Select suitable materials in additive manufacturing for various applications.	Apply
CO3: Explain the concept of photo polymerization and extrusion process system	Understand
CO4: Explain the concept of Powder bed fusion and direct energy system.	Understand
CO5: Apply the architecture of IoT in various additive manufacturing process and application	Apply

Text Book(s):

T1. Ian Gibson, David W.Rosen, Brent Stucker, “Additive Manufacturing Technologies‟, Springer, 3rd edition, 2020.

T2. Patri.K.Venuvinod and Weiyin Ma. “Rapid Prototyping” Springer science+ business Media, LLC, 2004.

Reference(s):

R1. Andreas Gebhardt, Hanser “Rapid Prototyping”, Gardener Publications, 2003

R2. LiouW.Liou, Frank W.Liou, “Rapid Prototyping and Engineering applications: A tool box for prototype development”, CRC Press, 2007.

R3. Chua C.K. Leong K.F., and Lim C.S., “Rapid prototyping: Principles and application”, Second edition, World Scientific Publishers, 2010.

Web references:

1. https://nptel.ac.in/courses/112/104/112104265/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	-	1	-	2	1	2
CO2	3	2	1	1	-	-	-	1	-	1	-	2	1	2
CO3	2	1	-	-	-	-	-	1	-	1	-	2	1	2
CO4	2	1	-	-	-	-	-	1	-	1	-	2	1	2
CO5	3	2	1	1	-	-	-	1	-	1	-	2	1	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				100

Course Code:19MEEC1001	Course Title: PRODUCT LIFE CYCLE MANAGEMENT (Common to AU, MC & ME)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. To explain the fundamentals of PLM
2. To provide an in-depth understanding of business processes in the PLM.
3. To explain the management concept for product development in PLM.
4. To explain the importance of Digital Manufacturing in PLM.
5. To explain the use case scenarios through various customer case studies.

UNIT I BUSINESS STRATEGY IN THE PLM 9

Definition, PLM Lifecycle Model, Threads of PLM, Need for PLM, Opportunities and Benefits of PLM, Views, Components and Phases of PLM, PLM feasibility Study, PLM Visioning, Strategy, Impact of strategy, Implementing a PLM strategy, PLM Initiatives to Support Corporate Objectives, Infrastructure Assessment, Assessment of Current Systems and Applications.

UNITII BUSINESS PROCESSES IN THE PLM 9

Characteristics of PLM, Environment Driving PLM, PLM Elements, Drivers of PLM, Conceptualization, Design, Development, Validation, Production, Support of PLM. Engineering Vaulting, Product Reuse, Smart Parts, Engineering Change Management, Workflow Management.

UNIT III PRODUCT DEVELOPMENT CONCEPTS IN THE PLM 9

Bill of Materials (E-BOM, M-BOM, S-BOM) and Process Consistency, Product Structure, Configuring BOM, Simulation Process Management, Variant Management, Digital Mock-Up and Prototype Development, Design for Environment, Virtual Testing and Validation, Marketing Collateral.

UNIT IV DIGITAL MANUFACTURING IN THE PLM 9

Digital Manufacturing, Benefits of Digital Manufacturing, Manufacturing the First-One, Ramp Up, Virtual Learning Curve, Manufacturing the Rest, Production Planning.

UNIT V CUSTOMER USE CASES OF THE PLM 9

Impact and Challenges faced while implementing a successful PLM strategy -Rolls Royce, Nissan Motor, Sunseeker International and Xtrac

Course Outcomes **At the end of this course, students will be able to:**	**Cognitive Level**
CO1: Understand PLM strategy based on the business needs	Understand
CO2: Explain various business processes in the PLM	Understand
CO3: Understand the product development concepts involved in the PLM	Understand
CO4: Explain the use of Digital Manufacturing environment in the PLM.	Understand
CO5: Understand the various customer use cases of the PLM	Understand

Text Book(s):

T1. John Stark, “Product Lifecycle Management: Volume 1: 21st Century Paradigm for Product Realisation”, Springer International Publishing Switzerland, 3rd edition, 2015.

