VIT®

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

SCHOOL OF MECHANICAL ENGINEERING

B. Tech. Mechanical with Specialization in Automotive Engineering

(B. Tech. BMA)

Curriculum

(*2019-2020 admitted students*)

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B. Tech. Mechanical with Specialization in Automotive Engineering

VISION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

Transforming life through excellence in education and research.

MISSION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

World class Education: Excellence in education, grounded in ethics and critical thinking, for improvement of life.

Cutting edge Research: An innovation ecosystem to extend knowledge and solve critical problems.

Impactful People: Happy, accountable, caring and effective workforce and students.

Rewarding Co-creations: Active collaboration with national & international industries & universities for productivity and economic development.

Service to Society: Service to the region and world through knowledge and compassion.

VISION STATEMENT OF THE SCHOOL OF MECHANICAL ENGINEERING

- To be a leader in imparting world class education in Mechanical Engineering, leading to nurturing of scientists and technologists of highest caliber who would engage in sustainable development of the globe.

MISSION STATEMENT OF THE SCHOOL OF MECHANICAL ENGINEERING

- The mission of the school is to create and maintain an environment for Excellence in Instruction, Learning and Applied Research in the area of Mechanical and allied disciplines so as to equip our students with necessary knowledge and skills for higher education/employment and to meet the societal demands.

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B. Tech. Mechanical with Specialization in Automotive Engineering

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. Graduates will be engineering practitioners and leaders, who would help solve industry's technological problems.

2. Graduates will be engineering professionals, innovators or entrepreneurs engaged in technology development, technology deployment, or engineering system implementation in industry.

3. Graduates will function in their profession with social awareness and responsibility.

4. Graduates will interact with their peers in other disciplines in industry and society and contribute to the economic growth of the country.

5. Graduates will be successful in pursuing higher studies in engineering or management.

6. Graduates will pursue career paths in teaching or research.

B. Tech. Mechanical with Specialization in Automotive Engineering

PROGRAMME OUTCOMES (POs)

PO_01: Having an ability to apply mathematics and science in engineering applications.

PO_02: Having a clear understanding of the subject related concepts and of contemporary issues and apply them to identify, formulate and analyse complex engineering problems.

PO_03: Having an ability to design a component or a product applying all the relevant standards and with realistic constraints, including public health, safety, culture, society and environment

PO_04: Having an ability to design and conduct experiments, as well as to analyse and interpret data, and synthesis of information

PO_05: Having an ability to use techniques, skills, resources and modern engineering and IT tools necessary for engineering practice

PO_06: Having problem solving ability- to assess social issues (societal, health, safety, legal and cultural) and engineering problems

PO_07: Having adaptive thinking and adaptability in relation to environmental context and sustainable development

PO_08: Having a clear understanding of professional and ethical responsibility

PO_09: Having cross cultural competency exhibited by working as a member or in teams

PO_10: Having a good working knowledge of communicating in English – communication with engineering community and society

PO_11: Having a good cognitive load management skills related to project management and finance

PO_12: Having interest and recognise the need for independent and lifelong learning

B. Tech. Mechanical with Specialization in Automotive Engineering

PROGRAMME SPECIFIC OUTCOMES (PSOs)

On completion of B. Tech. (Mechanical with Specialization in Automotive Engineering) programme, graduates will be able to

PSO_01: Model, Design & Analyse Automotive and Mechanical Engineering systems and components taking into account social, economic and environmental implications

PSO_02: Realize engineering components and products using appropriate materials and machine tools

PSO_03: Work professionally in mechanical, automotive and related systems

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B. Tech. Mechanical with Specialization in Automotive Engineering

CREDIT STRUCTURE

Category-wise Credit distribution

Category	Credits
University Core (UC)	53
Programme Core (PC)	60
Programme Elective (PE)	35
University Elective (UE)	12
Total Credits	160

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B. Tech. Mechanical with Specialization in Automotive Engineering

DETAILED CURRICULUM

University Core

Sl.No.	Course Code	Course Title	L	T	P	J	C
1	CHY1701	Engineering Chemistry	3	0	2	0	4
2	CSE1001	Problem Solving and Programming	0	0	6	0	3
3	CSE1002	Problem Solving and Object Oriented Programming	0	0	6	0	3
4	ENG1901	Technical English – I	0	0	4	0	2
5	ENG1902	Technical English - II	0	0	4	0	2
6	ENG1903	Advanced Technical English	0	0	2	4	2
7	ESP1001	ESPANOL FUNDAMENTAL*	2	0	0	0	2
8	ESP2001	ESPANOL INTERMEDIO*	2	0	2	0	3
9	FRE1001	Francais quotidian*	2	0	0	0	2
10	FRE2001	Francais progressif*	2	0	2	0	3
11	GER1001	Grundstufe Deutsch*	2	0	0	0	2
12	GER2001	Mittelstufe Deutsch*	2	0	2	0	3
13	GRE1001	Modern Greek*	2	0	0	0	2
14	HUM1021	Ethics and Values	2	0	0	0	2
15	JAP1001	Japanese for Beginners*	2	0	0	0	2
16	MAT1011	Calculus for Engineers	3	0	2	0	4
17	MAT2001	Statistics for Engineers	3	0	2	0	4
18	MEE1901	Technical Answers for Real World Problems (TARP)	1	0	0	4	2
19	MEE1902	Industrial Internship	0	0	0	0	1
20	MEE1903	Comprehensive Examination	0	0	0	0	1
21	MEE1904	Capstone Project	0	0	0	0	12

22	MGT1022	Lean Start-up Management	1	0	0	4	2
23	PHY1701	Engineering Physics	3	0	2	0	4
24	PHY1901	Introduction to Innovative Projects	1	0	0	0	1
25	RUS1001	Russian for Beginners*	2	0	0	0	2
26	STS1101	Fundamentals of Aptitude	3	0	0	0	1
27	STS 1102	Arithmetic problem solving	3	0	0	0	1
28	STS2101	Getting started to skill enhancement[#]	3	0	0	0	1
29	STS2102	Enhancing problem solving skills[#]	3	0	0	0	1
30	STS3301	JAVA for beginners[#]	3	0	0	0	1
31	STS3105	Computational thinking[#]	3	0	0	0	1
32	STS1201	Introduction to problem solving[$]	3	0	0	0	1
33	STS1202	Introduction to quantitative, logical and verbal ability[$]	3	0	0	0	1
34	STS2201	Numerical ability and cognitive intelligence[$]	3	0	0	0	1
35	STS2202	Advanced aptitude and reasoning skills[$]	3	0	0	0	1
36	STS3401	Foundation to programming skills[$]	3	0	0	0	1
37	STS3205	Advanced JAVA Programming[$]	3	0	0	0	1

***Student may choose any foreign language courses restricted to 2 credits. Even a student take a 3 credit foreign language course, only 2 credits will be accounted.**

 # Students who are not clearing English Proficiency Test (EPT) should undergo these courses.

[$] Students who are clearing English Proficiency Test (EPT) should undergo these courses.

Program Core

Sl. No.	Course Code	Course Title	L	T	P	J	C
1	MAT2002	Applications of Differential and Difference Equations	3	0	2	0	4
2	MAT3003	Complex Variables and Partial Differential Equations	3	2	0	0	4
3	MAT3005	Applied Numerical Methods	3	2	0	0	4
4	MEE1001	Engineering Drawing	1	0	4	0	3
5	MEE1002	Engineering Mechanics	2	2	0	0	3
6	MEE1003	Engineering Thermodynamics	2	2	0	0	3
7	MEE1005	Materials Engineering and Technology	3	0	2	0	4
8	MEE1007	Manufacturing Processes	2	0	2	0	3
9	MEE1032	Mechanics of Solids and Fluids	3	0	2	0	4
10	MEE1035	Automotive Electricals	3	0	0	0	3
11	MEE1036	Automotive Chassis	3	0	2	0	4
12	MEE1037	Automotive Electronics	3	0	2	0	4
13	MEE2001	Machine Drawing	1	0	4	0	3
14	MEE2004	Mechanics of Machines	2	2	2	0	4
15	MEE2038	Thermal and Heat Transfer	2	2	0	0	3
16	MEE2039	Automotive Transmission Systems	2	0	0	4	3
17	MEE3015	Automotive Engines	3	0	2	0	4

Program Elective

Sl.No.	Course Code	Course Title	L	T	P	J	C
1	CHE2006	Fuels and Combustion	3	0	0	0	3
2	MEE1013	Fuel Cells	3	0	0	0	3
3	MEE1014	Industrial Engineering and Management	3	0	0	0	3
4	MEE1024	Operations Research	2	2	0	0	3

5	MEE1038	Solar Photovoltaic System Design	2	0	0	4	3
6	MEE1039	Automotive Fuels and Energy	3	0	2	0	4
7	MEE1040	Auto Certification and Homologation	3	0	0	0	3
8	MEE1041	Automotive Safety Systems	3	0	0	0	3
9	MEE1042	Ergonomics and Styling	3	0	0	0	3
10	MEE1043	Design Failure Mode and Effects Analysis	3	0	0	0	3
11	MEE2006	Machining Processes and Metrology	2	0	2	0	3
12	MEE2007	CAD/CAM	2	0	4	0	4
13	MEE2008	Product Design for Manufacturing	2	0	0	4	3
14	MEE2026	Turbo Machines	2	2	2	0	4
15	MEE2028	Automotive Aerodynamics	2	2	0	4	4
16	MEE2040	Non-Destructive Testing	2	0	2	4	4
17	MEE2041	Vehicle Body Engineering	3	0	0	0	3
18	MEE2042	Two and Three Wheeler	3	0	0	0	3
19	MEE2043	Vehicle Inspection and Maintenance	2	0	0	4	3
20	MEE2044	Instrumentation and Vehicle Diagnostics	3	0	0	0	3
21	MEE2045	Automotive Control Systems	2	0	0	4	3
22	MEE2046	Automotive Braking Systems	2	0	0	4	3
23	MEE2047	Automotive Suspension and Steering Systems	2	0	0	4	3
24	MEE2048	Applied Hydraulics and Off Road Vehicles	3	0	0	0	3
25	MEE2049	Manufacturing of Automotive Components	3	0	0	0	3
26	MEE2050	Vehicle Dynamics	2	2	0	0	3
27	MEE3016	Design of Chassis Components	2	2	0	4	4
28	MEE3017	Automotive HVAC	3	0	0	0	3
29	MEE3018	Noise, Vibration and Harshness	3	0	0	0	3
30	MEE4006	Computational Fluid Dynamics	2	2	2	0	4

University Elective Baskets

Management courses

Sl.No	Code	Title	L	T	P	J	C
1	MGT1001	Basic Accounting	3	0	0	0	3
2	MGT1002	Principles of Management	2	0	0	4	3
3	MGT1003	Economics for Engineers	2	0	0	4	3
4	MGT1004	Resource Management	2	0	0	4	3
5	MGT1005	Design, Systems and Society	2	0	0	4	3
6	MGT1006	Environmental and Sustainability Assessment	2	0	0	4	3
7	MGT1007	Gender, Culture and Technology	2	0	0	4	3
8	MGT1008	Impact of Information Systems on Society	2	0	0	4	3
9	MGT1009	Technological Change and Entrepreneurship	2	0	0	4	3
10	MGT1010	Total Quality Management	2	2	0	0	3
11	MGT1014	Supply Chain Management	3	0	0	0	3
12	MGT1015	Business Mathematics	3	0	0	0	3
13	MGT1016	Intellectual Property Rights	3	0	0	0	3
14	MGT1017	Business Regulatory Framework For Start-ups	3	0	0	0	3
15	MGT1018	Consumer Behaviour	3	0	0	0	3
16	MGT1019	Services Marketing	3	0	0	0	3
17	MGT1020	Marketing Analytics	2	0	2	0	3
18	MGT1021	Digital and Social Media Marketing	3	0	0	0	3
19	MGT1022	Lean Start-up Management	1	0	0	4	2
20	MGT1023	Fundamentals of Human Resource Management	3	0	0	4	4
21	MGT1024	Organizational Behaviour	3	0	0	4	4
22	MGT1025	Foundations of Management And Organizational Behaviour	3	0	0	4	4
23	MGT1026	Information Assurance and Auditing	2	0	0	4	3
24	MGT1028	Accounting and Financial Management	2	2	0	4	4

25	MGT1029	Financial Management	2	1	0	4	4
26	MGT1030	Entrepreneurship Development	3	0	0	4	4
27	MGT1031	International Business	3	0	0	4	4
28	MGT1032	Managing Asian Business	3	0	0	4	4
29	MGT1033	Research Methods in Management	2	1	0	4	4
30	MGT1034	Project Management	3	0	0	4	4
31	MGT1035	Operations Management	3	0	0	0	3
32	MGT1036	Principles of Marketing	3	0	0	4	4
33	MGT1037	Financial Accounting and Analysis	2	1	0	4	4
34	MGT1038	Financial Econometrics	2	0	0	4	3
35	MGT1039	Financial Markets and Institutions	2	0	0	4	3
36	MGT1040	Personal Financial Planning	2	0	0	4	3
37	MGT1041	Financial Derivatives	2	1	0	4	4
38	MGT1042	Investment Analysis and Portfolio Management	2	0	0	4	3
39	MGT1043	Applications in Neuro Marketing	3	0	0	4	4
40	MGT1044	Global Brand Marketing Strategies	3	0	0	4	4
41	MGT1045	Industrial Marketing	3	0	0	4	4
42	MGT1046	Sales and Distribution Management	3	0	0	4	4
43	MGT1047	Social Marketing	3	0	0	4	4
44	MGT1048	Political Economy of Globalization	3	0	0	4	4
45	MGT1049	Sustainable Business Models	3	0	0	4	4
46	MGT1050	Software Engineering Management	2	0	0	4	3
47	MGT1051	Business Analytics for Engineers	2	2	0	0	3
48	MGT1052	Bottom of the Pyramid Operations	3	0	0	0	3
49	MGT1053	Entrepreneurship Development, Business Communication and IPR	1	0	2	0	2
50	MGT1054	Product Planning and Strategy	2	2	0	0	3
51	MGT1055	Design Management	2	2	0	0	3
52	MGT1056	Accounting and Financial Management	3	0	0	4	4

53	MGT6001	Organizational Behaviour	2	0	0	4	3

Humanities courses

Sl.No	Code	Title	L	T	P	J	C
1	HUM1001	Fundamentals of Cyber Laws	3	0	0	0	3
2	HUM1002	Business Laws	3	0	0	0	3
3	HUM1003	Basic Taxation for Engineers	3	0	0	0	3
4	HUM1004	Corporate Law for Engineers	3	0	0	0	3
5	HUM1005	Cost Accounting for Engineers	3	0	0	0	3
6	HUM1006	Business Accounting for Engineers	3	0	0	0	3
7	HUM1007	Contemporary Legal Framework for Business	3	0	0	0	3
8	HUM1009	International Business	3	0	0	0	3
9	HUM1010	Foreign Trade Environment	3	0	0	0	3
10	HUM1011	Export Business	3	0	0	0	3
11	HUM1012	Introduction to Sociology	3	0	0	0	3
12	HUM1013	Population Studies	3	0	0	0	3
13	HUM1021	Ethics and Values	2	0	0	0	2
14	HUM1022	Psychology in Everyday Life	2	0	0	4	2
15	HUM1023	Indian Heritage and Culture	2	0	0	4	2
16	HUM1024	India and Contemporary World	2	0	0	4	2
17	HUM1025	Indian Classical Music	1	0	2	4	1
18	HUM1033	Micro Economics	3	0	0	0	3
19	HUM1034	Macro Economics	3	0	0	0	3
20	HUM1035	Introductory Econometrics	2	0	2	0	2
21	HUM1036	Engineering Economics and Decision Analysis	2	0	0	4	2
22	HUM1037	Applied Game Theory	2	0	0	4	2
23	HUM1038	International Economics	3	0	0	0	3
24	HUM1039	Community Development in India	2	0	0	4	2

25	HUM1040	Indian Social Problems	3	0	0	0	3
26	HUM1041	Indian Society Structure and Change	3	0	0	0	3
27	HUM1042	Industrial Relations and Labour Welfare in India	3	0	0	0	3
28	HUM1043	Mass Media and Society	2	0	0	4	2
29	HUM1044	Network Society	3	0	0	0	3
30	HUM1045	Introduction to Psychology	2	0	2	0	2
31	HUM1706	Business Accounting for Engineers	3	0	0	0	3

Course code	Environmental Sciences	L	T	P	J	C
CHY1002		3	0	0	0	3
Pre-requisite	Chemistry of 12th standard or equivalent	Syllabus version				
		V:1.1				

Course Objectives

1. To make students understand and appreciate the unity of life in all its forms, the implications of life style on the environment.
2. To understand the various causes for environmental degradation.
3. To understand individuals contribution in the environmental pollution.
4. To understand the impact of pollution at the global level and also in the local environment.

Expected Course Outcome

Students will be able to

1. Students will **recognize** the environmental issues in a problem oriented interdisciplinary perspectives
2. Students will **understand** the key environmental issues, the science behind those problems and potential solutions.
3. Students will **demonstrate** the significance of biodiversity and its preservation
4. Students will **identify** various environmental hazards
5. Students will **design** various methods for the conservation of resources
6. Students will **formulate** action plans for sustainable alternatives that incorporate science, humanity, and social aspects
7. Students will have foundational **knowledge** enabling them to make sound life decisions as well as enter a career in an environmental profession or higher education.

Module:1	Environment and Ecosystem	7 hours	

Key environmental problems, their basic causes and sustainable solutions. IPAT equation. Ecosystem, earth – life support system and ecosystem components; Food chain, food web, Energy flow in ecosystem; Ecological succession- stages involved, Primary and secondary succession, Hydrarch, mesarch, xerarch; Nutrient, water, carbon, nitrogen, cycles; Effect of human activities on these cycles.

Module:2	Biodiversity	6 hours	

Importance, types, mega-biodiversity; Species interaction - Extinct, endemic, endangered and rare species; Hot-spots; GM crops- Advantages and disadvantages; Terrestrial biodiversity and Aquatic biodiversity – Significance, Threats due to natural and anthropogenic activities and Conservation methods.

Module:3	Sustaining Natural Resources and Environmental Quality	7 hours	

Environmental hazards – causes and solutions. Biological hazards – AIDS, Malaria, Chemical hazards- BPA, PCB, Phthalates, Mercury, Nuclear hazards- Risk and evaluation of hazards. Water footprint; virtual water, blue revolution. Water quality management and its conservation. Solid and hazardous waste – types and waste management methods.

Module:4	**Energy Resources**	**6 hours**	
Renewable - Non renewable energy resources- Advantages and disadvantages - oil, Natural gas, Coal, Nuclear energy. Energy efficiency and renewable energy. Solar energy, Hydroelectric power, Ocean thermal energy, Wind and geothermal energy. Energy from biomass, solar- Hydrogen revolution.			
Module:5	**Environmental Impact Assessment**	**6 hours**	
Introduction to environmental impact analysis. EIA guidelines, Notification of Government of India (Environmental Protection Act – Air, water, forest and wild life). Impact assessment methodologies. Public awareness. Environmental priorities in India.			
Module:6	**Human Population Change and Environment**	**6 hours**	
Urban environmental problems; Consumerism and waste products; Promotion of economic development – Impact of population age structure – Women and child welfare, Women empowerment. Sustaining human societies: Economics, environment, policies and education.			
Module:7	**Global Climatic Change and Mitigation**	**5 hours**	
Climate disruption, Green house effect, Ozone layer depletion and Acid rain. Kyoto protocol, Carbon credits, Carbon sequestration methods and Montreal Protocol. Role of Information technology in environment-Case Studies.			
Module:8	**Contemporary issues**	**2 hours**	
Lecture by Industry Experts			
	Total Lecture hours:	**45 hours**	

Text Books

1. G. Tyler Miller and Scott E. Spoolman (2016), Environmental Science, 15th Edition, Cengage learning.
2. George Tyler Miller, Jr. and Scott Spoolman (2012), Living in the Environment – Principles, Connections and Solutions, 17th Edition, Brooks/Cole, USA.

Reference Books

1. David M.Hassenzahl, Mary Catherine Hager, Linda R.Berg (2011), Visualizing Environmental Science, 4thEdition, John Wiley & Sons, USA.

Mode of evaluation: Internal Assessment (CAT, Quizzes, Digital Assignments) & FAT			
Recommended by Board of Studies	12.08.2017		
Approved by Academic Council	No. 46	Date	24.08.2017

Course code	Engineering Chemistry	L	T	P	J	C

CHY1701		3	0	2	0	4
Pre-requisite	**Chemistry of 12th standard or equivalent**	Syllabus version				
		1.1				

Course Objectives:

1. To impart technological aspects of applied chemistry
2. To lay foundation for practical application of chemistry in engineering aspects

Expected Course Outcomes (CO)

Students will be able to

1. Recall and analyze the issues related to impurities in water and their removal methods and apply recent methodologies in water treatment for domestic and industrial usage
2. Evaluate the causes of metallic corrosion and apply the methods for corrosion protection of metals
3. Evaluate the electrochemical energy storage systems such as lithium batteries, fuel cells and solar cells, and design for usage in electrical and electronic applications
4. Assess the quality of different fossil fuels and create an awareness to develop the alternative fuels
5. Analyze the properties of different polymers and distinguish the polymers which can be degraded and demonstrate their usefulness
6. Apply the theoretical aspects: (a) in assessing the water quality; (b) understanding the construction and working of electrochemical cells; (c) analyzing metals, alloys and soil using instrumental methods; (d) evaluating the viscosity and water absorbing properties of polymeric materials

Module:1	**Water Technology**		**5 hours**

Characteristics of hard water - hardness, DO, TDS in water and their determination – numerical problems in hardness determination by EDTA; Modern techniques of water analysis for industrial use - Disadvantages of hard water in industries.

Module:2	**Water Treatment**		**8 hours**

Water softening methods: - Lime-soda, Zeolite and ion exchange processes and their applications. Specifications of water for domestic use (ICMR and WHO); Unit processes involved in water treatment for municipal supply - Sedimentation with coagulant- Sand Filtration - chlorination; Domestic water purification – Candle filtration- activated carbon filtration; Disinfection methods- Ultrafiltration, UV treatment, Ozonolysis, Reverse Osmosis; Electro dialysis.

Module:3	**Corrosion**		**6 hours**

Dry and wet corrosion - detrimental effects to buildings, machines, devices & decorative art forms, emphasizing Differential aeration, Pitting, Galvanic and Stress corrosion cracking; Factors that enhance corrosion and choice of parameters to mitigate corrosion.

Module:4	**Corrosion Control**		**4 hours**

Corrosion protection - cathodic protection – sacrificial anodic and impressed current protection methods; Advanced protective coatings: electroplating and electroless plating, PVD and CVD. Alloying for corrosion protection – Basic concepts of Eutectic composition and Eutectic mixtures - Selected examples – Ferrous and non-ferrous alloys.

Module:5	**Electrochemical Energy Systems**		**6 hours**

Brief introduction to conventional primary and secondary batteries; High energy electrochemical energy systems: Lithium batteries – Primary and secondary, its Chemistry, advantages and applications.

Fuel cells – Polymer membrane fuel cells, Solid-oxide fuel cells- working principles, advantages, applications.
Solar cells – Types – Importance of silicon single crystal, polycrystalline and amorphous silicon solar cells, dye sensitized solar cells - working principles, characteristics and applications.

Module:6	**Fuels and Combustion**		**8 hours**

Calorific value - Definition of LCV, HCV. Measurement of calorific value using bomb calorimeter and Boy's calorimeter including numerical problems.
Controlled combustion of fuels - Air fuel ratio – minimum quantity of air by volume and by weight- Numerical problems-three way catalytic converter- selective catalytic reduction of NO_X; Knocking in IC engines-Octane and Cetane number - Antiknocking agents.

Module:7	**Polymers**		**6 hours**

Difference between thermoplastics and thermosetting plastics; Engineering application of plastics - ABS, PVC, PTFE and Bakelite; Compounding of plastics: moulding of plastics for Car parts, bottle caps (Injection moulding), Pipes, Hoses (Extrusion moulding), Mobile Phone Cases, Battery Trays, (Compression moulding), Fibre reinforced polymers, Composites (Transfer moulding), PET bottles (blow moulding);

Conducting polymers- Polyacetylene- Mechanism of conduction – applications (polymers in sensors, self-cleaning windows)

Module:8	**Contemporary issues:**		**2 hours**
Lecture by Industry Experts			
	Total Lecture hours:	**45 hours**	

Text Book(s)

1. Sashi Chawla, A Text book of Engineering Chemistry, Dhanpat Rai Publishing Co., Pvt. Ltd., Educational and Technical Publishers, New Delhi, 3rd Edition, 2015.
2. O.G. Palanna, McGraw Hill Education (India) Private Limited, 9th Reprint, 2015.
3. B. Sivasankar, Engineering Chemistry 1st Edition, Mc Graw Hill Education (India), 2008
4. "Photovoltaic solar energy : From fundamentals to Applications", AngÃ¨le Reinders, Pierre Verlinden, Wilfried van Sark, Alexandre Freundlich, Wiley publishers, 2017.

Reference Books

1. O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013.
2. S. S. Dara, A Text book of Engineering Chemistry, S. Chand & Co Ltd., New Delhi, 20th Edition, 2013.

Mode of Evaluation: Internal Assessment (CAT, Quizzes, Digital Assignments) & FAT

List of Experiments

1.	Water Purification: Estimation of water hardness by EDTA method and its removal by ion-exchange resin	1 h 30 min
2. 3.	Water Quality Monitoring: Assessment of total dissolved oxygen in different water samples by Winkler's method Estimation of sulphate / chloride in drinking water by conductivity method	3 h
4/5	Material Analysis: Quantitative colorimetric determination of divalent metal ions of Ni/Fe/Cu using conventional and smart phone digital-imaging methods	**3h**
6.	Analysis of Iron in carbon steel by potentiometry	1 h 30 min
7.	Construction and working of an Zn-Cu electrochemical cell	1 h 30 min

8.	Determination of viscosity-average molecular weight of different natural/ synthetic polymers	1 h 30 min
9.	Arduino microcontroller based sensor for monitoring temperature / conductivity in samples.	1 h 30 min
	Total Laboratory Hours	**17 hours**

Mode of Evaluation: Viva-voce and Lab performance & FAT			
Recommended by Board of Studies	31-05-2019		
Approved by Academic Council	54th ACM	Date	13-06-2019

Course code	Problem Solving and Programming	L	T	P	J	C
CSE1001		0	0	6	0	3
Pre-requisite	NIL	Syllabus version				
		v1.0				

Course Objectives:

1. To develop broad understanding of computers, programming languages and their generations
2. Introduce the essential skills for a logical thinking for problem solving
3. To gain expertise in essential skills in programming for problem solving using computer

Expected Course Outcome:

1.Understand the working principle of a computer and identify the purpose of a computer programming language
2. Learn various problem solving approaches and ability to identify an appropriate approach to solve the problem
3. Differentiate the programming Language constructs appropriately to solve any problem
4. Solve various engineering problems using different data structures
5. Able to modulate the given problem using structural approach of programming
6. Eefficiently handle data using at les to process and store data for the given problem

List of Challenging Experiments (Indicative)

1.Steps in Problem Solving Drawing Flowchart using yEd tool/Raptor Tool	4 hours
2. Introduction to Python, Demo on IDE, Keywords, Identifiers, I/O Statements,Simple Program to display Hello world in Python.	4 hours
3. Operators and Expressions in Python	4 hours
4. Algorithmic Approach 1: Sequential	2
5.Algorithmic Approach 2: Selection (if, elif, if.. else, nested if Else	2 hours
6. Algorithmic Approach 3: Iteration (while and for)	4 hours
7. Strings and its Operations	2 hours
8.Regular Expressions	2 hours
9.List and its operations.	2 hours
10.Dictionaries: operations	2 hours
11. Tuples and its operations	2 hours
12.Set and its operations	2 hours
13. Functions, Recursions	2 hours
14. Sorting Techniques (Bubble/Selection/Insertion)	4 hours
15. Searching Techniques : Sequential Search and Binary Search	3 hours
16. Files and its Operations	4 hours
Total Laboratory hours	**45 hours**

Text Book(s)			
1.	John V. Guttag., 2016. Introduction to computation and programming using python: with applications to understanding data. PHI Publisher.		
Reference Books			
1.	Charles Severance.2016.Python for everybody: exploring data in Python 3, Charles Severance.		
2	Charles Dierbach.2013.Introduction to computer science using python: a computational problem-solving focus. Wiley Publishers.Mode of Evaluation: PAT / CAT/ FAT		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	04-04-2014		
Approved by Academic Council	38th		23-10-2015

CSE1002	Problem Solving and Object Oriented Programming	L	T	P	J	C
		0	0	6	0	3
Pre-requisite	NIL	Syllabus version				
		v1.0				

Course Objectives:

1. To emphasize the benefits of object oriented concepts
2. To enable the students to solve the real time applications using object oriented programming features.
3. To improve the skills of a logical thinking and to solve the problems using any processing elements

Expected Course Outcome:

1. Recall the basics of procedural programming and to represent the real world entities as programming constructs
2. Enumerate object oriented concepts and translate real-world applications into graphical representations
3. Demonstrate the usage of classes and objects of the real world entities in applications
4. Discriminate the reusability and multiple interfaces with same functionality based features to solve complex computing problems
5. Propose possible error-handling constructs for unanticipated states/inputs and to use generic programming constructs to accommodate different datatypes
6. Validate the program against file inputs towards solving the problem

Module:1	Structured Programming	12 hours

Structured Programming conditional and looping statements-arrays – functions - pointers – dynamic memory allocation - structure

Module:2	Introduction to object oriented approach	10 hours

Introduction to object oriented approach: Why object oriented programming?- Characteristics of object oriented language: classes and objects - encapsulation-data abstraction- inheritance - polymorphism - Merits and Demerits of object oriented programming. UML- class diagram of OOP - Inline function – default argument function- Exception handling (Standard) - reference: independent reference – function returning reference – pass by reference.

Module:3	Classes and objects	14 hours

Classes and objects: Definition of classes – access specifier – class versus structure – constructor – destructor – copy constructor and its importance – array of objects – dynamic objects- friend function-friend class

Module:4	Polymorphism and Inheritance	26 hours

Polymorphism and Inheritance: Polymorphism-compile time polymorphism – function overloading – operator overloading - . Inheritance-types of inheritance- constructors and destructors in inheritance – constraints of multiple inheritance-virtual base class - run time polymorphism-function overriding.

Module:5	Exception handling and Templates	18 hours

Exception handling and Templates Exception handling(user-defined exception)- Function

template , Class template – Template with inheritance , STL – Container, Algorithm, Iterator - vector, list, stack, map.			
Module:6	**IO Streams and Fi les**		**10 hours**
IOstreams and Files IOstreams, Manipulators- overloading Inserters(<<) and Extractors(>>)Sequential and Random files – writing and reading objects into/from files			
	Total Lab hours:	**90 hours**	

Text Book(s)	
1.	Stanley B Lippman, Josee Lajoie, Barbara E, Moo, "C++ primer", Fifth edition, Addison-Wesley, 2012.
2.	Ali Bahrami, Object oriented Systems development, Tata McGraw - Hill Education, 1999
3.	Brian W. Kernighan, Dennis M. Ritchie , The „C" programming Language, 2nd edition, Prentice Hall Inc., 1988.
Reference Books	
1.	Bjarne stroustrup, The C++ programming Language, Addison Wesley, 4th edition, 2013
2.	Harvey M. Deitel and Paul J. Deitel, C++ How to Program, 7th edition, Prentice Hall, 2010.
3.	Maureen Sprankle and Jim Hubbard, Problem solving and Programming concepts, 9th edition, Pearson Eduction, 2014
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	
List of Challenging Experiments (Indicative)	
1.	**Postman Problem** A postman needs to walk down every street in his area in order to deliver the mail. Assume that the distances between the streets along the roads are given. The postman starts at the post office and returns back to the post office after delivering all the mails. Implement an algorithm to help the post man to walk minimum distance for the purpose.
2.	**Budget Allocation for Marketing Campaign** A mobile manufacturing company has got several marketing options such as Radio advertisement campaign, TV non peak hours campaign, City top paper network, Viral marketing campaign, Web advertising. From their previous experience, they have got a statistics about paybacks for each marketing option. Given the marketing budget (rupees in crores) for the current year and details of paybacks for each option, implement an algorithm to determine the amount that shall spent on each marketing option so that the company attains the maximum profit.
3.	**Missionaries and Cannibals** Three missionaries and three cannibals are on one side of a river, along with a boat that can hold one or two people. Implement an algorithm to find a way to get everyone to the other side of the river, without ever leaving a group of missionaries in one place outnumbered by the cannibals in that place.
4.	**Register Allocation Problem** A register is a component of a computer processor that can hold any type of data and can be accessed faster. As registers are faster to access, it is desirable to use them to the maximum so that the code execution is faster. For each code submitted to the processor, a register interference graph (RIG) is constructed. In a RIG, a node represents a temporary variable and

	an edge is added between two nodes (variables) t1 and t2 if they are live simultaneously at some point in the program. During register allocation, two temporaries can be allocated to the same register if there is no edge connecting them. Given a RIG representing the dependencies between variables in a code, implement an algorithm to determine the number of registers required to store the variables and speed up the code execution.
5.	**Selective Job Scheduling Problem** A server is a machine that waits for requests from other machines and responds to them. The purpose of a server is to share hardware and software resources among clients. All the clients submit the jobs to the server for execution and the server may get multiple requests at a time. In such a situation, the server schedule the jobs submitted to it based on some criteria and logic. Each job contains two values namely time and memory required for execution. Assume that there are two servers that schedules jobs based on time and memory. The servers are named as Time_Schedule_Server and memory_Schedule_Server respectively. Design a OOP model and implement the time_Schedule_Server and memory_Schedule_Server. The Time_Schedule_Server arranges jobs based on time required for execution in ascending order whereas memory_Schedule_Server arranges jobs based on memory required for execution in ascending order.
6.	**Fragment Assembly in DNA Sequencing** DNA, or deoxyribonucleic acid, is the hereditary material in humans and almost all other organisms. The information in DNA is stored as a code made up of four chemical bases: adenine (A), guanine (G), cytosine (C), and thymine (T). In DNA sequencing, each DNA is sheared into millions of small fragments (reads) which assemble to form a single genomic sequence ("superstring"). Each read is a small string. In such a fragment assembly, given a set of reads, the objective is to determine the shortest superstring that contains all the reads. For example, given a set of strings, {000, 001, 010, 011, 100, 101, 110, 111} the shortest superstring is 0001110100. Given a set of reads, implement an algorithm to find the shortest superstring that contains all the given reads.
7.	**House Wiring** An electrician is wiring a house which has many rooms. Each room has many power points in different locations. Given a set of power points and the distances between them, implement an algorithm to find the minimum cable required.

		Total Laboratory Hours	90 hours
Recommended by Board of Studies	29-10-2015		
Approved by Academic Council	39th ACM	Date	17-12-2015

Course code	English for Engineers	L	T	P	J	C
ENG1011		0	0	4	0	2
Pre-requisite	Cleared EPT / Effective English	Syllabus version				
		v. 2.2				

Course Objectives:

1. To facilitate effective language skills for academic purposes and real-life situations.
2. To enhance students' language and communication with focus on placement skills development.
3. To aid students apply language and communication skills in professional reading and reporting.

Expected Course Outcome:

1. Apply language skills with ease in academic and real-life situations.
2. Build up a job winning digital foot print and learn to face interviews confidently.
3. Develop good interpreting and reporting skills to aid them in research.
4. Comprehend language and communication skills in academic and social contexts.
5. Acquire vocabulary and learn strategies for error-free communication.

Module:1	**Listening**	**4 hours**
Casual and Academic		
Module:2	**Speaking**	**4 hours**
Socializing Skills - Introducing Oneself- His / Her Goals & SWOT		
Module:3	**Reading**	**2 hours**
Skimming and Scanning		
Module:4	**Writing**	**2 hours**
Error-free sentences, Paragraphs		
Module:5	**Listening**	**4 hours**
News (Authentic Material): Analyzing General and Domain Specific Information		
Module:6	**Speaking**	**4 hours**
Group Discussion on factual, controversial and abstract issues		
Module:7	**Reading:**	**2 hours**
Extensive Reading		
Module:8	**Writing**	**2 hours**
Email Etiquette with focus on Content and Audience		
Module:9	**Listening**	**4 hours**
Speeches : General and Domain Specific Information		
Module:10	**Speaking**	**4 hours**
Developing Persuasive Skills - Turncoat and Debate		

Module:11	**Reading**	**2 hours**
Intensive Reading		
Module:12	**Writing**	**2 hours**
Data Transcoding		
Module:13	**Cross Cultural Communication**	**4 hours**
Understanding Inter and Cross-Cultural Communication Nuances		
Module:14	**Speaking**	**4 hours**
Public Speaking/Extempore /Monologues		
Module:15	**Reading for research**	**2 hours**
Reading Scientific/Technical Articles		
Module:16	**Writing**	**2 hours**
Creating a Digital/Online Profile – LinkedIn (Résumé/Video Profile)		
Module:17	**Speaking:**	**4 hours**
Mock Job/Placement Interviews		
Module:18	**Writing**	**2 hours**
Report Writing		
Module:19	**Speaking**	**4 hours**
Presentation using Digital Tools		
Module:20	**Vocabulary**	**2 hours**
Crossword Puzzles/Word games		
	Total Lecture hours:	**60 hours**

Text Book(s)

1.	Clive Oxenden and Christina Latham-Koenig, New English File: Advanced: Teacher's Book with Test and Assessment CD-ROM: Six-level general English course for adults Paperback –Feb 2013, Oxford University Press, UK
2.	Clive Oxenden and Christina Latham-Koenig,New English File: Advance Students
3.	Book Paperback – Feb 2012, Oxford University Press, UK Michael Vince, Language Practice for Advanced - Students Book, Feb. 2014, 4th Edition, Macmillan Education, Oxford, United Kingdom

Reference Books

1.	Steven Brown, Dorolyn Smith, Active Listening 3, 2011, 3rd Edition, Cambridge University Press,UK
2.	Tony Lynch, Study Listening, 2013, 2nd Edition, Cambridge University Press, UK
3.	Liz Hamp-Lyons, Ben Heasley, Study Writing, 2010, 2nd Edition, Cambridge University Press, UK
4.	Kenneth Anderson, Joan Maclean, Tony Lynch, Study Speaking, 2013, 2nd Edition,

	Cambridge, University Press, UK
5.	Eric H. Glendinning, Beverly Holmstrom, Study Reading, 2012, 2nd Edition Cambridge University Press, UK
6.	Michael Swan, Practical English Usage (Practical English Usage), Jun 2017, 4th edition, Oxford University Press, UK
7.	Michael McCarthy, Felicity O'Dell, English Vocabulary in Use Advanced (South Asian Edition), May 2015, Cambridge University Press, UK
8.	Michael Swan, Catherine Walter, Oxford English Grammar Course Advanced, Feb 2012, 4th Edition, Oxford University Press, UK
9.	Heather Silyn-Roberts, Writing for Science and Engineering: Papers, Presentations and Reports, Jun 2016, 2nd Edition, Butterworth-Heinemann, UK

Mode of Evaluation: Assignment and FAT- Mini Project, Flipped Class Room, Lecture, PPT's, Role play, Assignments Class/Virtual Presentations, Report and beyond the classroom activities

List of Challenging Experiments (Indicative)

1.	Create a Digital or Online Profile or a Digital Footprint	6 hours
2.	Prepare a video resume	8 hours
3.	Analyse a documentary critically	4 hours
4.	Turn Coat- Speaking for and against the topic / Activities through VIT Community Radio	6 hours
5.	Present a topic using 'Prezi'	6 hours
6.	Analyse a case on cross cultural communication critically	6 hours
7.	Create a list of words relating to your domain	4 hours
8.	Listen to a conversation of native speakers of English and answer the following questions	6 hours
9.	Read an article and critically analyse the text in about 150 words	6 hours
10.	Read an autobiography and role play the character in class by taking an excerpt from the book	8 hours
	Total Practical Hours	**60 hours**

Mode of assessment:

Recommended by Board of Studies	22-07-2017		
Approved by Academic Council	No. 47	Date	24.08.2017

Course code	ESPAÑOL FUNDAMENTAL	L	T	P	J	C
ESP1001		2	0	0	0	2
Pre-requisite	Nil	Syllabus version				
		v.1.0				

Course Objectives:

1. To enable students to demonstrate Proficiency in reading, writing, and speaking in basic Spanish. Learning vocabulary related to profession, education centres, day today activities, food, culture, sports and hobby, family set up, workplace, market and classroom activities is essential.
2. To enable students to demonstrate the ability to describe things and will be able to translate into English and vice versa.
3. To enable students to describe in simple terms (both in written and oral form) aspects of their background, immediate environment and matters in areas of immediate need.