T2. Grieves Michael, “Product Lifecycle Management- Driving the Next Generation of Lean Thinking”, McGraw-Hill, 2010.

T3. Wang, Lihui; Nee, Andrew Y.C. (Eds.) Collaborative Design and Planning for Digital Manufacturing, Springer, 2009.

Reference(s):

R1. Elangovan, U., “Product Lifecycle Management (PLM)”. Boca Raton, CRC Press, 2020.

R2. Fabio Giudice, Guido La Rosa, Product Design for the environment-A life cycle approach, Taylor & Francis 2006.

R3. Antti Saaksvuori, “ Product Life Cycle Management” - Anselmi Immonen, Springer, 1st Edition, 2003.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	1	-	-	1	-	1	-	1	3	2
CO2	2	1	-	-	1	-	-	1	-	1	-	1	3	2
CO3	2	1	-	-	1	-	-	1	-	1	-	1	3	2
CO4	2	1	-	-	1	-	-	1	-	1	-	1	3	2
CO5	2	1	-	-	1	-	-	1	-	1	-	1	3	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19MEEC1021	Course Title : JAVA PROGRAMMING FOR MECHANICAL SCIENCES (Common to AU & ME)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- Nil

Course Objectives:

The course is intended to:

1. Describe the distinct properties and features of Java.
2. Implement name spaces, concurrency and handle exceptional conditions.
3. Employ Java standard library functions.
4. Apply Java utility, input/output functions and file manipulators.
5. Develop Java applications using user interfaces and database connectivity.

UNIT I INTRODUCTION 9

Overview of Java – Data types, operators, control flows –Class fundamentals, objects and constructors –Method overloading- argument passing, Returning objects, recursion – Method Overriding and Dynamic Method dispatch- Abstract class.

UNIT II PACKAGES, EXCEPTIONS AND THREADS 9

Packages and access protection – Interfaces and extending interfaces – Exception fundamentals and types – Try, catch, throw, throws and finally; Chained Exceptions – Thread model, Creating threads and thread priorities – Synchronization –Inter thread communication.

UNIT III JAVA UTILITIES 9

String Handling –String Buffer class and functions – Library Functions – Math – Process – Clone – System Functions.

UNIT IV COLLECTIONS AND I/O STREAMS 9

Collections – Classes and Interfaces – Iterators and User defined collections – String Tokenizer – Java I/O classes and Interfaces - Streams – Byte Streams - Character Streams – File concepts.

UNIT V EXPLORING SWING 9

Java Swing – Features –Components and Containers – Event handling – Exploring Swing – Menus – Java Database Connectivity.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Describe the distinct properties and features of Java	Understand
CO2: Implement name spaces, concurrency and handle exceptional conditions in programs	Apply
CO3: Employ Java standard library functions for solving complex problems	Apply
CO4: Apply Java utility, input/output functions and file manipulators	Apply
CO5: Develop Java applications using user interfaces and database connectivity.	Apply

Text Book(s):

T1. Herbert Schildt, “Java the Complete Reference”, Mcgraw Hill Education, Ninth Edition, 2014

T2. Mahmoud Parsian, “JDBC Metada, MySQL and Oracle Recipes: A Problem-Solution Approach”, Apress Publications, 2016.

Reference Book(s):

R1. Bart Baesens, Aimee Backiel, Seppe Vanden Brocke, “Beginning Java Programming: The Object Oriented Approach”, John Wiley & Sons, 2015.

R2. Daniel Liang, “Introduction to Java Programming, Comprehensive Version”, Pearson Education, Ninth Edition, 2014.

R3. James M Slack, Programming and Problem solving with JAVA, Thomson Learning, 2002.