Expected Course Outcome:

1. To greet people, give personal details and Identify genders by using correct articles
2. To know the correct use of SER, ESTAR and TENER verb and will be able to describe people, place and things
3. To give opinion about time and weather conditions by knowing months, days and seasons in Spanish.
4. To make sentences by using regular verbs and give opinion about people and places.
5. To write about their daily routine by using reflexive verbs and write small paragraphs about their hometown, their best friend etc.

Module:1	Abecedario, Saludos y Datos personales: Origen, Nacionalidad, Profesión		**3 hours**

Competencia Gramática: Vocales y Consonantes. Artículos definidos e indefinidos (Numero y Genero).
Competencia Escrita: Saludos y Datos personales

Module:2	Edad y posesión. Números (1-20)		**3 hours**

Competencia Gramática: Pronombres personales. Adjetivos. Los verbos SER y TENER.
Competencia Escrita: Escribe sobre mismo/a y los compañeros de la clase

Module:3	Vocabulario de Mi habitación. Colores. Descripción de lugares y cosas.		**5 hours**

Competencia Gramática: Adjetivos posesivos. El uso del verbo ESTAR. Diferencia entre SER y ESTAR.
Competencia Escrita: Mi habitación

Module:4	Mi familia. Números (21-100). Direcciones. Expresar la hora. Los meses del año.		**4 hours**

Competencia Gramática: Frases preposicionales. Uso del HAY. La diferencia entre MUY y MUCHO. Uso del verbo GUSTAR

Competencia Escrita: Mi familia. Dar opiniones sobre tiempo			
Module:5	Expresar fechas y el tiempo. Dar opiniones sobre personas y lugares.		**5 hours**
Competencia Gramática: Los verbos regulares (-AR, -ER, -IR) en el presente. Adjetivos demostrativos. Competencia Escrita: Mi mejor amigo/a. Expresar fechas. Traducción ingles a español y Español a Ingles.			
Module:6	Describir el diario. Las actividades cotidianas.		**3 hours**
Competencia Gramática: Los Verbos y pronombres reflexivos. Los verbos pronominales con e/ie, o/ue, e/i, u/ue. Competencia Escrita: El horario. Traducción ingles a español y Español a Ingles.			
Module:7	Dar opiniones sobre comidas y bebidas. Decir lo que está haciendo. Describir mi ciudad y Ubicar los sitios en la ciudad.		**5 hours**
Competencia Gramática: Los verbos irregulares. Estar + gerundio. Poder + Infinitivo. Competencia Escrita: Conversación en un restaurante. Traducción ingles a español y Español a Ingles. Mi ciudad natal. Mi Universidad. La clase. Mi fiesta favorita.			
Module:8	**Guest Lectures/ Native Speakers**		**2 hours**
	Total Lecture hours:	**30 hours**	

Text Book(s)	
1.	**Text Book**:**"Aula Internacional 1", Jaime Corpas, Eva Garcia, Agustin Garmendia, Carmen Soriano Goyal Publication ; reprinted Edition, (2010)**
Reference Books	
	"¡AcciónGramática!", Phil Turk and Mike Zollo, Hodder Murray, London 2006. "Practice makes perfect: Spanish Vocabulary", Dorothy Richmond, McGraw Hill Contemporary, USA,2012. "Practice makes perfect: Basic Spanish", Dorothy Richmond, McGraw Hill Contemporary, USA 2009. "Pasaporte A1 Foundation", Matilde Cerrolaza Aragón, Óscar Cerrolaza Gili, Begoña Llovet Barquero, Edelsa Grupo, España , 2010.

Recommended by Board of Studies	22-02-2016		
Approved by Academic Council	No. 41	Date	17-06-2016

FRE1001	Français Quotidien	L	T	P	J	C
		2	0	0	0	2
Pre-requisite		**Syllabus version**				
NIL		v.1				

Course Objectives:

The course gives students the necessary background to:

1. learn the basics of French language and to communicate effectively in French in their day to day life.
2. Achieve functional proficiency in listening, speaking, reading and writing
3. Recognize culture-specific perspectives and values embedded in French language.

Expected Course Outcome:

The students will be able to :

1. identify in French language the daily life communicative situations via personal pronouns, emphatic pronouns, salutations, negations and interrogations.
2. communicate effectively in French language via regular / irregular verbs.
3. demonstrate comprehension of the spoken / written language in translating simple sentences.
4. understand and demonstrate the comprehension of some particular new range of unseen written materials
5. demonstrate a clear understanding of the French culture through the language studied

Module:1	**Expressions simples**	**3 hours**

Les Salutations, Les nombres (1-100), Les jours de la semaine, Les mois de l'année, Les Pronoms Sujets, Les Pronoms Toniques, La conjugaison des verbes irréguliers- avoir / être / aller / venir / faire etc.

Savoir-faire pour:

Saluer, Se présenter, Présenter quelqu'un, Etablir des contacts

Module:2	**La conjugaison des verbes réguliers**	**3 hours**

La conjugaison des verbes réguliers, La conjugaison des verbes pronominaux, La Négation, L'interrogation avec 'Est-ce que ou sans Est-ce que'.

Savoir-faire pour:

Chercher un(e) correspondant(e), Demander des nouvelles d'une personne.

Module:3	**La Nationalité du Pays, L'article (défini/ indéfini), Les prépositions**	**6 hours**

La Nationalité du Pays, L'article (défini/ indéfini), Les prépositions (à/en/au/aux/sur/dans/avec etc.), L'article contracté, Les heures en français, L'adjectif (La Couleur, L'adjectif possessif, L'adjectif démonstratif/ L'adjectif interrogatif (quel/quelles/quelle/quelles), L'accord des adjectifs avec le nom, L'interrogation avec Comment/ Combien / Où etc.

Savoir-faire pour:

Poser des questions, Dire la date et les heures en français,

Module:4	**La traduction simple**	**4 hours**

La traduction simple :(français-anglais / anglais –français),

Savoir-faire pour :

Faire des achats, Comprendre un texte court, Demander et indiquer le chemin.		
Module:5	**L'article Partitif, Mettez les phrases aux pluriels**	**5 hours**
L'article Partitif, Mettez les phrases aux pluriels, Faites une phrase avec les mots donnés, Trouvez les questions. Savoir-faire pour : Répondez aux questions générales en français, Exprimez les phrases données au Masculin ou au Féminin, Associez les phrases.		
Module:6	**Décrivez :**	**3 hours**
Décrivez : La Famille / La Maison / L'université /Les Loisirs/ La Vie quotidienne etc.		
Module:7	Dialogue	**4 hours**
Dialogue : 1. Décrire une personne. 2. Des conversations à la cafeteria. 3. Des conversations avec les membres de la famille 4. Des dialogues entre les amis.		
Module:8	**Guest lecures**	**2 hours**
Guest lecures/ Natives speakers		

	Total Lecture hours:	**30 hours**	

Text Book(s)	
1.	Fréquence jeunes-1, Méthode de français, G. Capelle et N.Gidon, Hachette, Paris, 2010.
2.	Fréquence jeunes-1, Cahier d'exercices, G. Capelle et N.Gidon, Hachette, Paris, 2010.
Reference Books	
1.	CONNEXIONS 1, Méthode de français, Régine Mérieux, Yves Loiseau,Les Éditions Didier, 2010.
2	CONNEXIONS 1, Le cahier d'exercices, Régine Mérieux, Yves Loiseau, Les Éditions Didier, 2010
3	ALTER EGO 1, Méthode de français, Annie Berthet, Catherine Hugo, Véronique M. Kizirian, Béatrix Sampsonis, Monique Waendendries, Hachette livre Paris 2011
4	ALTER EGO 1, Le cahier d'activités, Annie Berthet, Catherine Hugo, Béatrix Sampsonis, Monique Waendendries , Hachette livre, Paris 2011

Mode of Evaluation: CAT / Assignment / Quiz / Seminar / FAT			
Recommended by Board of Studies	26.02.2016		
Approved by Academic Council	No.41	Date	17.06.2016

Course code	Grundstufe Deutsch	L	T	P	J	C
GER1001		2	0	0	0	2
Pre-requisite	Nil	Syllabus version				
		v.1				

Course Objectives:

The course gives students the necessary background to:

1. demonstrate Proficiency in reading, writing, and speaking in basic German. Learning vocabulary related to profession, education centres, day-to-day activities, food, culture, sports and hobby, family set up, workplace, market and classroom activities are essential.
2. make the students industry oriented and make them adapt in the German culture.

Expected Course Outcome:

The students will be able to

1. remember greeting people, introducing oneself and understanding basic expressions in German.
2. understand basic grammar skills to use these in a meaning way.
3. remember beginner's level vocabulary
4. create sentences in German on a variety of topics with significant precision and in detail.
5. apply good comprehension of written discourse in areas of special interests.

Module:1	3 hours

Begrüssung, Landeskunde, Alphabet, Personalpronomen, Verben- heissen, kommen, wohnen, lernen, Zahlen (1-100), W-Fragen, Aussagesätze, Nomen- Singular und Plural, der Artikel - Bestimmter- Unbestimmter Artikel)

Lernziel :

Sich vorstellen, Grundlegendes Verständnis von Deutsch, Deutschland in Europa

Module:2	3 hours

Konjugation der Verben (regelmässig /unregelmässig),das Jahr- Monate, Jahreszeiten und die Woche, Hobbys, Berufe, Artikel, Zahlen (Hundert bis eine Million), Ja-/Nein- Frage, Imperativ mit „Sie''

Lernziel:

Sätze schreiben, über Hobbys, Berufe erzählen, usw

Module:3	6 hours

Possessivpronomen, Negation, Kasus (Bestimmter- Unbestimmter Artikel) Trennbareverben, Modalverben, Uhrzeit, Präpositionen, Lebensmittel, Getränkeund Essen, Farben, Tiere

Lernziel :

Sätze mit Modalverben, Verwendung von Artikel, Adjektiv beim Verb

Module:4	4 hours

Übersetzung: (Deutsch – Englisch / Englisch – Deutsch)

Lernziel :

Die Übung von Grammatik und Wortschatz

Module:5	5 hours

Leserverständnis. Mindmap machen, Korrespondenz- Briefe und Email **Lernziel:** Übung der Sprache, Wortschatzbildung		
Module:6		**5 hours**
Aufsätze : Die Familie, Bundesländer in Deutschland, Ein Fest in Deutschland, **Lernziel :** Aktiver, selbständiger Gebrauch der Sprache		
Module:7		**4 hours**
Dialoge: a) Gespräche mit einem/einer Freund /Freundin. b) Gespräche beim Einkaufen ; in einem Supermarkt ; in einer Buchhandlung ; c) in einem Hotel - an der Rezeption ; ein Termin beim Arzt. d) Ein Telefongespräch ; Einladung–Abendessen		
Module:8		**2 hours**
Guest Lectures/ Native Speakers (Einleitung in die deustche Kultur und Politik		

	Total Lecture hours:	**30 hours**	

Text Book(s)	
1.	Netzwerk Deutsch als Fremdsprache A1, Stefanie Dengler, Paul Rusch, Helen Schmtiz, Tanja Sieber, Klett-Langenscheidt Verlag, München : 2013
Reference Books	
1.	Lagune, Hartmut Aufderstrasse, Jutta Müller, Thomas Storz, 2012.
2	Deutsche Sprachlehre für Ausländer, Heinz Griesbach, Dora Schulz, 2013
3	Studio d A1, Hermann Funk, Christina Kuhn, CorneslenVerlag, Berlin :2010
4	Tangram Aktuell-I, Maria-Rosa, SchoenherrTil, Max Hueber Verlag, Muenchen :2012
	www.goethe.de wirtschaftsdeutsch.de hueber.de klett-sprachen.de www.deutschtraning.org
Mode of Evaluation: CAT / Assignment / Quiz / FAT	
Recommended by Board of Studies	
Approved by Academic Council	No. Date

Course code	Ethics and Values	L	T	P	J	C
HUM1021 / HUM1032		2	0	0	0	2
Pre-requisite	Nil	Syllabus version				
		1.1				

Course Objectives:

1. To understand and appreciate the ethical issues faced by an individual in profession, society and polity
2. To understand the negative health impacts of certain unhealthy behaviors
3. To appreciate the need and importance of physical, emotional health and social health

Expected Course Outcome:

Students will be able to:

1. Follow sound morals and ethical values scrupulously to prove as good citizens
2. Understand various social problems and learn to act ethically
3. Understand the concept of addiction and how it will affect the physical and mental health
4. Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources, the objective presentation of data, and the treatment of human subjects
5. Identify the main typologies, characteristics, activities, actors and forms of cybercrime

Module:1	Being Good and Responsible	5 hours

Gandhian values such as truth and non-violence – Comparative analysis on leaders of past and present – Society's interests versus self-interests - Personal Social Responsibility: Helping the needy, charity and serving the society

Module:2	Social Issues 1	4 hours

Harassment – Types - Prevention of harassment, Violence and Terrorism

Module:3	Social Issues 2	4 hours

Corruption: Ethical values, causes, impact, laws, prevention – Electoral malpractices;
White collar crimes - Tax evasions – Unfair trade practices

Module:4	Addiction and Health	5 hours

Peer pressure - Alcoholism: Ethical values, causes, impact, laws, prevention – Ill effects of smoking - Prevention of Suicides;
Sexual Health: Prevention and impact of pre-marital pregnancy and Sexually Transmitted Diseases

Module:5	Drug Abuse	3 hours

Abuse of different types of legal and illegal drugs: Ethical values, causes, impact, laws and prevention

Module:6	Personal and Professional Ethics	4 hours

Dishonesty - Stealing - Malpractices in Examinations – Plagiarism

Module:7	**Abuse of Technologies**	**3 hours**
Hacking and other cyber crimes, Addiction to mobile phone usage, Video games and Social networking websites		
Module:8	**Contemporary issues:**	**2 hours**
Guest lectures by Experts		
	Total Lecture hours:	**30 hours**

Reference Books

1. Dhaliwal, K.K , "Gandhian Philosophy of Ethics: A Study of Relationship between his Presupposition and Precepts,2016, Writers Choice, New Delhi, India.
2. Vittal, N, "Ending Corruption? - How to Clean up India?", 2012, Penguin Publishers, UK.
3. Pagliaro, L.A. and Pagliaro, A.M, "Handbook of Child and Adolescent Drug and Substance Abuse: Pharmacological , Developmental and Clinical Considerations", 2012Wiley Publishers, U.S.A.
4. Pandey, P. K (2012), "Sexual Harassment and Law in India", 2012, Lambert Publishers, Germany.

Mode of Evaluation: CAT, Assignment, Quiz, FAT and Seminar

Recommended by Board of Studies	26-07-2017		
Approved by Academic Council	No. 46	Date	24-08-2017

Course Code	Calculus for Engineers	L	T	P	J	C
MAT1011		3	0	2	0	4
Pre-requisite	10+2 Mathematics or MAT1001	Syllabus Version				
		1.0				

Course Objectives (CoB):1,2,3

1. To provide the requisite and relevant background necessary to understand the other important engineering mathematics courses offered for Engineers and Scientists.
2. To introduce important topics of applied mathematics, namely Single and Multivariable Calculus and Vector Calculus etc.
3. To impart the knowledge of Laplace transform, an important transform technique for Engineers which requires knowledge of integration

Course Outcome (CO): 1,2,3,4,5,6

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

1. apply single variable differentiation and integration to solve applied problems in engineering and find the maxima and minima of functions
2. understand basic concepts of Laplace Transforms and solve problems with periodic functions, step functions, impulse functions and convolution
3. evaluate partial derivatives, limits, total differentials, Jacobians, Taylor series and optimization problems involving several variables with or without constraints
4. evaluate multiple integrals in Cartesian, Polar, Cylindrical and Spherical coordinates.
5. understand gradient, directional derivatives, divergence, curl and Greens', Stokes, Gauss theorems
6. demonstrate MATLAB code for challenging problems in engineering

Module:1	Application of Single Variable Calculus	9 hours	

Differentiation- Extrema on an Interval-Rolle's Theorem and the Mean Value Theorem-Increasing and Decreasing functions and First derivative test-Second derivative test-Maxima and Minima-Concavity. Integration-Average function value - Area between curves - Volumes of solids of revolution -

Module:2	Laplace transforms	7 hours	

Definition of Laplace transform-Properties-Laplace transform of periodic functions-Laplace transform of unit step function, Impulse function-Inverse Laplace transform-Convolution.

Module:3	Multivariable Calculus	4 hours	

Functions of two variables-limits and continuity-partial derivatives –total differential-Jacobian and its properties.

Module:4	Application of Multivariable Calculus	5 hours	

Taylor's expansion for two variables–maxima and minima–constrained maxima and minima-Lagrange's multiplier method.

Module:5	**Multiple integrals**	**8 hours**	
Evaluation of double integrals–change of order of integration–change of variables between Cartesian and polar co-ordinates - Evaluation of triple integrals-change of variables between Cartesian and cylindrical and spherical co-ordinates- Beta and Gamma functions–interrelation - evaluation of multiple integrals using gamma and beta functions.			
Module:6	**Vector Differentiation**	**5 hours**	
Scalar and vector valued functions – gradient, tangent plane–directional derivative-divergence and curl–scalar and vector potentials–Statement of vector identities-Simple problems			
Module:7	**Vector Integration**	**5 hours**	
line, surface and volume integrals - Statement of Green's, Stoke's and Gauss divergence theorems -verification and evaluation of vector integrals using them.			
Module:8	**Contemporary Issues:**	**2 hours**	
Industry Expert Lecture			
	Total Lecture hours:	**45 hours**	

Text Book(s)

[1] Thomas' Calculus, George B.Thomas, D.Weir and J. Hass, 13th edition, Pearson, 2014.
[2] Advanced Engineering Mathematics, Erwin Kreyszig, 10th Edition, Wiley India, 2015.

Reference Books

1. Higher Engineering Mathematics, B.S. Grewal, 43rd Edition ,Khanna Publishers, 2015
2. Higher Engineering Mathematics, John Bird, 6th Edition, Elsevier Limited, 2017.
3. Calculus: Early Transcendentals, James Stewart, 8th edition, Cengage Learning, 2017.
4. Engineering Mathematics, K.A.Stroud and Dexter J. Booth, 7th Edition, Palgrave Macmillan (2013)

Mode of Evaluation

Digital Assignments, Quiz, Continuous Assessments, Final Assessment Test

List of Challenging Experiments (Indicative)		**CO: 6**
1.	Introduction to MATLAB through matrices, and general Syntax	2 hours
2	Plotting and visualizing curves and surfaces in MATLAB – Symbolic computations using MATLAB	2 hours
3.	Evaluating Extremum of a single variable function	2 hours
4.	Understanding integration as Area under the curve	2 hours
5.	Evaluation of Volume by Integrals (Solids of Revolution)	2 hours
6.	Evaluating maxima and minima of functions of several variables	2 hours
7.	Applying Lagrange multiplier optimization method	2 hours
8.	Evaluating Volume under surfaces	2 hours

9.	Evaluating triple integrals	2 hours
10.	Evaluating gradient, curl and divergence	2 hours
11.	Evaluating line integrals in vectors	2 hours
12.	Applying Green's theorem to real world problems	2 hours
	Total Laboratory Hours	**24 hours**

Mode of Evaluation:			
Weekly Assessment, Final Assessment Test			
Recommended by Board of Studies	03-06-2019		
Approved by Academic Council	No. 55	Date	13-06-2019

Course Code	Statistics for Engineers	L	T	P	J	C
MAT2001		3	0	2	0	4
Prerequisites	MAT1011 – Calculus for Engineers	Syllabus Version: 1.0				

Course Objectives:

1. To provide students with a framework that will help them choose the appropriate descriptive methods in various data analysis situations.
2. To analyse distributions and relationship of real-time data.
3. To apply estimation and testing methods to make inference and modelling techniques for decision making.

Course Outcome:

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

1. Compute and interpret descriptive statistics using numerical and graphical techniques.
2. Understand the basic concepts of random variables and find an appropriate distribution for analysing data specific to an experiment.
3. Apply statistical methods like correlation, regression analysis in analysing, interpreting experimental data.
4. Make appropriate decisions using statistical inference that is the central to experimental research.
5. Use statistical methodology and tools in reliability engineering problems.
6. demonstrate R programming for statistical data

	Topics	Lecture Hrs	
Module: 1	**Introduction to Statistics**		**6 hours**
Introduction to statistics and data analysis-Measures of central tendency –Measures of variability-[Moments-Skewness-Kurtosis (Concepts only)].			
Module: 2	**Random variables**		**8 hours**
Introduction -random variables-Probability mass Function, distribution and density functions - joint Probability distribution and joint density functions- Marginal, conditional distribution and density functions- Mathematical expectation, and its properties Covariance , moment generating function – characteristic function.			
Module: 3	**Correlation and regression**		**4 hours**
Correlation and Regression – Rank Correlation- Partial and Multiple correlation- Multiple regression.			
Module: 4	**Probability Distributions**		**7 hours**
Binomial and Poisson distributions – Normal distribution – Gamma distribution – Exponential distribution – Weibull distribution.			
Module: 5	**Hypothesis Testing I**		**4 hours**
Testing of hypothesis – Introduction-Types of errors, critical region, procedure of testing hypothesis-Large sample tests- Z test for Single Proportion, Difference of Proportion, mean and difference of means.			
Module: 6	**Hypothesis Testing II**		**9 hours**
Small sample tests- Student's t-test, F-test- chi-square test- goodness of fit - independence of attributes- Design of Experiments - Analysis of variance – one and two way classifications - CRD-RBD- LSD.			

Module: 7	**Reliability**		5 hours
Basic concepts- Hazard function-Reliabilities of series and parallel systems- System Reliability - Maintainability-Preventive and repair maintenance- Availability.			
Module: 8	**Contemporary Issues**		2 hours
Industry Expert Lecture			
	Total Lecture hours	45 hours	

Text book(s)

- Probability and Statistics for engineers and scientists, R.E.Walpole, R.H.Myers, S.L.Mayers and K.Ye, 9th Edition, Pearson Education (2012).
- Applied Statistics and Probability for Engineers, Douglas C. Montgomery, George C. Runger, 6th Edition, John Wiley & Sons (2016).

Reference books

- Reliability Engineering, E.Balagurusamy, Tata McGraw Hill, Tenth reprint 2017.
- Probability and Statistics, J.L.Devore, 8th Edition, Brooks/Cole, Cengage Learning (2012).
- Probability and Statistics for Engineers, R.A.Johnson, Miller Freund's, 8th edition, Prentice Hall India (2011).
- Probability, Statistics and Reliability for Engineers and Scientists, Bilal M. Ayyub and Richard H. McCuen, 3rd edition, CRC press (2011).

Mode of Evaluation

Digital Assignments (Solutions by using soft skills), Continuous Assessment Tests, Quiz, Final Assessment Test.

List of Experiments (Indicative)			
•	Introduction: Understanding Data types; importing/exporting data.	2 hours	
•	Computing Summary Statistics /plotting and visualizing data using Tabulation and Graphical Representations.	2 hours	
•	Applying correlation and simple linear regression model to real dataset; computing and interpreting the coefficient of determination.	2 hours	
•	Applying multiple linear regression model to real dataset; computing and interpreting the multiple coefficient of determination.	2 hours	
•	Fitting the following probability distributions: Binomial distribution	2 hours	
•	Normal distribution, Poisson distribution	2 hours	
•	Testing of hypothesis for One sample mean and proportion from real-time problems.	2 hours	
•	Testing of hypothesis for Two sample means and proportion from real-time problems	2 hours	
•	Applying the t test for independent and dependent samples	2 hours	
•	Applying Chi-square test for goodness of fit test and Contingency test to real dataset	2 hours	
•	Performing ANOVA for real dataset for Completely randomized design, Randomized Block design ,Latin square Design	2 hours	
	Total laboratory hours	22 hours	

Mode of Evaluation

Weekly Assessment, Final Assessment Test

Recommended by Board of Studies	03-06-2019		
Approved by Academic Council	No. 55	Date	13-06-2019

MEE1902	Industrial Internship	L	T	P	J	C
		0	0	0	0	2
Pre-requisite	Completion of minimum of Two semesters					

Course Objectives:

The course is designed so as to expose the students to industry environment and to take up on-site assignment as trainees or interns.

Expected Course Outcome:

At the end of this internship the student should be able to:

1. Have an exposure to industrial practices and to work in teams
2. Communicate effectively
3. Understand the impact of engineering solutions in a global, economic, environmental and societal context
4. Develop the ability to engage in research and to involve in life-long learning
5. Comprehend contemporary issues
6. Engage in establishing his/her digital footprint

Contents	**4**	**Weeks**
Four weeks of work at industry site. Supervised by an expert at the industry.		

Mode of Evaluation: Internship Report, Presentation and Project Review

Recommended by Board of Studies	28-02-2016		
Approved by Academic Council	No. 37	Date	16-06-2015

Course code	TECHNICAL ANSWERS FOR REAL WORLD PROBLEMS (TARP)	L	T	P	J	C
MEE3999		1	0	0	8	3
Pre-requisite	PHY1999 and 115 Credits Earned	Syllabus version				
		v. 2.2				

Course Objectives:

1. To help students to identify the need for developing newer technologies for industrial / societal needs
2. To train students to propose and implement relevant technology for the development of the prototypes / products
3. To make the students learn to the use the methodologies available for analysing the developed prototypes / products

Expected Course Outcome:

1. Identify real life problems related to society
2. Apply appropriate technology (ies) to address the identified problems using engineering principles and arrive at innovative solutions

Module:1		2 hours

Steps involved:

1. Strategies to identify the societal and industrial problems that need to be solved
2. SWOC analysis of the available technologies to overcome the problem
3. Possible technology revolution in the next 5 – 10 years
4. Analysis of the problems of present and future
5. Challenges in sustainable prototype / product development
6. Design of specific workflow in developing the prototype / product
7. Validation of the developed prototype / product
8. Analysis of the prototype/product with respect to social, economical, environmental relevance

(The proposed contact hours are for discussion on the projects)
(Projects to be done by a group of 6 – 10 students)

Mode of Evaluation: (No FAT) Continuous Assessment the project done – Mark weightage of 20:30:50 – project report to be submitted.

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	47	Date	05-10-2017

Course Code	Comprehensive Examination	L	T	P	J	C
MEE4098		0	0	0	0	2
Pre-requisite	NIL	Syllabus version				
		2.2				

Course Objectives:

1. To evaluate the overall understanding of the students in the core areas of B.Tech Mechanical Engineering Programme.

Expected Course Outcome:

1. Define, explain, evaluate, and interpret the fundamental knowledge pertaining to the field of Mechanical Engineering and apply those essential knowledge to the field of Energy Engineering.

Module:1	Engineering Thermodynamics, Mechanics of Solids and Fluids, Mechanics of Machines.	

Engineering Thermodynamics - Thermodynamic systems and processes - properties of pure substances, behaviour of ideal and real gases - zeroth and first laws of thermodynamics, calculation of work and heat in various processes - second law of thermodynamics - thermodynamic property charts and tables, availability and irreversibility - thermodynamic relations.

Mechanics of Solids And Fluids - Stress and strain, elastic constants, Poisson's ratio - Mohr's circle for plane stress and plane strain - thin shells - bending and shear stresses - torsion of circular shafts - testing of materials with universal testing machine - Fluid properties - fluid statics, kinematics - Euler and Bernoulli's equations and their applications - viscous flow of incompressible fluids, flow through pipes - boundary layer concepts.

Mechanics of Machines Stress and strain, elastic constants, Poisson's ratio; Mohr'scircle for plane stress and plane strain; thin cylinders; shear force and bendingmoment diagrams; bending and shear stresses; deflection of beams; torsion ofcircular shafts; Euler's theory of columns; energy methods; thermal stresses; straingauges and rosettesMechanisms with lower pairs, displacement, velocity and acceleration analysis of planar mechanisms; Synthesis of mechanism; kinematic analysis of cams and follower, cam profile; gears and gear trainsDynamic force analysis of engines; Flywheels design for engines and punching press; Balancing of reciprocating and rotating masses; Longitudinal damped free and forced vibration of single degree of freedom system. Transverse and torsional vibrations; Governors and gyroscope.

Module:2	Materials Engineering and Technology, Manufacturing Process, Engineering Mechanics	

Materials Engineering and Technology - Metal and alloys-Properties and Applications – crystal structure – crystalline imperfections – Solidification – Phase diagrams – Binary alloy - Cu-Ni alloy; Cu-Zn alloy and Pb-Sn alloy; Iron-Iron carbide phase diagram -TTT and CCT diagram. Steels and Cast Irons – Types and properties, Effect of alloying elements on structure and properties of steels - Heat Treatment and Surface Heat treatments - Mechanical Properties of Materials -Strengthening mechanisms – Hardness measurements – Tensile properties of the materials – Fracture of metals – Fatigue – Endurance limit of ferrous and non-ferrous metals , S-N curves, factors affecting fatigue, Creep and stress rupture.

Manufacturing Process - Casting Processes - Defects - Runner and riser design; Joining Processes - Consumable and Non-consumable welding processes; Metal Forming processes - Cold and Hot working ; Processing of Powder Metals, Ceramics, Glass and Plastics

Engineering Mechanics - Resultant of system of forces-Equivalent force couple system-Principle of statics-Concept of free body diagram-Application problem on beams, trusses and frames. Theory of dry friction- wedge ladder friction. Concept of first moment of area and second moment of area, Principal moment of inertia, Kinematics of particles and rigid bodies - Types of motion - Rectilinear and curvilinear translations, General plane motion, ICR method and Relative velocity method for kinematics of rigid bodies, Kinetics of particles and rigid bodies - D'Alembert's principle- Work and energy methods, Linear Impulse and momentum principle, Elastic impact problems.

Module:3	**Automotive Electricals and Automotive Electronics**	

Automotive Electricals - Introduction to electrical fundamentals – Ohm's Law, Kirchhoff's Law, Capacitance and Inductance, Simple Electric Circuits, Automotive Wiring Harnesses, Insulated and Earth Return System, Positive and Negative Earth Systems, Connectors and its types. Principle and construction of Lead Acid Battery, Nickel – Cadmium Battery, Nickel Metal, Hybrid Battery, Sodium Sulphur Battery and Aluminium Air Battery-Choice of Batteries for automotive applications. Characteristics of Battery, Battery Rating, Capacity and Efficiency, Various Tests on Battery, Battery– Charging Techniques. Maintenance of batteries. Requirements of Starter Motor, Starter Motor types, construction and characteristics, Starter drive mechanisms, Starter Switches and Solenoids. Brushless DC Motor, speed control, Brushless PM Motor for electric vehicles. Charging-Ignition and Lighting Systems.

Automotive Electronics Zener diode, BJTs, MOSFETs, IGBTs, SCRs, DIAC/TRIACs and GTOs; forward and reverse characteristics, Break down characteristics and their applications.

Basic Logic Circuit Concepts, Representation of Numerical Data in Binary Form- Memory Types. Buses, memory, timing, CPU registers; Microprocessor architecture: Initialization, operation codes, program counter, branch and jump instructions, subroutine. Analog to digital converters and Digital to analog converters, sampling, polling and interrupts, digital filters, lookup table. Speed sensors, Pressure sensors: Manifold Absolute Pressure sensor, knock sensor, Temperature sensors: Coolant and Exhaust gas temperature, Exhaust Oxygen level sensor. Position sensors: Throttle position sensor, accelerator pedal position sensor and crankshaft position sensor, Air mass flow sensor. Solenoids, stepper motors and relays. Engine management and vehicle management systems.

Module:4	**Automotive Chassis and Automotive Transmission Systems**	

Automotive Chassis - Types of Chassis Layout with reference to Power Plant Location and Drive. Types of Front Axles and Stub Axles, Front Wheel Geometry, Condition for True Rolling Motion of Wheels during Steering, Steering Mechanisms, Steering Error Curve, Steering Linkages, Different Types of Steering Gears, Slip Angle, Over Steer and Under Steer, Reversible and Irreversible Steering, Power Assisted Steering. Constructional details and Characteristics of Single Leaf, Multi Leaf, Coil, Torsion bar, Rubber, Pneumatic and Hydro – elastic Suspension Systems, Independent Suspension System, Shock Absorbers - Types and Constructional details. Stopping Distance, Braking Efficiency, Weight Transfer during Braking, Drum Brakes - Constructional Details, Leading and Trailing Shoe, Braking Torque, Disc Brake - Types and Constructional Details, Relative advantages and disadvantages over Disc Brakes. Hydraulic Braking System, Pneumatic Braking System, Power–Assisted Braking System, Servo Brakes, Retarders, Types and Construction. Axles – Live and Dead Axles, Types of Wheels, Construction, Structure and Function, Wheel Dimensions. Structure and Function of Tyres. Static and Dynamic Properties of Pneumatic Tyres.

Automotive Transmission Systems:

Different types of Clutches – materials – clutch troubles and their causes – clutch lining. Fluid coupling: advantages and limitations, construction details, torque capacity, slip in fluid coupling, performance characteristics. Means used to reduce drag torque in fluid coupling. Necessity of gear box, Desirable ratios of 3speed & 4speed gear boxes. Constructional details of, Sliding-mesh gear box , Constant-mesh gear box, synchromesh gear box, transfer case, overdrive. Design of gear box – How to select 4 or 6 or 8 speed gear box for a vehicle.

Torque Converters – single and multi stage converters. Performance characteristics, constructional and operational details of typical hydraulic transmission drives. Leyland, White Hydro torque drives. Effects of driving thrust and torque reaction. Hotchkiss drive. Torque tube drive, radius rods. Propeller shaft. Universal joints. Final drives – different types, double reaction final drive. Two speed rear axle. Rear axle construction – full floating, three quarter floating and semifloating arrangements. Differential – conventional type, non-slip type. Differential locks. Automatic transmission: Planetary gearboxes - Ford T-model, Cotal and Wilson Gear box: Epicyclic transmission, hydromatic transmission, continuously variable transmission: Types – Belt and Toroidal - Relative merits and demerits when compared to conventional transmission. Semi-automatic transmissions – Dual clutch transmission, Direct shift gearbox, Multimode manual transmission, Tiptronic transmission, Paddle shift gearbox.

Module:5	**Thermal and Heat Transfer, Automotive Engines**	

Thermal and Heat Transfer Reciprocating compressors – Construction – Working – Effect of clearance volume – Multi staging - Volumetric efficiency - Isothermal efficiency. Steam Nozzle – One-dimensional steady flow of steam through a convergent and divergent nozzle – Equilibrium and Meta stable flow. Reverse Carnot cycle - Bell-Colman's cycle – Vapor compression cycle – Components – Working – P-H and T-S diagrams – Calculation of COP – Effect of sub-cooling and super-heating – Vapour absorption system. Psychometric - Processes – Chart – Summer and winter air conditioning – Cooling load calculations – SHF – RSHF – GSHF – ESHF components used in air conditioner – Types of air conditioning units. Conduction, Convection and Radiation heat transfer.

Automotive Engines : Review of Otto, diesel and dual cycles. Construction and working: spark ignition (SI) and compression ignition (CI) engines - Two stroke SI and CI engines. Comparison of SI and CI engines and four stroke and two stroke engines. Engine classification, firing order. Air fuel ratio requirements of SI engines, Air fuel ratio and emissions, Working of a simple fixed venturi carburetor, Constant vacuum carburetor and modern carburetor. Diesel fuel injection systems-Jerk pumps, distributor pumps, pintle and multi-hole nozzles, Unit injector and common rail injection systems, Fuel Filters, Governors. Combustion in SI and CI engines and stages of combustion, Ignition delay period, Knock in SI and CI engines. Combustion chambers for SI and CI engines. Direct and indirect injection combustion chambers for CI engines. Importance of Swirl, squish and turbulence. Factors controlling combustion chamber design. Need for cooling, types of cooling systems and its working, Properties of coolants.
Requirements of lubrication systems. Types of lubricating systems and its working, Properties of lubricants. Supercharging and Turbocharging – types - working – control. Dynamometers, Indicated thermal, brake thermal and volumetric efficiencies. Measurement of friction, Cylinder pressure measurement. Heat Balance, Engine performance maps, Engine testing standards.

Mode of Evaluation: Online Exam

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	47	Date	05-10-2017

VIT®
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

Course code	CAPSTONE PROJECT	L	T	P	J	C
MEE4099		-	-	-	-	20
Pre-requisite	As per the academic regulations	Syllabus version				
		v. 2.2				

Course Objectives:

1. To provide a definite context, to apply the leanings from various courses of the program and solve unstructured and ill-defined problems
2. To develop an integrated approach for problem solving
3. To provide an exposure to take up a real life research problem / product development / industrial problem and arrive at meaningful conclusions / product design / solution

Expected Course Outcome:

1. Formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints
2. Perform literature search and / or patent search in the area of interest
3. Develop a suitable solution methodology for the problem
4. Conduct experiments / Design & Analysis / solution iterations and document the results
5. Perform error analysis / benchmarking / costing
6. Synthesise the results and arrive at scientific conclusions / products / solution
7. Document the results in the form of technical report / presentation

Topics

Capstone Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, etc. or a combination of these.

Project can be for one or two semesters based on the completion of required number of credits as per the academic regulations.

Criteria

1. Can be individual work or a group project, with a maximum of 3 students.
2. In case of group projects, the individual project report of each student should specify the individual's contribution to the group project.
3. Carried out inside or outside the university, in any relevant industry or research institution.
4. Publications in the peer reviewed journals / International Conferences will be an added advantage
5. Plagiarism checking by Turnitin is compulsory part of UG Project Report. Plagiarism level should not exceed more than 13%.