Web Reference:

1. https://docs.oracle.com/javase/tutorial/java/index.html
2. http://javabeginnerstutorial.com/core-java/
3. http://www.w3schools.in/java/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	1	-	-	1	-	1	-	1	1	-
CO2	3	2	1	1	1	-	-	1	-	1	-	1	1	-
CO3	3	2	1	1	1	-	-	1	-	1	-	1	1	-
CO4	3	2	1	1	1	-	-	1	-	1	-	1	1	-
CO5	3	2	1	1	1	-	-	1	-	1	-	1	1	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				100

Course Code:19MEEC1022	Course Title : DATA STRUCTURES AND OBJECT ORIENTED PROGRAMMING WITH C++ (Common to AU & ME)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- Nil

Course Objectives:

The course is intended to:

1. Write simple C++ programs.
2. Write advanced C++ programs.
3. Implement linear data structures and sorting & searching algorithms.
4. Implement non-linear data structures such as Trees and Graphs.
5. Explain Data mining in Knowledge discovery process.

UNIT I PRINCIPLES OF OBJECT ORIENTED PROGRAMMING 8

Introduction-Tokens-Control Structures– Functions & Pointers –Concepts of OOP - Classes and Objects - Constructors and Destructors- Inheritance.

UNIT II ADVANCED OBJECT ORIENTED PROGRAMMING 9

Polymorphism – Overloading: Function loading & Operator overloading - Overriding-Virtual Functions – File Handling: Read & Write operations – Introduction to Exception Handling.

UNIT III LINEAR DATA STRUCTURES 11

Algorithm Analysis-Abstract Data Types-List ADT-array and Linked List Implementation– Stack ADT - Queue ADT– Applications of Linear Data structure - Sorting Techniques: Bubble sort - Merge sort-Quick sort-Searching Techniques: Linear Search–Binary Search.

UNIT IV TREES AND GRAPHS 9

Trees: Binary Trees-Binary Search Tree ADT - Graph Algorithms: Topological Sort-Single Source Shortest Path Algorithm-All Pairs Shortest Path Algorithm - Minimum Spanning Tree - Prim’s and Kruskal’s Algorithm.

UNIT V INTRODUCTION TO DATA MINING **8**

Data Mining Overview – Knowledge Discovery in Databases process – Different Kinds of Data – Kinds of Patterns Mined – Technologies Used – Kinds of Applications – Issues in Data Mining – Data Warehouse Basic Concepts.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Write C++ programs using classes, objects and Inheritance paradigms.	Apply
CO2: Write C++ programs using polymorphism, File and Exception handling operations.	Apply
CO3: Implement linear data structures and sorting& searching algorithms.	Apply
CO4: Implement non-linear data structures such as Trees and Graphs.	Apply
CO5: Explain Data mining in Knowledge discovery process and its applications.	Understand

Text Book(s):

T1. Robert Lafore, "Object Oriented Programming in C++", Sams Publishing, Fourth edition, 2002.

T2. MarkAllenWeiss,"DataStructuresandAlgorithmAnalysisinC",PearsonEducation Asia, New Delhi, Third Edition, 2007.

T3. JiaweiHan, MichelineKamber, JianPei "Data Mining Concepts and Techniques", Elsevier,ThirdEdition, 2012.

Reference Book(s):

R1. Balagurusamy.E,"ObjectOrientedProgrammingwithC++",TataMcGrawHill, New Delhi, Fourth Edition,2008.

R2. Alfred V.Aho,JohnE. Hopcroft and Jeffry D.Ullman, "Data Structures and Algorithms", Pearson Education, New Delhi, 2006.

R3. Ellis Horowitz, Sartaj Sahni,Dinesh Mehta "Fundamentals of Data Structures inC++", Galgotia Publication, NewDelhi, Third Edition, 2009.

R4. Seymour Lipschutz, "Data Structures", McGraw-Hill,NewDelhi, Third Edition,2007.

R5. Michael Berthold, David.J.Hand, “Intelligent Data Analysis”, Springer, Second Edition, 2007.