Mode of Evaluation: Mid reviews, Final Viva-Voce, Thesis and Poster Submission

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	47	Date	05-10-2017

Course code	Lean Start-Up Management	L	T	P	J	C
MGT1022		1	0	0	4	2
Pre-requisite	Nil	Syllabus version				
		v. 2.2				

Course Objectives:

The objective of the course is to make a student to create and commercialize the product

Expected Course Outcome:

1. Understand developing business models and growth drivers
2. Use the business model canvas to map out key components of enterprise
3. Analyze market size, cost structure, revenue streams, and value chain
4. Understand build-measure-learn principles
5. Foreseeing and quantifying business and financial risks

Module:1		**2 hours**
Creativity and Design Thinking (identify the vertical for business opportunity, understand your customers, accurately assess market opportunity)		
Module:2		**3 hours**
Minimum Viable Product (Value Proposition, Customer Segments, Build-measure-learn process)		
Module:3		**3 hours**
Business Model Development(Channels and Partners, Revenue Model and streams, Key Resources, Activities and Costs, Customer Relationships and Customer Development Processes, Business model canvas –the lean model-templates)		
Module:4		**3 hours**
Business Plan and Access to Funding(visioning your venture, taking the product/ service to market, Market plan including Digital & Viral Marketing, start-up finance - Costs/Profits & Losses/cash flow, Angel/VC,/Bank Loans and Key elements of raising money)		
Module:5		**2 hours**
Legal, Regulatory, CSR, Standards, Taxes		
Module:6	**Contemporary discussion**	**2 hours**
	Total Lecture hours:	**15 hours**

Text Book(s)

1.	Steve Blank, K & S Ranch (2012)The Startup Owner's Manual: The Step-By-Step Guide for Building a Great Company, 1st edition
2.	Steve Blank (2013)The Four Steps to the Epiphany, K&S Ranch; 2nd edition
3.	Eric Ries (2011) The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Crown Business
Reference Books	
1.	Steve Blank (2014) Holding a Cat by the Tail, , K&S Ranch Publishing LLC
2.	Karal T Ulrich, Product Design and Development, SDEppinger, McGraw Hill
3.	Peter Thiel, (2014) Zero to One: Notes on Startups, or How to Build the Future, Crown Business;
4.	Lean Analytics: Use Data to Build a Better Startup Faster(Lean Series), Alistair Croll & Benjamin Yoskovitz,O'Reilly Media; 1stEdition
5.	Marty Cagan, (2008) Inspired: How To Create Products Customers Love, SVPG Press; 1stedition

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	47	Date	05-10-2017

PHY1701	Engineering Physics	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	Physics of 12th standard or equivalent	Syllabus version				
		V.2.1				

Course Objectives:

1.To enable the students to understand the basics of the latest advancements in Physics viz.,
2.Quantum Mechanics, Nanotechnology, Lasers, Electro Magnetic Theory and Fiber Optics.

Expected Course Outcome:

1. To understand the dual nature of radiation and matter.
2. To apply Schrodinger's equations to solve finite and infinite potential problems.
3. To apply quantum ideas at the nanoscale.
4. To apply quantum ideas for understanding the operation and working principle of optoelectronic devices.
5. To analyze the Maxwell's equations in differential and integral form.
6. To classify the optical fiber for different Engineering applications.
7. To apply concept of Lorentz Transformation for Engineering applications.
8. To demonstrate the quantum mechanical ideas – LAB

Module:1	Introduction to Modern Physics	6 hours	

Planck's concept (hypothesis), Compton Effect, Particle properties of wave: Matter Waves, Davisson Germer Experiment, Heisenberg Uncertainty Principle, Wave function, and Schrodinger equation (time dependent & independent).

Module:2	Applications of Quantum Physics	5 hours	

Particle in a 1-D box (Eigen Value and Eigen Function), 3-D Analysis (Qualitative), Tunneling Effect (Qualitative) (AB 205), Scanning Tunneling Microscope (STM).

Module:3	Nanophysics	5 hours	

Introduction to Nano-materials, Moore's law, Properties of Nano-materials, Quantum confinement, Quantum well, wire & dot, Carbon Nano-tubes (CNT), Applications of nanotechnology in industry.

Module:4	Laser Principles and Engineering Application	6 hours	

Laser Characteristics, Spatial and Temporal Coherence, Einstein Coefficient & its significance, Population inversion, Two, three & four level systems, Pumping schemes, Threshold gain coefficient, Components of laser, Nd-YAG, He-Ne, CO2 and Dye laser and their engineering applications.

Module:5	Electromagnetic Theory and its application	6 hours	

Physics of Divergence, Gradient and Curl, Qualitative understanding of surface and volume integral, Maxwell Equations (Qualitative), Wave Equation (Derivation), EM Waves, Phase velocity, Group velocity, Group index , Wave guide (Qualitative)

Module:6	Propagation of EM waves in Optical fibers and Optoelectronic Devices	10 hours	

Light propagation through fibers, Acceptance angle, Numerical Aperture, Types of fibers - step index, graded index, single mode & multimode, Attenuation, Dispersion-intermodal and intramodal. Sources-LED & Laser Diode, Detectors-Photodetectors- PN & PIN - Applications of fiber optics in communication- Endoscopy.			
Module:7	**Special Theory of Relativity**	**5 hours**	
Frame of reference, Galilean relativity, Postulate of special theory of relativity, Simultaneity, length contraction and time dilation.			
Module:8	**Contemporary issues:**	**2 hours**	
Lecture by Industry Experts			
	Total Lecture hours:	**45 hours**	

Text Book(s)

1.	Arthur Beiser et al., Concepts of Modern Physics, 2013, Sixth Edition, Tata McGraw Hill.
2.	William Silfvast, Laser Fundamentals, 2008, Cambridge University Press.
3.	D. J. Griffith, Introduction to Electrodynamics, 2014, 4th Edition, Pearson.
4.	Djafar K. Mynbaev and Lowell L.Scheiner, Fiber Optic Communication Technology, 2011, Pearson

Reference Books

1.	Raymond A. Serway, Clement J. Mosses, Curt A. Moyer Modern Physics, 2010, 3rd Indian Edition Cengage learning.
2.	John R. Taylor, Chris D. Zafiratos and Michael A. Dubson, Modern Physics for Scientists and Engineers, 2011, PHI Learning Private Ltd.
3.	Kenneth Krane Modern Physics, 2010, Wiley Indian Edition.
4.	Nityanand Choudhary and Richa Verma, Laser Systems and Applications, 2011, PHI Learning
5.	Private Ltd.
6.	S. Nagabhushana and B. Sathyanarayana, Lasers and Optical Instrumentation, 2010, I.K. International Publishing House Pvt. Ltd.,
7.	R. Shevgaonkar, Electromagnetic Waves, 2005, 1st Edition, Tata McGraw Hill
8.	Principles of Electromagnetics, Matthew N.O. Sadiku, 2010, Fourth Edition, Oxford.
	Ajoy Ghatak and K. Thyagarajan, Introduction to Fiber Optics, 2010, Cambridge University Press.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Experiments

1.	Determination of Planck's constant using electroluminescence process	2 hrs
2.	Electron diffraction	2 hrs
3.	Determination of wavelength of laser source (He -Ne laser and diode lasers of different wavelengths) using diffraction technique	2 hrs
4.	Determination of size of fine particle using laser diffraction	2 hrs
5.	Determination of the track width (periodicity) in a written CD	2 hrs
6.	Optical Fiber communication (source + optical fiber + detector)	2 hrs
7.	Analysis of crystallite size and strain in a nano -crystalline film using X-ray diffraction	2 hrs
8.	Numerical solutions of Schrödinger equation (e.g. particle in a box problem) (can be given as an assignment)	2 hrs

9.	Laser coherence length measurement	2 hrs
10.	Proof for transverse nature of E.M. waves	2 hrs
11.	Quantum confinement and Heisenberg's uncertainty principle	2 hrs
12.	Determination of angle of prism and refractive index for various colour – Spectrometer	2 hrs
13.	Determination of divergence of a laser beam	2 hrs
14.	Determination of crystalline size for nanomaterial (Computer simulation)	2 hrs
15.	Demonstration of phase velocity and group velocity (Computer simulation)	2 hrs
	Total Laboratory Hours	**30 hrs**

Mode of evaluation: CAT / FAT			
Recommended by Board of Studies	04-06-2019		
Approved by Academic Council	No. 55	Date	13-06-2019

Course code	Introduction to Innovative Projects	L	T	P	J	C
PHY1999		1	0	0	4	2
Pre-requisite	Nil	Syllabus version				
		1.0				

Course Objectives:

This course is offered to the students in the 1st Year of B.Tech. in order to orient them towards independent, systemic thinking and be innovative.

1. To make students confident enough to handle the day to day issues.
2. To develop the "Thinking Skill" of the students, especially Creative Thinking Skills
3. To train the students to be innovative in all their activities
4. To prepare a project report on a socially relevant theme as a solution to the existing issues

Expected Course Outcome:

1. To understand the various types of thinking skills.
2. To enhance the innovative and creative ideas.
3. To find out a suitable solution for socially relevant issues- J component

Module:1 A	Self Confidence	1 hour

Understanding self – Johari Window –SWOT Analysis – Self Esteem – Being a contributor – Case Study

Project : Exploring self, understanding surrounding, thinking about how s(he) can be a contributor for the society, Creating a big picture of being an innovator – writing a 1000 words imaginary autobiography of self – Topic "Mr X – the great innovator of 2015" and upload. **(4 non- contact hours)**

Module:1 B	Thinking Skill	1 hour

Thinking and Behaviour – Types of thinking– Concrete – Abstract, Convergent, Divergent, Creative, Analytical, Sequential and Holistic thinking – Chunking Triangle – Context Grid – Examples – Case Study.

Project : Meeting at least 50 people belonging to various strata of life and talk to them / make field visits to identify a min of100 society related issues, problems for which they need solutions and categories them and upload along with details of people met and lessons learnt. **(4 non-contact hours)**

Module:1 C	Lateral Thinking Skill	1 hour

Blooms Taxonomy – HOTS – Outof the box thinking – deBono lateral thinking model – Examples

Project : Last weeks - incomplete portion to be done and uploaded

Module:2 A	Creativity	1 hour

Creativity Models – Walla – Barrons – Koberg & Begnall – Examples

Project : Selecting 5 out of 100 issues identified for future work. Criteria based approach for prioritisation, use of statistical tools & upload . **(4 non- contact hours)**

Module:2 B	Brainstorming	1 hour

25 brainstorming techniques and examples

Project : Brainstorm and come out with as many solutions as possible for the top 5 issues

identified & upload . **(4 non- contact hours)**		
Module:3	**Mind Mapping**	**1 hour**
Mind Mapping techniques and guidelines. Drawing a mind map **Project :** Using Mind Maps get another set of solutions forthe next 5 issues (issue 6 – 10) . **(4 non- contact hours)**		
Module:4 A	**Systems thinking**	**1 hour**
Systems Thinking essentials – examples – Counter Intuitive condemns **Project :** Select 1 issue / problem for which the possible solutions are available with you. Apply Systems Thinking process and pick up one solution [explanation should be given why the other possible solutions have been left out]. Go back to the customer and assess the acceptability and upload. . **(4 non- contact hours)**		
Module:4 B	**Design Thinking**	**1 hour**
Design thinking process – Human element of design thinking – case study **Project :** Apply design thinking to the selected solution, apply the engineering & scientific tinge to it. Participate in "design week" celebrations upload the weeks learning out come.		
Module:5 A	**Innovation**	**1 hour**
Difference between Creativity and Innovation – Examples of innovation –Being innovative. **Project:** A literature searches on prototyping of your solution finalized. Prepare a prototype model or process and upload. . **(4 non- contact hours)**		
Module:5 B	**Blocks for Innovation**	**1 hour**
Identify Blocks for creativity and innovation – overcoming obstacles – Case Study **Project :** Project presentation on problem identification, solution, innovations-expected results – Interim review with PPT presentation. . **(4 non- contact hours)**		
Module:5 C	**Innovation Process**	**1 hour**
Steps for Innovation – right climate for innovation **Project:** Refining the project, based on the review report and uploading the text. . **(4 non-contact hours)**		
Module:6 A	**Innovation in India**	**1 hour**
Stories of 10 Indian innovations **Project:** Making the project better with add ons. . **(4 non- contact hours)**		
Module:6 B	**JUGAAD Innovation**	**1 hour**
Frugal and flexible approach to innovation - doing more with less Indian Examples **Project:** Fine tuning the innovation project with JUGAAD principles and uploading (Credit for JUGAAD implementation) . **(4 non- contact hours)**		
Module:7 A	**Innovation Project Proposal Presentation**	**1 hour**
Project proposal contents, economic input, ROI – Template **Project:** Presentation of the innovative project proposal and upload . **(4 non- contact hours)**		
Module:8 A	Contemporary issue in Innovation	**1 hour**
Contemporary issue in Innovation **Project:** Final project Presentation , Viva voce Exam (**4 non- contact hours)**		
	Total Lecture hours:	**15 hours**

Text Book(s)	
1.	How to have Creative Ideas, Edward debone, Vermilon publication, UK, 2007
2.	The Art of Innovation, Tom Kelley & Jonathan Littman, Profile Books Ltd, UK, 2008
Reference Books	
1.	Creating Confidence, Meribeth Bonct, Kogan Page India Ltd, New Delhi, 2000

2.	Lateral Thinking Skills, Paul Sloane, Keogan Page India Ltd, New Delhi, 2008		
3.	Indian Innovators, Akhat Agrawal, Jaico Books, Mumbai, 2015		
4.	JUGAAD Innovation, Navi Radjou, Jaideep Prabhu, Simone Ahuja Random house India, Noida, 2012.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar Three reviews with weightage of 25 : 25 : 50 along with reports			
Recommended by Board of Studies	15-12-2015		
Approved by Academic Council	38	Date	17-12-2015

Course code	Introduction to Soft Skills	L	T	P	J	C
STS1001		3	0	0	0	1
Pre-requisites	None	Version				
		2.0				

Course Objectives:

- To understand the importance of ethics plotted in exploring the moral landscape to meet global expectations.

Expected Course Outcome:

- Enabling students to know themselves and interact better with self and environment

Module:1	Lessons on excellence:	10 hrs

Ethics and integrity

1. Importance of ethics in life
2. Intuitionism vs Consequentialism
3. Non-consequentialism
4. Virtue ethics vs situation ethics
5. Integrity - listen to conscience
6. Stand up for what is right

Change management

1. Who moved my cheese?
2. Tolerance of change and uncertainty
3. Joining the bandwagon
4. Adapting change for growth - overcoming inhibition

How to pick up skills faster?

1. Knowledge vs skill
2. Skill introspection
3. Skill acquisition
4. "10,000 hours rule" and the converse

Habit formation

1. Know your habits
2. How habits work? - The scientific approach
3. How habits work? - The psychological approach
4. Habits and professional success
5. "The Habit Loop"
6. Domino effect
7. Unlearning a bad habit

Analytic and research skills.

1. Focused and targeted information seeking
2. How to make Google work for you
3. Data assimilation

Team skills:

Goal setting

1. SMART goals
2. Action plans
3. Obstacles -Failure management

Module:2	Motivation	11 hrs

Motivation

1. Rewards and other motivational factors
2. Maslow's hierarchy of needs
3. Internal and external motivation

Facilitation

1. Planning and sequencing
2. Challenge by choice
3. Full Value Contract (FVC)
4. Experiential learning cycle
5. Facilitating the Debrief

Introspection

1. Identify your USP
2. Recognize your strengths and weakness
3. Nurture strengths
4. Fixing weakness
5. Overcoming your complex
6. Confidence building

Trust and collaboration

1. Virtual Team building
2. Flexibility
3. Delegating

Shouldering responsibilities

Module:3	Emotional Intelligence - L1	12 hrs

Transactional Analysis 1.Introduction
2.Contracting, ego states 3.Life positions

Brain storming 1.Individual Brainstorming 2.Group Brainstorming 3.Stepladder Technique 4.Brain writing
4.Crawford's Slip writing approach 5.Reverse brainstorming
6.Star bursting 7.Charlette procedure
8.Round robin brainstorming **Psychometric Analysis** 1.Skill Test
2.Personality Test

Rebus Puzzles/Problem Solving

1. More than one answer

Unique ways

Module:4	Adaptability:	12 hrs

Theatrix 1.Motion Picture 2.Drama

3. Role Play
4. Different kinds of expressions

Creative expression

1.Writing 2.Graphic Arts 3.Music
4.Art and Dance

Flexibility of thought

1.The 5'P' framework (Profiling, prioritizing, problem analysis, problem solving, planning)

Adapt to changes(tolerance of change and uncertainty) 1. Adaptability Curve Survivor syndrome		
	Total Lecture Hours	**45 hrs**
Mode of Evaluation: Mode of Evaluation: FAT, Assignments, Projects, Case studies, Role plays, 3 Assessments with Term End FAT (Computer Based Test)		
Reference Books: Spencer Johnson(1998) Who moved my cheese. New York. G.P.Putham's Sons MalcomGladwel(2008) Outliers. London.. Little, Brown and Company Daniel Goleman(1995) Emotional Intellegence. New York City. Bantam Books Scott Peck. M(1978) Road Less Travelled. New York City. M. Scott Peck. **Websites: www.chalkstreet.com www.skillsyouneed.com www.mindtools.com www.thebalance.com www.eguru.ooo**		

Recommended by Board of Studies	09/06/2017		
Approved by Academic Council	45	Date	15-06-2017

Course code	Introduction to Business Communication	L	T	P	J	C
STS1002		3	0	0	0	1
Pre-requisites	None	Syllabus Version				
		2.0				

Course Objectives:

- To understand the importance of ethics plotted in exploring the moral landscape to meet global expectations.

Expected Course Outcome:

- Enabling students to know themselves and interact better with self and environment

Module:1	Study skills:	10 hrs

Memory techniques

1. Relation between memory and brain
2. Story line technique
3. Learning by mistake
4. Image-name association
5. Sharing knowledge
6. Visualization

Concept map

1. Mind Map
2. Algorithm Mapping
3. Top down and Bottom Up Approach,

Time management skills

1. Prioritization - Time Busters
2. Procrastination
3. Scheduling
4. Multitasking
5. Monitoring

Working under pressure and adhering to deadlines

Module:2	Emotional Intelligence L2 (Self Esteem): Empathy	6 hrs

Affective Empathy and Cognitive Empathy

Sympathy

1.Level of sympathy (Spatial proximity, Social Proximity, Compassion fatigue)

Module:3	Business Etiquette: Social and Cultural Etiquette	9 hrs

1. Value

2. Manners 3.Customs 4.Language 5.Tradition ,

Writing Company Blogs 1.Building a blog 2.Developing brand message 3.FAQs'

4. Assessing Competition

Internal Communications

1. Open and objective Communication

2. Two way dialogue
3. Understanding the audience

Planning

1.Identifying
Gathering Information 3.Analysis 4.Determining 5.Selecting plan
6.Progress check 7.Types of planning

Writing press release and meeting notes

1. Write a short, catchy headline.
2. Get to the Point –summarize your subject in the first paragraph.
Body – Make it relevant to your audience

Module:4	**Quantitative Ability:** **Numeracy concepts**	**4 hrs**

1. Fractions, Decimals
2. Bodmas, Simplifications 3.HCF, LCM
4.Tests of divisibility

Beginning to Think without Ink

Problems solving using techniques such as: Percentage, Proportionality, Support of answer choices, Substitution of convenient values, Bottom-up approach etc.

Math Magic

1.Puzzles and brain teasers involving mathematical concepts

Speed Calculations 1.Square roots 2.Cube roots 3.Squaring numbers
4.Vedic maths techniques

Module:5	**Reasoning Ability:** **Interpreting Diagramming and sequencing information**	**3 hrs**

Picture analogy 2.Odd picture 3.Picture sequence 4.Picture formation
5.Mirror image and water image

Logical Links

1.Logic based questions-based on numbers and alphabets

Module:6	**Verbal Ability:** **Strengthening Grammar Fundamentals**	**3 hrs**

1.Parts of speech
2.Tenses
3.Verbs(Gerunds and infinitives)

Reinforcements of Grammar concepts

1.Subject Verb Agreement
2. Active and Passive Voice
3.Reported Speech

Module:7	**Communication and Attitude:** **Writing**	**10 hrs**

1. Writing formal & informal letters
2. How to write a blog & knowing the format Effective ways of writing a blog
3. How to write an articles & knowing the format 4.Effective ways of writing an articles.
5.Designing a brochures

Speaking skills 1.How to present a JAM Public speaking **Self managing** 1.Concepts of self management and self motivation 2.Greet and Know 3.Choice of words 4.Giving feedback 5.Taking criticism		
	Total Lecture Hours	**45 hrs**
Mode of Evaluation: Mode of Evaluation: FAT, Assignments, Projects, Case studies, Role plays, 3 Assessments with Term End FAT (Computer Based Test)		
Reference Books: Peggy Klauss(2008) Hard Truth About Soft Skill. New York City. HarperCollins Daniel Goleman(1995) Emotional Intellegence. New York City. Bantam Books FACE(2016) Aptipedia Aptitude Encyclopedia. Delhi. Wiley publications ETHNUS(2013) Aptimithra. Bangalore. McGraw-Hill Education Pvt. Ltd. **Websites: www.chalkstreet.com www.skillsyouneed.com www.mindtools.com www.thebalance.com www.eguru.ooo**		

Recommended by Board of Studies	09/06/2017		
Approved by Academic Council	45	Date	15-06-2017

Course code	Reasoning Skill Enhancement	L	T	P	J	C
STS2001		3	0	0	0	1
Pre-requisites	None	Syllabus version				
		2.0				

Course Objectives:

- To understand the importance of ethics plotted in exploring the moral landscape to meet global expectations.

Expected Course Outcome:

- Enabling students to know themselves and interact better with self and environment

Module:1	Social interaction and social media	6 hrs

Effective use of social media :
Moderating personal information
3. Social media for job/profession
4. Communicating diplomatically
Networking on social media
1. Maximizing network with social media
2. How to advertise on social media
Event management
1. Event management methods
2. Effective techniques for better event management
Influencing
1. How to win friends and influence people
2. Building relationships
3. Persistence and resilience
4. Tools for talking when stakes are high
Conflict resolution
1. Definition and strategies
2. Styles of conflict resolution

Module:2	Non Verbal Communication proximecs	6 hrs

1.Types of proximecs
2. rapport building
Reports and Data Transcoding
1.Types of reports
Negotiation Skill
1.Effective negotiation strategies
Conflict Resolution
1.Types of conflicts

Module:3	Interpersonal Skill Social Interaction	8 hrs

.Interpersonal Communication,
2.Peer Communication,
3.Bonding,

4.Types of social interaction

Responsibility

1.Types of responsibilities

2. Moral and personal responsibilities

Networking

1.Competition

2. collaboration

3. content sharing

Personal Branding

1. Image Building
2. Grooming
3. Using social media for branding
4. **Delegation and compliance** 1.Assignment and responsibility 2.Grant of authority

3.Creation of accountability

Module:4	**Quantitative Ability -L1**	**10 hrs**

Number properties 1.Number of factors 2.Factorials

3.Remainder Theorem 4.Unit digit position 5.Tens digit position **Averages**

1.Averages 2.Weighted Average **Progressions**

1. Arithmetic Progression
2. Geometric Progression
3. Harmonic Progression

Percentages

1.Increase & Decrease or successive increase

Ratios

Types of ratios and proportions

Module:5	**Reasoning Ability-L1**	**8 hrs**

Analytical Reasoning

1. Data Arrangement(Linear and circular & Cross Variable Relationship)
2. Blood Relations 3.Ordering/ranking/grouping 4.Puzzletest

5.Selection Decision table

Module:6	**Verbal Ability:** S**trengthening Grammar Fundamentals**	**7 hrs**

Vocabulary Building 1.Synonyms & Antonyms 2.One word substitutes 3.Word Pairs

4.Spellings 5.Idioms

6. Sentence completion

Analogies

	Total Lecture Hours	**45 hrs**

Mode of Evaluation: Mode of Evaluation: FAT, Assignments, Projects, Case studies, Role plays, 3 Assessments with Term End FAT (Computer Based Test)

References:

Kerry Patterson, Joseph Grenny, Ron McMillan, Al Switzler(2001)Crucial Conversations: Tools

for Talking When Stakes are High. Bangalore. McGraw- Hill Contemporary
Dale Carnegie,(1936) How to Win Friends and Influence People. New York. Gallery Books FACE(2016) Aptipedia Aptitude Encyclopedia. Delhi. Wiley publications
ETHNUS(2013) Aptimithra. Bangalore. McGraw-Hill Education Pvt. Ltd.

Recommended by Board of Studies	09/06/2017		
Approved by Academic Council	45	Date	15-06-2017

STS2002	Introduction to Etiquette	L	T	P	J	C
		3	0	0	0	1
Course Pre-requisites	None					Version
						2.0

Course Objectives:

- To develop skills on etiquette, thought process, quantitative, verbal and reasoning.

Expected Course Outcome:

- Enabling students enhance knowledge of relevant topics and evaluate the information

Module:1	Impression Management Types and techniques	8 hrs

Importance of impression management

1. Types of impression management
2. Techniques and case studies
3. Making a good first impression in an interview (TEDOS technique)
4. How to recover from a bad impressions/experience
5. Making a good first impression online

Non-verbal communication and body language

1. Dressing, Appearance and Grooming
2. Facial expression and Gestures
3. Body language (Kinesics)
4. Keywords to be used

Voice elements (tone, pitch and pace)

Module:2	Thinking Skills	4 hrs

Introduction to problem solving process

1.Steps to solve the problem 2.Simplex process

Introduction to decision making and decision making process

1.Steps involved from identification to implementation 2.Decision making model

Module:3	Beyond Structure Art of questioning	4 hrs

1.How to frame questions 2.Blooms questioning pyramid 3.Purpose of questions Etiquette 1.Business 2.Telephone etiquette 3.Cafeteria etiquette 4.Elevator etiquette 5.Email etiquette 6.Social media etiquette

Module:4	Quantitative Ability-L2	9 hrs

Profit and Loss

1.Cost Price & Selling Price 2.Margins & Markup **Interest Calculations**

Simple Interest, Compound Interest, Recurring

Mixtures and solutions 1.Ratio & Averages 2.Proportions

Time and Work 1.Pipes & Cisterns, 2.Man Day concept 3.Division Wages

Time Speed and Distance

1.Average speed, Relative speed, Boats and streams.

Proportions & Variations

Module:5	**Reasoning Ability-L2**	**11 hrs**
Logical Reasoning 1.Sequence and series 2.Coding and decoding 3.Directions Visual Reasoning 1.Abstract Reasoning 2.Input Type Diagrammatic Reasoning 3.Spatial reasoning 4.Cubes Data Analysis And Interpretation 1.DI-Tables/Charts/Text		
Module:6	**Verbal Ability-L2 Grammar**	**9 hrs**
1.Spot the Errors 2.Sentence Correction 3.Gap Filling Exercise 4.Sentence Improvisations 5.Misc. Grammar Exercise		
	Total Lecture Hours	**45 hrs**

Mode of Evaluation: Mode of Evaluation: FAT, Assignments, Projects, Case studies, Role plays, 3 Assessments with Term End FAT (Computer Based Test)

Kenneth H. Blanchard and Spencer Johnson(2003) The One Minute Manager. New York. William Morrow& Co

David Allen(2002) Getting Things done : The Art of Stress -Free productivity. New York. Simon and Schuster.

FACE(2016) Aptipedia Aptitude Encyclopedia. Delhi. Wiley publications ETHNUS(2013) Aptimithra. Bangalore. McGraw-Hill Education Pvt. Ltd.

Websites: www.chalkstreet.com www.skillsyouneed.com

Recommended by Board of Studies	09/06/2017		
Approved by Academic Council	45	Date	15-06-2017

Course code	Preparedness for External Opportunities	L	T	P	J	C
STS3001		3	0	0	0	1
Pre-requisites	None	Syllabus Version				
		2.0				

Course Objectives:

- To understand the importance of ethics plotted in exploring the moral landscape to meet global expectations.

Expected Course Outcome:

- Enabling students to know themselves and interact better with self and environment

Module:1	Interview skills	3 hrs

Types of interview
1. Structured and unstructured interview orientation
2. Closed questions and hypothetical questions
3. Interviewers' perspective
4. Questions to ask/not ask during an interview

Techniques to face remote interviews
1. Video interview
2.Recorded feedback
3. Phone interview preparation

Mock Interview
1.Tips to customize preparation for personal interview
2. Practice rounds

Module:2	Resume skills	2 hrs

Resume Template
1. Structure of a standard resume
2. Content, color, font

Use of power verbs
1. Introduction to Power verbs and Write up

Types of resume
1. Quiz on types of resume

Customizing resume
1. Frequent mistakes in customizing resume
2. Layout - Understanding different company's requirement
3. Digitizing career portfolio

Module:3	Presentation skills	6 hrs

Preparing presentation
1. 10 Tips to prepare PowerPoint presentation
2. Outlining the content
3. Passing the Elevator Test

Organizing materials
1. Blue sky thinking
2. Introduction , body and conclusion

3. Use of Font, Use of Color
4. Strategic presentation

Maintaining and preparing visual aids

1.Importance and types of visual aids
2.Animation to captivate your audience
3.Design of posters

Dealing with questions

1. Setting out the ground rules
2. Dealing with interruptions
3. Staying in control of the questions

Handling difficult questions

Module:4	**Quantitative Ability-L3**	**14 hrs**

Permutation-Combinations 1.Counting
2.Grouping
3.Linear Arrangement
4.Circular Arrangements **Probability** 1.Conditional Probability
2.Independent and Dependent Events **Geometry and mensuration**
1.Properties of Polygon
2.2D & 3D Figures 3.Area & Volumes **Trigonometry**
1.Heights and distances
2.Simple trigonometric functions
Logarithms 1.Introduction 2.Basic rules **Functions**
1.Introduction 2.Basic rules
Quadratic Equations
1.Understanding Quadratic Equations
2.Rules & probabilities of Quadratic Equations
Set Theory
1.Basic concepts of Venn Diagram

Module:5	**Reasoning ability-L3**	**7 hrs**

Logical reasoning 1.Syllogisms
2.Binary logic
3.Sequential output tracing 4.Crypto arithmetic
Data Analysis and Interpretation
1.Data Sufficiency
2.Data interpretation-Advanced
Interpretation tables, pie charts & bar chats

Module:6	**Verbal Ability-L3**	**8 hrs**

Comprehension and Logic 1.Reading comprehension 2.Para Jumbles
3..Critical Reasoning :
a) Premise and Conclusion
b) Assumption & Inference
Strengthening & Weakening an Argument

Module:7	**Writing skills**	**5 hrs**

Note making

1.What is note making 2.Different ways of note making **Report writing** 1.What is report writing 2.How to write a report 3.Writing a report & work sheet **Product description** 1.Designing a product 2.Understanding it's features 3.Writing a product description **Research paper** 1.Research and it's importance Writing sample research paper

	Total Lecture Hours	**45 hrs**

Mode of Evaluation: Mode of Evaluation: FAT, Assignments, Projects, Case studies, Role plays, 3 Assessments with Term End FAT (Computer Based Test)

References

Michael Farra and JIST Editors(2011)Quick Resume & Cover Letter Book: Write and Use an Effective Resume in Just One Day. Saint paul, Minnesota.Jist Works

Daniel Flage Ph.D(2003)The Art of Questioning: An Introduction to Critical Thinking. London. Pearson

David Allen(2002) Getting Things done : The Art of Stress -Free productivity. New York City. Penguin Books.

FACE(2016) Aptipedia Aptitude Encyclopedia. Delhi. Wiley publications ETHNUS(2013) Aptimithra. Bangalore. McGraw-Hill Education Pvt. Ltd.

Websites: www.chalkstreet.com www.skillsyouneed.com www.mindtools.com www.thebalance.com www.eguru.ooo

Recommended by Board of Studies	09/06/2017		
Approved by Academic Council	45	Date	15-06-2017

Course code	Code Mithra	L	T	P	J	C
3005		3	0	0	0	1
Pre-requisite	None	Syllabus version				
		2				

Course Objectives:

1. To develop logics which will help them to create programs, applications in C.
2. To learn how to design a graphical user interface (GUI) with Java Swing.
3. To present an introduction to database management systems, with an emphasis on how to organize, maintain and retrieve - efficiently, and effectively.

Expected Course Outcome:

- Enabling students to write coding in C,C++,Java and DBMS concepts

Module:1	C Programming	15 hours

Introduction to C, Execution and Structure of a C Program, Data Types and Operators, Control Statements, Looping, Arrays, Structure, Pointers, Memory Management in C, Functions.

Module:2	C++ Programming	15 hours

Introduction to C++, Need for OOP, Class & Objects, Create C++ & Java class and show the similarity Encapsulation, Access Specifiers, Relationship, Polymorphism, Exception Handling, Abstract Classes, Interfaces.

Module:3	JAVA	10 hours

Introduction to Java, Data Types and Operators, Control Statements, Looping, Arrays, Need for OOP, Class & Objects, Create C++ & Java class and show the similarity Encapsulation, Access Specifiers, Relationship, Polymorphism, Exception Handling, Abstract Classes, Interfaces.

Module:4	Database	5 hours

Introduction to database, DDL, Data Manipulation, SELECT, Joins.

	Total Lecture hours:	45 hours	

Reference Books

1. Data Structures and Algorithms: https://ece.uwaterloo.ca/~dwharder/aads/Lecture_materials/
2. C Programming: C Programming Absolute Beginner's Guide (3rd Edition) by Greg Perry, Dean Miller
3. Java: Thinking in Java, 4th Edition
4. **Websites: www.eguru.ooo**

Mode of Evaluation: FAT, Assignments, Projects 3 Assessments with Term End FAT (Computer Based Test)

Recommended by Board of Studies	09/06/2017		
Approved by Academic Council	No.45th AC	Date	15/06/2017

Course code	Applications of Differential and Difference Equations	L	T	P	J	C
MAT2002		3	0	2	0	4
Pre-requisite	MAT1011 - Calculus for Engineers	Syllabus Version				
		1.0				

Course Objectives (CoB):

1. The course is aimed at
2. Presenting the elementary notions of Fourier series, which is vital in practical harmonic analysis
3. Imparting the knowledge of eigenvalues and eigen vectors of matrices and the transform techniques to solve linear systems, that arise in sciences and engineering
4. Enriching the skills in solving initial and boundary value problems
5. Impart the knowledge and application of difference equations and the Z-transform in discrete systems, that are inherent in natural and physical processes

Course Outcome (CO):

1. Employ the tools of Fourier series to find harmonics of periodic functions from the tabulated values
2. Apply the concepts of eigenvalues, eigen vectors and diagonalisation in linear systems
3. Know the techniques of solving differential equations
4. Understand the series solution of differential equations and finding eigen values, eigen functions of Strum-Liouville's problem
5. Know the Z-transform and its application in population dynamics and digital signal processing
6. Demonstrate MATLAB programming for engineering problems

Module:1	Fourier series:		6 hours

Fourier series - Euler's formulae - Dirichlet's conditions - Change of interval - Half range series – RMS value – Parseval's identity – Computation of harmonics

Module:2	Matrices:		6 hours

Eigenvalues and Eigen vectors - Properties of eigenvalues and eigen vectors – Cayley-Hamilton theorem - Similarity of transformation - Orthogonal transformation and nature of quadratic form

Module:3	Solution of ordinary differential equations:		6 hours

Linear second order ordinary differential equation with constant coefficients – Solutions of homogenous and non-homogenous equations - Method of undetermined coefficients – method of variation of parameters – Solutions of Cauchy-Euler and Cauchy-Legendre differential equations

Module:4	**Solution of differential equations through Laplace transform and matrix method**		**8 hours**
Solution of ODE's - Nonhomogeneous terms involving Heaviside function, Impulse function - Solving nonhomogeneous system using Laplace transform – Reduction of *n*th order differential equation to first order system - Solving nonhomogeneous system of first order differential equations $(X' = AX + G)$ and $X'' = AX$			
Module:5	**Strum Liouville's problems and power series Solutions:**		**6 hours**
The Strum-Liouville's Problem - Orthogonality of Eigen functions - Series solutions of differential equations about ordinary and regular singular points - Legendre differential equation - Bessel's differential equation			
Module:6	**Z-Transform:**		**6 hours**
Z-transform -transforms of standard functions - Inverse Z-transform: by partial fractions and convolution method			
Module:7	**Difference equations:**		**5 hours**
Difference equation - First and second order difference equations with constant coefficients - Fibonacci sequence - Solution of difference equations - Complementary function - Particular integral by the method of undetermined coefficients - Solution of simple difference equations using Z-transform			
Module:8	**Contemporary Issues**		**2 hours**
Industry Expert Lecture			
	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	Advanced Engineering Mathematics, Erwin Kreyszig, 10th Edition, John Wiley India, 2015
Reference Books	
1.	Higher Engineering Mathematics, B. S. Grewal, 43rd Edition, Khanna Publishers, India, 2015
2.	Advanced Engineering Mathematics by Michael D. Greenberg, 2nd Edition, Pearson Education, Indian edition, 2006

Mode of Evaluation		
Digital Assignments (Solutions by using soft skills), Continuous Assessment Tests, Quiz, Final Assessment Test		
1.	Solving Homogeneous differential equations arising in engineering problems	2 hours
2.	Solving non-homogeneous differential equations and Cauchy, Legendre equations	2 hours
3.	Applying the technique of Laplace transform to solve differential equations	2 hours
4.	Applications of Second order differential equations to Mass spring system (damped, undamped, Forced oscillations), LCR circuits etc.	2 hours
5.	Visualizing Eigen value and Eigen vectors	2 hours

6.	Solving system of differential equations arising in engineering applications	2 hours
7.	Applying the Power series method to solve differential equations arising in engineering applications	2 hours
8.	Applying the Frobenius method to solve differential equations arising in engineering applications	2 hours
9.	Visualising Bessel and Legendre polynomials	2 hours
10.	Evaluating Fourier series-Harmonic series	2 hours
11.	Applying Z-Transforms to functions encountered in engineering	2 hours
12.	Solving Difference equations arising in engineering applications	2 hours
	Total Laboratory Hours	**24 hours**

Mode of Evaluation: Weekly Assessment, Final Assessment Test			
Recommended by Board of Studies	03-06-2019		
Approved by Academic Council	No. 55	Date	13-06-2019

Course code	Complex Variables and Partial Differential Equation	L	T	P	J	C
MAT3003		3	2	0	0	4
Pre-requisite	MAT2002 Applications of Differential and Difference Equations	Syllabus version				
		1.0				

Course Objectives (CoB):

The aim of this course is to present a comprehensive, compact and integrated treatment of two most important branches of applied mathematics for engineers and scientists namely the functions of complex variable and Partial differential equations in finite and infinite domains

Course Outcome (CO):

1. Construct analytic functions and find complex potential of fluid flow and electric fields
2. Find the image of straight lines by elementary transformations and
3. Express analytic functions in power series
4. Evaluate real integrals using techniques of contour integration
5. Analyze partial differential equations, and its applications, design the boundary value problems (one dimensional heat and wave equations) and find Fourier series, Fourier transform techniques in their respective engineering problems.

Module:1	Analytic Functions	6 hours	

Complex variable-Analytic functions and Cauchy – Riemann equations - Laplace equation and Harmonic functions - Construction of Harmonic conjugate and analytic functions - Applications of analytic functions to fluid-flow and Field problems.

Module:2	Conformal and Bilinear transformations	5 hours	

Conformal mapping - Elementary transformations-translation, magnification, rotation, inversion. Exponential and Square transformations ($w = e^z$, z^2) - Bilinear transformation - Cross-ratio-Images of the regions bounded by straight lines under the above transformations.

Module:3	Power series	4 hours	

Functions given by Power Series - Taylor and Laurent series -singularities - poles – Residues.

Module:4	Complex Integration	5 hours	

Integration of a complex function along a contour - Cauchy-Goursat theorem- Cauchy's integral formula -Cauchy's residue theorem - Evaluation of real integrals - Indented contour integral.

Module:5	Partial Differential equations of first order	6 hours	

Formation and solution of partial differential equation - General, Particular, Complete and Singular integrals - Partial Differential equations of first order of the forms: F(p,q)=0, F(z,p,q)=0, F(x,p)=G(y,q) and Clairaut's form - Lagrange's equation: Pp+Qq = R.