Web Reference:

1. https://nptel.ac.in/courses/117/103/117103063/
2. https://nptel.ac.in/courses/108/108/108108111/
3. https://nptel.ac.in/courses/108/104/108104091/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	1	-	1	-	1	1	-
CO2	3	2	1	1	1	-	-	1	-	1	-	1	1	-
CO3	3	2	1	1	1	-	-	1	-	1	-	1	1	-
CO4	3	2	1	1	1	-	-	1	-	1	-	1	1	-
CO5	2	1	-	-	1	-	-	1	-	1	-	1	1	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				100

Course Code: 19MEEC1023	Course Title: MODEL BASED SYSTEMS ENGINEERING (Common to AU, ME & MC)		
Course Category: Professional Elective		Course Level: Introductory	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Prerequisites

The student should have undergone the courses:

- Nil

Course Objective

The course is intended to

1. Explain the basis of system modeling
2. Explain the system specification
3. Develop a system architecture
4. Develop a handoff to downstream engineering
5. Demonstration of meeting needs

UNIT I BASICS OF SYSTEMS MODELING 9

Concept Generation and Selection-Product Architecture - Design for Manufacturing and Product Development– Managing backlog - Managing risk- Product roadmap- Release plan – Iteration plan – Estimating effort – Work item prioritization- Organizing your models.

UNIT II SYSTEM SPECIFICATION 9

Functional analysis with scenarios, activities, state machine and user stories- Model based safety and threat analysis- specific logical system interfaces – Creating the logical data schema- Technological forecasting.

UNIT III DEVELOPING SYSTEM ARCHITECTURES 9

General architectural guidelines – Architectural merging – Pattern driven architecture – Subsystem and component architecture – Architectural allocation - Creating subsystem interfaces.

UNIT IV HANDOFF TO DOWNSTREAM ENGINEERING 9

Preparation for handoff – Federating models for handoff – Logical to physical interfaces – Deployment architecture – Allocation to engineering facets – Interdisciplinary interfaces.

UNIT V VERIFICATION AND VALIDATION 9

Demonstration of meeting needs- Model simulation – Model based testing – Computable constraint modeling – Traceability – Effective reviews – Test driven models.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain the purpose, inputs & preconditions and outputs & post conditions of model based systems engineering	Understand
CO2: Explain the purpose, inputs & preconditions and outputs & post conditions of functional analysis and threat analysis	Understand
CO3: Explain the purpose, inputs & preconditions and outputs & post conditions of critical views of architecture	Understand
CO4: Explain the purpose, inputs & preconditions and outputs & post conditions of activities regarding the handoff to downstream engineering.	Understand
CO5: Explain the purpose, inputs & preconditions and outputs & post conditions of verification and validation.	Understand

Text Book(s):

T1. Bruce Powel Douglass, ”Agile Model-Based Systems Engineering Cookbook” ,Packt Publishing Ltd, UK, 1st edition, 2021.

T2. Tim Weikiens, Jesko G Lamm, Stephan Roth, Markus Walker ,”Model-Base Systems Architecture ” , John Wiley & Sons, Inc., Hoboken, New Jersey, 1st edition, 2016.

Reference Book(s):

R1. John Holt,” Systems Engineering Demystified” ,Packt Publishing Ltd, UK, 1st edition, 2021.

R2. Andrew P Sage and James E Armstrong,” Introduction to Systems Engineering”, John Wiley & Sons, Inc., Hoboken, New Jersey, 1st edition, 2017.

Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1	-	-	1	-	-	1	-	1	-	1	3	2
CO2	2	1	-	-	1	-	-	1	-	1	-	1	3	2
CO3	2	1	-	-	1	-	-	1	-	1	-	1	3	2
CO4	2	1	-	-	1	-	-	1	-	1	-	1	3	2
CO5	2	1	-	-	1	-	-	1	-	1	-	1	3	2

High-3; Medium-2; Low-1

Assessment pattern

Continuous Comprehensive Evaluation	Assessment Component	CO .No.	Marks	Total
	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				100