Module:6	Applications of Partial Differential	10 hours	

	Equations		
Linear partial differential equations of higher order with constant coefficients. Solution of a partial differential equation by separation of variables - Boundary Value Problems-one dimensional wave and heat equations- Fourier series solution.			
Module:7	**Fourier transforms**	**7 hours**	
Complex Fourier transform and properties - Relation between Fourier and Laplace transforms - Fourier sine and cosine transforms – Convolution Theorem and Parseval's identity.			
Module:8	**Contemporary issues:**	**2 hours**	
Industry Expert Lecture			
	Total Lecture hours:	**45 hours**	
Tutorial	• A minimum of 10 problems to be worked out by students inventory Tutorial Class • Another 5 problems per Tutorial Class to be given as home work**.**	**30 hours**	

Text Book(s)

1.	Advanced Engineering Mathematics, Erwin Kreyszig, 10th Edition, John Wiley & Sons (Wiley student Edison) (2015)

Reference Books

1	Higher Engineering Mathematics, B. S. Grewal, 43rd Edition (2019), Khanna Publishers, New Delhi
2	A first course in complex analysis with applications, G.Dennis Zill, Patrick D. Shanahan, 3rd Edition, 2013, Jones and Bartlett Publishers Series in Mathematics:
3	Advanced Engineering Mathematics, Michael, D. Greenberg, 2nd Edition, Pearson Education (2006)
4	Advanced Engineering Mathematics, Peter V. O' Neil, 7th Edition, Cengage Learning (2012)
5	Complex Analysis for Mathematics and Engineers, JH Mathews, R. W. Howell, 5th Edition, Narosa Publishers (2013)

Mode of Evaluation:

Digital Assignments(Solutions by using soft skill),Quiz, Continuous Assessments, Final Assessment Test.

Recommended by Board of Studies	03-06-2019		
Approved by Academic Council	No. 55	Date	13-06-2019

Course Code	Applied Numerical Methods	L	T	P	J	C
MAT3005		3	2	0	0	4
Pre-requisite	MAT2002	Syllabus Version				
		1.0				

Course Objectives :

The aim of this course

1. is to cover certain basic, important computer oriented numerical methods for analyzing problems that arise in engineering and physical sciences.
2. is to use MATLAB as the primary computer language to obtain solutions to a few problems that arise in their respective engineering courses.
3. is to impart skills to analyse problems connected with data analysis,
4. is to solve ordinary and partial differential equations numerically

Course Outcome :

1. Observe the difference between exact solution and approximate solution.
2. Use the numerical techniques (algorithms) to find the solution (approximate) algebraic equations and system of equations.
3. Fit the data using interpolation technique and spline methods.
4. Find the solution of ordinary differential equations , Heat and Wave equation numerically.
5. Apply calculus of variation techniques to extremize the functional and also find approximate series solution to ordinary differential equations

Module:1	Algebraic and Transcendental Equations	5 hours	

General iterative method- rates of convergence- Secant method - Newton – Raphson method- System of non-linear equations by Newton's method.

Module:2	System of Linear Equations and Eigen Value Problems	6 hours	

Gauss –Seidel iteration method. Convergence analysis of iterative methods-LU Decomposition -Tri diagonal system of equations-Thomas algorithm- Eigen values of a matrix by Power and Jacobi methods.

Module:3	Interpolation	6 hours	

Finite difference operators- Newton's forward-Newton's Backward- Central differences-Stirling's interpolation - Lagrange's interpolation - Inverse Interpolation-Newton's divided difference-Interpolation with cubic splines.

Module:4	Numerical Differentiation and Integration	6 hours	

Numerical differentiation with interpolation polynomials-maxima and minima for tabulated values-Trapezoidal rule, Simpsons $1/3^{rd}$ and $3/8^{th}$ rules. –Romberg's method. Two and Three point Gaussian quadrature formula.

Module:5	Numerical Solution of Ordinary Differential Equations	8 hours	

First and second order differential equations - Fourth order Runge – Kutta method. Adams-Bashforth-Moulton predictor-corrector methods. Finite difference solution for the second order ordinary differential equations.

Module:6	**Numerical Solution of Partial Differential Equations**	**6 hours**	
Classification of second order linear partial differential equations-Laplace equation –Gauss-Seidal method-One dimensional heat equation- Schmidt explicit method-Crank-Nicolson implicit method.-One dimensional wave equation–Explicit method.			
Module:7	**Variational Methods**	**6 hours**	
Introduction - functional –variational problems- extremals of functional of a single dependent variable and its first derivative- functional involving higher order derivatives- Isoperimetric problems- Galerkins- Rayleigh Ritz methods.			
Module:8	**Contemporary Issues**	**2 hours**	
Industry Expert Lecture			
	Total Lecture hours:	**45 hours**	
Tutorial	• A minimum of 10 problems to be worked out by students in every Tutorial Class. • Another 5 problems per Tutorial Class to be given for practise.	**30 hours**	

Text Book(s)

1. Numerical Methods for Scientific and Engineering, M. K. Jain, S. R. K. Iyengar and R. K. Jain, New Age International Ltd., 6th Edition, 2012.
2. Applied Numerical Analysis, C. F. Gerald and P.V. Wheatley, Addition-Wesley, 7th Edition, 2004.

Reference Books

1. Introductory Methods of Numerical Analysis, S.S. Sastry, PHI Pvt. Ltd., 5th Edition, New Delhi, 2009.
2. Applied Numerical Methods Using MATLAB, W.Y. Yang, W. Cao, T.S. Chung and J. Morris, Wiley India Edn., 2007.
3. Numerical Methods for Engineers with Programming and Software Applications, Steven C. Chapra and Ra P. Canale, 7th Edition, Tata McGraw Hill, 2014.
4. Numerical Analysis, R.L. Burden and J. D. Faires, 4th Edition, Brooks Cole, 2012.
5. Numerical Methods: Principles, Analysis and Algorithms, Srimanta Pal, Oxford University Press India; 978-0195693751, 2009.

Mode of Evaluation

Digital Assignments (Solutions by using soft skills), Continuous Assessment Tests, Final Assessment Test

Recommended by Board of Studies	03-06-2019		
Approved by Academic Council	No. 55	Date	13-06-2019

Course Code	ENGINEERING DRAWING	L	T	P	J	C
MEE1001		1	0	4	0	3
Pre-requisite	NIL	Syllabus version				
		v. 2.2				

Course Objectives:

1. Understand and escalate the importance of basic concepts and principles of Engineering Drawing (components, sections, views, and graphical representation).
2. Enable the students with various concepts like dimensioning, conventions and standards related to working drawings in order to become professionally efficient.
3. Develop the ability to communicate with others through the language of technical drawing and sketching.
4. Ability to read and interpret engineering drawings created by others.
5. Ability to draw orthographic projections and sections.
6. Develop an understanding for size specification procedures and use of SI and traditional units of linear measure.

Expected Course Outcome:

1. Apply BIS and ISO Standards in Engineering Drafting.
2. Graphically construct mathematical curves in engineering applications.
3. Visualize geometrical solids in 3D space through Orthographic Projections
4. Construct isometric scale, isometric projections and views.
5. Draw sections of solids including cylinders, cones, prisms and pyramids.
6. Draw projections of lines, planes, solids, isometric projections and sections of solids including cylinders, cones, prisms and pyramids using Mini-Dafter and CAD.
7. Construct orthographic projections from pictorial views.

Module:1	Lettering and Dimensioning	1 hours

Introduction, lettering practice, Elements of dimensioning - systems of dimensioning.

Module:2	Geometric Constructions	2 hours

Free hand sketching, Conic sections, Special curves.

Module:3	Projection of Points and Projection of Lines	2 hours

Projection of Points: First and Third Angle Projections; Projection of points.

Projection of Lines: Projection of straight lines (First angle projection only); Projection of lines inclined to one plane and both planes, true length and true inclinations.

Module:4	Projection of Solids and Section of Solids	3 hours

Projection of solids: Classification of solids, Projection of solids in simple position, Projection of solids inclined to one plane. Sections of Solids: Right regular solids and auxiliary views for the true shape of the sections.		
Module:5	**Development of Surfaces**	**2 hours**
Development of surfaces for various regular solids.		
Module:6	**Isometric Projection and Perspective Projection**	**2 hours**
Isometric Projection: Isometric scales, Isometric projections of simple and combination of solids; **Perspective Projection:** Orthographic representation of a perspective views – Plane figures and simple solids - Visual ray method.		
Module:7	**Orthographic Projection**	**2 hours**
Conversion of pictorial view into orthographic Projection.		
Module:8	**Contemporary issues**	**1 hours**
	Total Lecture hours:	**15 hours**

Text Book(s)	
1.	Venugopal K and Prabhu Raja V, "Engineering Graphics", New AGE International Publishers, 2015.
Reference Books	
1.	N. D. Bhatt, Engineering Drawing, Charotar publishing House, 2012.
2	Natarajan, K. V., A Text book of Engineering Graphics, Dhanalakshmi Publishers, 2012.
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

List of Challenging Experiments (Indicative)		
1.	Identifying the incorrect dimensioning and correct it as per BIS standards for Engineering Components.	4 hours
2.	Tutorials on free hand sketching of the plan view of stadium, garden, etc.,	4 hours
3.	Tutorials on geometric constructions like conics and special curves for projection of cricket ball, missile projection, etc.,	4 hours
4.	Representation of orthographic projection of points	4 hours
5.	Representation of orthographic projection of lines (First angle projection only) inclined to one plane and projection of lines inclined to both the planes-solving problems like electrical bulbs hanging from the roof, finding the shortest distance between fan to electrical switch board, etc.,	8 hours
6.	Sketching orthographic projection of solids in simple position and projection of solids inclined to one plane for household accessories and objects.	8 hours
7.	Drawing the auxiliary views, orthographic views and true shape of sectioned regular solids for household accessories and objects.	4 hours

8.	Development of lateral surfaces of the regular shapes and sectioned shapes for water cans, refrigerator, cylinder container, funnel, etc.,	4 hours
9.	Conversion of orthographic views to isometric views for engineering components.	8 hours
10.	Tutorial problems on perspective projection of plane figures and simple solids for train with track, landscape, etc.,	4 hours
11.	Conversion of pictorial drawing into orthographic projection for engineering components, architectural structures, etc.,	8 hours
	Total Laboratory Hours	**60 hours**

Mode of assessment:			
Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	47	Date	05-10-2017

Course code	Engineering Mechanics	L	T	P	J	C
MEE1002		2	2	0	0	3
Pre-requisite	NIL	Syllabus version				
		v. 2.2				

Course Objectives:

1. To enable students to apply fundamental laws and basic concepts of rigid body mechanics to solve problems of bodies under rest or in motion.
2. To enable the students to apply conditions of static equilibrium to analyse physical systems.
3. To compute the properties of areas and bodies.

Expected Course Outcome:

1. Compute the resultant of system of forces in plane and space acting on bodies.
2. Predict the support-reactions and the internal forces of the members of various trusses and frames.
3. Analyse equilibrium problems with friction.
4. Apply transfer theorems to determine properties of various sections.
5. Analyse equilibrium of connected bodies virtual work method.
6. Predict motion parameters of bodies under rectilinear, curvilinear and general plane motion.

Module:1	Basics of Statics	5 hours

Fundamental Principles – Coplanar forces – Resolution and Composition of forces and equilibrium of particles – Forces of a particle in space – Equivalent system of forces – Principle of transmissibility – Single equivalent force – Free body diagram – Equilibrium of rigid bodies in two dimensions and three dimensions.

Module:2	Analysis of Structures	4 hours

Types of supports and their reactions – Plane trusses and frames - Analysis of forces by method of joints and method of sections.

Module:3	Friction	3 hours

Characteristics of dry friction – simple contact friction – Wedges and Ladder friction.

Module:4	Properties of Surfaces and Solids	4 hours

Centroid - First moment of area – Second moment of area – Moment and product of inertia of plane areas – Transfer Theorems - Polar moment of inertia – Principal axes – Mass moment of inertia.

Module:5	Virtual Work	4 hours

Virtual work – Principle of virtual work – System of connected rigid bodies – Degrees of freedom

– Conservative forces – Potential energy – Potential energy criteria for equilibrium.		
Module:6	**Kinematics**	**4 hours**
Displacements, Velocity and Acceleration – Rectilinear motion – Curvilinear motion – Tangential and Normal components – Radial and Transverse components.		
Module:7	**Energy and Momentum Methods**	**4 hours**
Principle of work and energy for a particle and a rigid body in plane motion – Conservation of energy - Principle of impulse and momentum for a particle and a rigid bodies in plane motion – Conservation of momentum.		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)	
1.	Beer, Johnston, Cornwell and Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, 10th Edition, McGraw-Companies, Inc., New York, 2013.
Reference Books	
1.	Russell C Hibbeler and Ashok Gupta, Engineering Mechanics: Statics and Dynamics (11th Edition), Pearson Education Inc., Prentice Hall, 2010.
2.	Meriam J.L and Kraige L.G., Engineering Mechanics, Volume I - Statics, Volume II - Dynamics, 7th Edition, John Wiley & Sons, New York, 2012.
3.	Rajasekaran S and Sankarasubramanian G, Fundamentals of Engineering Mechanics, 3rd Edition, Vikas Publishing House Pvt Ltd., India, 2013.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Mode of assessment:			
Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	47	Date	05-10-2017

Course code	Engineering Thermodynamics	L	T	P	J	C
MEE1003		2	2	0	0	3
Pre-requisite	NIL	Syllabus version				
		v. 2.2				

Course Objectives:

1. Familiarize with the concepts of 1st and 2nd Laws of Thermodynamics.
2. Evaluate the properties of pure substances and mixtures.
3. Understand and analyze power and refrigeration cycles.

Expected Course Outcome:

1. Identify thermodynamics systems, point functions and path functions.
2. Solve engineering problems using zeroth and first laws of thermodynamics.
3. Analyse the heat and work interactions by applying the concepts of entropy principles and exergy.
4. Analyse thermodynamic systems involving pure substances and mixtures.
5. Calculate thermodynamics properties based on thermodynamics relations.
6. Analyse basic thermodynamic cycles of various systems.

Module:1	Basic Concepts in Thermodynamics	3 hours

Basic concepts of Thermodynamics - Thermodynamics and Energy - Closed and open systems - Properties of a system - State and equilibrium - Processes and cycles - Forms of energy - Work and heat transfer - Temperature and Zeroth law of thermodynamics.

Module:2	First law of thermodynamics	3 hours

Energy balance for closed systems - First law applied to steady – flow engineering devices

Module:3	Second Law of Thermodynamics and Exergy	6 hours

Limitations of the first law of Thermodynamics - Kelvin-Planck and Clausius statements and its equivalence- Refrigerators, Heat Pump–COP - Perpetual Motion Machines - Reversible and Irreversible process Carnot's Theorem - Entropy - The Clausius inequality - Availability and irreversibility - Second law efficiency-Quality of Energy

Module:4	Properties of Pure Substance and Mixtures	5 hours

Property diagram for water-phase change processes-refrigerants-real gases-Compressibility factor-Composition of gas mixtures - Mass and mole fractions - Dalton's law of additive pressures - Amagat's law of additive volumes - Evaluating properties of gas mixtures

Module:5	Thermodynamic relations	2 hours

Gibbs and Helmholtz function-Maxwell's relations-Clapeyron equations-general relations of properties

Module:6	**Gas power cycles**	**4 hours**
Air standard assumptions - Otto cycle - Diesel and Dual cycles - Brayton cycle		
Module:7	**Vapor and Refrigeration Cycles**	**5 hours**
Rankine cycle-reheat-regeneration- Vapor compression refrigeration cycle		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)	
1.	Yunus A. Cengel, Thermodynamics: An Engineering Approach, 8th Edition, McGraw - Hill Education, 2017.
Reference Books	
1.	P. K. Nag, Engineering Thermodynamics, 6th Edition, McGraw - Hill Education, 2017.
2.	Michael Moran and Howard Shapiro, Principles of Engineering Thermodynamics, 8th Edition, Wiley, 2015.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	47	Date	05-10-2017

Course code	Materials Engineering and Technology	L	T	P	J	C
MEE1005		3	0	2	0	4
Pre-requisite	NIL	Syllabus version				
		v. 2.2				

Course Objectives:

1. To develop the knowledge on structure of materials including crystallography, microstructure, defects and phase diagrams
2. To provide an understanding to students on the correlation between structure, processing, mechanical properties and performance of materials
3. To develop the knowledge on mechanical properties of materials and strengthening mechanism
4. To give insight in to advanced materials such as polymers, ceramics and composite and their applications

Expected Course Outcome:

1. Suggest suitable engineering materials for different application
2. Identify various phases of metals and alloys through appropriate phase diagrams
3. Apply suitable heat treatment process based on material properties
4. Evaluate the effect of alloying elements, properties and application of ferrous and non-ferrous metals
5. Evaluate the mechanical behavior of materials for different applications
6. Apply advanced materials such as polymers, ceramics and composites in product design
7. Correlate the structure-property relationship in metals/alloys in as-received and heat treated conditions

Module:1	Structure of Materials	8 hours

Introduction to engineering materials – significance of structure property correlations in all classes of engineering materials, Unit Cells, Metallic Crystal Structures, Density Computations, Crystal Systems, Crystallographic Points, Crystallographic Directions, Crystallographic Planes, Linear and Planar Densities, Close-Packed Crystal Structures, Crystalline and Non-crystalline Materials, Single Crystals, Polycrystalline Materials, Imperfection in solids – Point, Line, Surface and Volume defects - Polymorphism and Allotropy.

Module:2	Constitution of Alloys	7 hours

Mechanism of Crystallization- Nucleation-Homogeneous and Heterogeneous Nucleation- Growth of crystals- Planar growth – dendritic growth – Cooling curves - Diffusion - Construction of Phase diagram -Binary alloy phase diagram – Cu-Ni alloy; Cu-Zn alloy and Pb-Sn alloy; Iron-Iron carbide phase diagram – Invariant reactions – microstructural changes of hypo and hyper-eutectoid steel- TTT and CCT diagram.

Module:3	Heat Treatment and Surface Heat treatment	5 hours

Heat treatment – Overview – Objectives – Annealing and types, normalizing, quenching, austempering and martempering – microstructure changes –Surface hardening processes - Carburizing – nitriding – cyaniding and carbonitriding, induction and flame hardening, Laser and Electron beam hardening– principles and case depths.		
Module:4	**Ferrous Metals**	**6 hours**
Steels – Types of Steels - HSLA – TRIP - White, Grey, Malleable and Nodular - Properties and application of cast irons, Effect of alloying elements on structure and properties of steels - Properties and uses of Silicon and Hadfield Manganese steels, High speed steels - Stainless steel and Types.		
Module:5	**Non Ferrous metals**	**6 hours**
Properties and Applications of Aluminum, Magnesium, Copper, Nickel, Titanium and their alloys.		
Module:6	**Mechanical behavior of Materials**	**7 hours**
Strengthening mechanisms – Hardness measurements – Hardenability - Tensile properties of the materials – Fracture of metals – Ductile Fracture, Brittle Fracture, Ductile to Brittle Transition Temperature (DBTT) –Fatigue – Endurance limit of ferrous and non-ferrous metals -Fatigue test, S-N curves, factors affecting fatigue, structural changes accompanying fatigue; Creep and stress rupture– mechanism of creep – stages of creep and creep test.		
Module:7	**Introduction to Advanced Materials**	**4 hours**
Properties and Applications of Engineering polymers- Ceramics – properties and applications of various ceramics – Composites – and their types; properties and processing of composites – Manufacture of fibers.		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	W.D. Callister, David G. Rethwisch, Materials Science and Engineering: An Introduction, 9th ed., Wiley & Sons, 2013.
Reference Books	
1.	Donald R. Askeland, Pradeep P. Fulay, Wendelin J. Wright, The Science and Engineering of Materials 6th Edition, Cenage Publications, 2010.
2.	G. F. Carter, Giles F. Carter and Donald E. Paul, Materials Science and Engineering, Digital Printing Edition, ASM International, 2011.
3.	William D. Callister, Jr., David G. Rethwisch, Fundamentals of Materials Science and Engineering: An Integrated Approach, 5th Edition International Student Version, Wiley & Sons, 2016.
4.	W Bolton, Materials for Engineering, 2nd Edition, Routledge Publishers, USA, 2011.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Challenging Experiments (Indicative)		
1.	Overview of Materials Characterization – Optical Microscopy, Scanning Electron Microscopy, X-Ray Diffraction and Energy Dispersive X-ray analysis.	2 hours
2.	Perform the metallographic studies and identify the given ferrous/non-ferrous samples.	7 hours
3.	Use metallographic analysis software to establish the phases and average grain size of the given samples.	2 hours
4.	Design the heat treatments that result in the following microstructures (a) Coarse pearlite (b) Medium/Fine pearlite (c) 100% Martensite (d) Martensite and retained austenite.	2 hours
5.	Compare the microstructures of the given steel sample before and after heat treatment. Also measure the hardness of the samples.	3 hours
6.	Perform the hardness examination on the given samples using Rockwell Hardness Tester and find out the equivalent Vickers hardness in HV.	2 hours
7.	Perform the phase analysis using XRD.	2 hours
8.	Conduct the tensile studies on the given sample and infer whether the given sample is ductile or brittle. Evaluate the elastic and plastic properties of the given sample.	2 hours
9.	A fractured sample is given for assessment to interpret the reasons for fracture. What are the various metallurgical tests to be carried out to infer the same?	2 hours
10.	Conduct the corrosion studies on the given sample using electrochemical cell. What is the inference drawn from the polarization curves?	3 hours
11.	Perform high temperature corrosion studies on the given sample at 500°C in air oxidation and analyze the microstructure before and after corrosion.	3 hours
	Total laboratory hours	**30 hours**

Mode of assessment:			
Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	47	Date	05-10-2017

Course code	Manufacturing Processes	L	T	P	J	C
MEE1007		2	0	2	0	3
Pre-requisite	NIL	Syllabus version				
		v. 2.2				

Course Objectives:

1. To identify and explain manufacturing concepts.
To impart students, knowledge on fundamentals concepts in metal casting, welding, and forming processes.
To enable students understand basics of digital printing, powder metallurgy process and fabrication methods for polymer products and glass products.

Expected Course Outcome:

1. Develop suitable casting processes for various materials and components
2. Identify a suitable welding process & Process Parameters for an application
3. Design a suitable metal forming system for making an industrial product
4. Analyse the influence of Process Parameters on the powder metallurgy process
5. Select fabrication method for glass and polymer products
6. Identify suitable manufacturing process for product realisation
7. Fabricate simple components by various manufacturing processes

Module:1	Manufacturing	3 hours

Manufacturing – Role of Manufacturing in the development of a country – classification of manufacturing processes.

Module:2	Casting Processes	3 hours

Casting: Fundamentals of metal casting – Types of patterns – sand mold making –different casting techniques – types of furnaces – Defects in castings – Testing and inspection of castings.

Module:3	Joining processes	6 hours

Fusion welding processes – solid state welding processes – other welding techniques – Welding defects – Testing of welded joints.

Module:4	Metal forming processes	6 hours

Cold and hot working of metals – Bulk metal forming- Sheet metal forming- High Energy Rate Forming processes: Explosive forming- Electro hydraulic forming – Electromagnetic forming.

Module:5	Processing parts made of metal powders, ceramics and glass	3 hours

Powder metallurgy-production of metal powders-stages in powder metallurgy – production of ceramic parts-production of glass parts.

Module:6	**Shaping methods for polymer parts**	**3 hours**
Injection molding-Blow molding – compression molding-transfer molding-thermoforming.		
Module:7	**Process selection**	**4 hours**
Systematic process selection for given parameters – Process selection charts-economic quantity selection.		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)	
1.	Serope Kalpakjian; Steven R. Schmid, Manufacturing Engineering and Technology, 6th Edition, Publisher: Prentice Hall, ISBN-10 0-13-608168-1, ISBN- 13 978-0-13-608168-5, 2013.
Reference Books	
1.	P. N. Rao, Manufacturing Technology (Volume 1) – Foundry, Forging and Welding, 4th Edition, Tata McGraw Hill Education, New Delhi, 2013.
2.	Mikell P. Groover, Fundamentals of Modern Manufacturing Materials, Processes and Systems, Publishers: Wiley India, 2012.
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

List of Challenging Experiments (Indicative)		
1.	Estimation of molding sand properties.	4 hours
2.	Fabrication of Pattern for sand moulding-through conventional, digital manufacturing method.	2 hours
3.	Evaluation of 3D printed pattern over conventional pattern for complex profiles	3 hours
4.	Investigation of casting properties of 3D printed pattern	3 hours
5.	Preparation of sand mould for the given engineering part and investigating the mould properties	2 hours
6.	Comparison of 3D printed pattern and wax pattern for Investment Casting	2 hours
7.	Edge preparation for Butt joint (V, J) & Welding practice by SMAW process and heat input basic calculations.	2 hours
8.	Welding practice on T/Butt joint using MIG/GTAW welding through manual and automation	2 hours
9.	Evaluation of welded joint using NDT and DT	3 hours
10.	Deformation behavior during Rolling	2 hours
11.	Recovery, recrystallization, grain growth & grain size measurement by Quantitative metallography.	2 hours
12.	Ericson cupping test to measure the ductility	3 hours
	Total laboratory hours	**30 hours**
Mode of assessment:		

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	47	Date	05-10-2017

Course code	Mechanics of Solids And Fluids	L	T	P	J	C
MEE1032		3	0	2	0	4
Pre-requisite	NIL	Syllabus version				
		v. 2.2				

Course Objectives:

1. To enable students to understand the concept of stress and strain of deformable bodies of different material properties.
2. To enable the students to understand what are principal stresses and strains to follow various failure theories.
3. To prepare the students to understand fluid properties in order to solve problems of liquids under static and flowing conditions.
4. To demonstrate about flow measurement devices and procedures for various flow network design and multi reservoir problems.

Expected Course Outcome:

Upon successful completion of the course the students will be able to

1. Solve problems of axially loaded members either for stress calculation or load calculation with or without accounting temperature effect..
2. Calculate stress planes in other than the cross section for different loading conditions
3. Analyse the members subjected to bending, torsion, combined bending and torsion and able to solve problems of thin shell vessels.
4. Understand application of manometry during flow measurements.
5. Determine the hydrostatic forces on inclined and curved surfaces and able to find centre of buoyancy and metacentre.
6. Apply the fundamental equations to predict fluid flow and solve problems of fluid kinematics and fluid dynamics.
7. Calculate major and minor losses for flow through pipes and able to solve multi reservoir problems.
8. Experimentally determine the mechanical properties of materials and important hydraulic coefficients.

Module:1	Introduction	6 hours

Introduction - Definition/derivation of normal stress, shear stress, and normal strain and shear strain – Stress-strain diagram- Elastic constants – Poisson's ratio – relationship between elastic constants and Poisson's ratio – Generalised Hook’s law – Uniaxial deformation.

Module:2	Fundamentals of Elasticity and Theories of Failure	6 hours

Stress - Biaxial state of stress – Stress at a point – stresses on inclined planes – Principal stresses and Principal strains and Mohr's circle of stress, Theories of failure - Fundamentals of theory of elasticity – Yield criteria and plasticity

Module:3	**Thin Shells**	**6 hours**
Solid Mechanics applications – Thin shells, torsion, bending, buckling		
Module:4	**Fluid Pressure**	**5 hours**
Pressure, Pressure head, Pressure Measurement- Simple Manometers, Differential Manometers		
Module:5	**Hydrostatic Forces**	**6 hours**
Fluid properties – Hydrostatic forces on plane – inclined and curved surfaces – buoyancy – centre of buoyancy – metacentre.		
Module:6	**Fluid Kinematics**	**7 hours**
Types of fluid flows - Streamline and Velocity potential lines- Euler and Bernoulli's equations and their applications – moment of momentum – Momentum and Energy correction factors – Impulse – Momentum equation-Navier-Stokes Equations-Applications.		
Module:7	**Flow through Pipes**	**7 hours**
Flow through pipes – Open Channels and Measurement pipe flow: Darcy's law – Minor losses – Multi reservoir problems – pipe network design – Moodys diagram – Hagen Poiseuille equation – Turbulent flow.		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**45 hours**

List of Challenging Experiments		
1.	Evaluation of Engineering Stress / Strain Diagram on Steel rod, Thin and Twisted Bars under tension.	3 hours
2.	Compression test on Bricks, Concrete blocks.	3 hours
3.	Deflection test – Verification of Maxwell theorem.	3 hours
4.	Comparison of hardness values of Steel, Copper and Aluminium using Brinell and Rockwell hardness measuring machines.	3 hours
5.	Estimation of Spring Constant under Tension and Compression.	3 hours
6.	Flow through Orifice	3 hours
7.	Flow through Mouth Piece	3 hours
8.	Flow through Triangular Notch	3 hours
9.	Flow through Venturimeter	3 hours
10.	Flow through Pipe	3 hours
	Total Laboratory Hours	**30 hours**

Text Book(s)			
1.	P.N.Modi and S.M.Seth, (2011), Hydraulics and Fluid Mechanics including Hydraulic Machines, Standard Book House		
Reference Books			
1.	Timoshenko, S.P. and Young, D.H., (2011), Strength of Materials, East West Press Ltd.		
2.	R.K. Bansal, (2017), Strength of Materials, Laxmi Publications		
3.	D.S. Kumar, (2013) Fluid Mechanics and Fluid Power Engineering, Katson Publishing House, Delhi		
4.	Rowland Richards, (2000) Principles of Solid Mechanics, CRC Press		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	47	Date	05-10-2017

Course code	Automotive Electricals	L	T	P	J	C
MEE1035		3	0	0	0	3
Pre-requisite		Syllabus version				
		v. 1.0				

Course Objectives:

To help students to gain essential and basic knowledge of automotive electrical systems and working principle with necessary design requirement as per the testing standards, so as to equip them with knowledge required for the automotive electrical development.

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1. Learn about the wiring of an automobile
2. Understand the construction and working of batteries
3. Understand the working of charging and starting systems
4. Knowledge about the need and working of ignition systems
5. Understand the working of lighting system
6. Gain the skills on the recent development in the area of automotive electricals

Module:1	Fundamentals of Automotive Wiring:	6 hours

Introduction to electrical fundamentals – Ohm's Law, Kirchhoff's Law, Capacitance and Inductance, Simple Electric Circuits, Automotive Wiring Harnesses, Insulated and Earth Return System, Positive and Negative Earth Systems, Connectors and its types

Module:2	Automotive Batteries	6 hours

Principle and construction of Lead Acid Battery, Nickel – Cadmium Battery, Nickel Metal, Hybrid Battery, Sodium Sulphur Battery and Aluminum Air Battery-Choice of Batteries for automotive applications

Module:3	Battery Characteristics	5 hours

Characteristics of Battery, Battery Rating, Capacity and Efficiency, Various Tests on Battery, Battery– Charging Techniques. Maintenance of batteries.

Module:4	Starting System and Electric Drives	6 hours

Requirements of Starter Motor, Starter Motor types, construction and characteristics, Starter drive mechanisms, Starter Switches and Solenoids.
Brushless DC Motor, speed control, Brushless PM Motor for electric vehicles

Module:5	Charging Systems	6 hours

Charging system components, Generators and Alternators, types, construction and Characteristics, Voltage and Current Regulation, Cut –out relays and regulators, Charging circuits for D.C. Generator, A.C. Single Phase and Three – Phase Alternators

Module:6	Ignition Systems	6 hours

Spark Plugs, Constructional details and Types, Battery Coil and Magneto–Ignition System Circuit details and Components, Centrifugal and Vacuum Advance Mechanisms, Non–Contact–type Ignition Triggering devices, Capacitive Discharge Ignition, Distributor–less Ignition

System.			
Module:7	**Lighting Systems**		**6 hours**
Head Lamp and Indicator Lamp construction and working details, Focusing of head lamps, Anti–Dazzling and Dipper Details, Automotive Wiring Circuits**.**			
Module:8	**Contemporary issues:**		**4 hours**
Electromagnetic Compatibility and its suppression techniques, Hybrid Vehicles			
	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	Tom Denton, "Automotive Electrical and Electronic Systems", Routledge, 2012 ISBN: 9780080969428
Reference Books	
1.	Crouse.W.H., "Automobile Electrical Equipment", McGraw Hill Book Co Inc.NewYork,2005
2	Judge.A.W., "Modern Electrical Equipments of Automobiles", Chapman & Hall, London, 2004.
3	Robert Bosch, "Automotive Handbook", Bently Publishers,2004
4	Young, A.P. and Griffith, S.L., "Automobile Electrical Equipments", ELBS and New Press, 1999
5	Kholi .P.L, "Automotive Electrical Equipment", Tata McGraw-Hill co ltd, New Delhi,2004

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course code	Automotive Chassis	L	T	P	J	C
MEE1036		3	0	2	0	4
Pre-requisite	nil	Syllabus version				
		v. 1.1				

Course Objectives:

1. To gain the basic knowledge about the vehicle frame.
2. To help the students to identify the various type of steering systems.
3. To understand the different types of drive line and final drive.
4. To study the fundamental and working of different types of suspension systems, wheels and tyres.
5. To acquire the fundamental knowledge about the braking systems.
6. To enable the students to apply the knowledge of automotive chassis to develop modern vehicle parts.

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1. Possess the knowledge about various vehicle frames and vehicle sub systems
2. Know the suitable steering system for different vehicles application.
3. Familiarize the various axles and drive line systems for automobiles
4. Evaluate the different type of suspension system and brake performances.
5. Select suitable wheels and tires according to the application.
6. Apply the fundamental knowledge to develop modern vehicle systems.

Module:1	Chassis Layouts and Frames	5 hours

Types of Chassis Layout with reference to Power Plant Location and Drive, Automotive Frames - Material Selection and its Constructional Details, Various types, Different Loads acting on Frame, Testing of Automotive Frames.

Module:2	Steering System	6 hours

Types of Front Axles and Stub Axles, Front Wheel Geometry, Condition for True Rolling Motion of Wheels during Steering, Steering Mechanisms, Steering Error Curve, Steering Linkages, Different Types of Steering Gears, Slip Angle, Over Steer and Under Steer, Reversible and Irreversible Steering, Power Assisted Steering.

Module:3	Drive Line	6 hours

Propeller Shaft - Design Considerations & Constructional Details, Universal Joints, Constant Velocity Joints, Hotchkiss Drive, Torque Tube Drive, Radius Rods and Stabilizers, Final drive - Different types, Multiaxled Vehicles, Differential - Working Principle and Constructional Details, Non–Slip Differential, Differential Locks.

Module:4	Suspension System	6 hours

Need for Suspension System, Types of Suspension Springs, Constructional details and Characteristics of Single Leaf, Multi Leaf, Coil, Torsion bar, Rubber, Pneumatic and Hydro – elastic Suspension Systems, Independent Suspension System, Shock Absorbers - Types and Constructional details.

Module:5	Braking Systems	6 hours

Stopping Distance, Braking Efficiency, Weight Transfer during Braking, Drum Brakes - Constructional Details, Leading and Trailing Shoe, Braking Torque, Disc Brake - Types and Constructional Details, Relative advantages and disadvantages over Disc Brakes. Hydraulic Braking System, Pneumatic Braking System, Power–Assisted Braking System, Servo Brakes, Retarders, Types and Construction.		
Module:6	**Axles**	**5 hours**
Axles – Live and Dead Axles, Constructional Details, Different Types of Loads acting on Drive Axles, Rear Axle Shaft Supporting Types: Semi Floating, Full Floating, Three Quarter Floating, Axle Housings and Types.		
Module:7	**Wheels and Tyres**	**6 hours**
Types of Wheels, Construction, Structure and Function, Wheel Dimensions. Structure and Function of Tyres, Static and Dynamic Properties of Pneumatic Tyres, Types of Tyres, Materials, Tyre Section & Designation, Factors affecting Tyre Life, Quick Change Wheels, Special W**heels**		
Module:8	**Recent Trends in Chassis Systems**	**5 hours**
Special Steering Columns, Four Wheel Steering, Variable Ratio Steering System, Steer by Wire, Electric Power Steering, Anti–Lock Braking System, Traction Control Systems, Electronic Brake force Distribution Systems.		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	K.V James, D Halderman (2013) “Automotive Chassis Systems” 6th Edition, Prentice Hall Publisher.
Reference Books	
1.	James E Duffy (2011) “Modern Automotive Technology”, Goodheart-Willcox; Seventh Edition.
2	Jack Erjavec (2009) “Automotive Technology – A systems approach”, Cengage Learning.
3	William H. Crouse and Donald L. Anglin (2007) Automotive Mechanics, 10th edition.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Mode of assessment:			
Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course code	Automotive Electronics	L	T	P	J	C
MEE1037		3	0	0	4	4
Pre-requisite	nil	Syllabus version				
		v. 1.2				

Course Objectives:

1. The students can learn basic knowledge about function of electronics and logic devices .
2. The students able to known about interfacing sensors and actuators with microcontrollers.
3. The students can know the different types, automotive sensors and actuators.
4. The student will be well versed in the engine management systems and vehicle management systems

Expected Course Outcome:

1. To impart basic knowledge about the fundamental electronic devices and logic circuits.
2. To acquire the different sensors and actuator interfacing with microcontroller.
3. Acquire different automotive sensors working principles and its applications.
4. To acquire the different automotive actuators working principle and its applications.
5. To analyze the effects of fuel injection control and engine open loop and close loop control system.
6. To understand the modern vehicle management system and their requirements.

Module:1	Fundamentals:	7 hours

Introduction to diodes, Zener diode, BJTs, MOSFETs, IGBTs, SCRs, DIAC/TRIACs and GTOs; forward and reverse characteristics, Break down characteristics and their applications.

Module:2	Logic Circuits:	5 hours

Basic Logic Circuit Concepts, Representation of Numerical Data in Binary Form- Memory Types

Module:3	Microcomputers:	7 hours

Buses, memory, timing, CPU registers; Microprocessor architecture: Initialization, operation codes, program counter, branch and jump instructions, subroutine. Analog to digital converters and Digital to analog converters, sampling, polling and interrupts, digital filters, lookup table.

Module:4	Pressure and Temperature Sensors:	7 hours

Speed sensors, Pressure sensors: Manifold Absolute Pressure sensor, knock sensor, Temperature sensors: Coolant and Exhaust gas temperature, Exhaust Oxygen level sensor.

Module:5	Position Sensors and Actuators:	7 hours

Position sensors: Throttle position sensor, accelerator pedal position sensor and crankshaft position sensor, Air mass flow sensor. Solenoids, stepper motors and relays

Module:6	Engine Management System	6 hours

Electronic engine control: Input, output and control strategies, electronic fuel control system, fuel control modes: open loop and closed loop control at various modes, EGR control, Electronic ignition systems – Spark advance correction schemes, fuel injection timing control.			
Module:7	**Vehicle Management Systems:**		**6 hours**
Cruise control system, Antilock braking system, electronic suspension system, electronic steering control, traction control system, Transmission control system			
	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	William B Ribbens, "Understanding Automotive Electronics: An Engineering Perspective", Newne Butterworth- Heinermann, 7th edition 2012
1.	Robert Bosch "Automotive Hand Book", SAE (8th Edition), 2011.
2	Tom Denton, "Automobile Electrical and Electronic Systems" 4th edition- Routledge - 2012.
3	Barry Hollembeak, "Automotive Electricity and Electronics", Delmar Cengage Learning; 5th edition, 2011
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course code	Machine Drawing	L	T	P	J	C
MEE2001		1	0	4	0	3
Pre-requisite	MEE1001	Syllabus version				
		v. 2.2				

Course Objectives:

1. To understand and apply national and international standards while drawing machine component.
2. To understand the concept of various tolerances and fits used for component design
3. To familiarize in drawing assembly, orthographic and sectional views of various machine components.

Expected Course Outcome:

Upon successful completion of the course the students will be able to

1. Apply the national and international standards in machine drawing.
2. Apply limits and tolerances to assemblies and choose appropriate fits.
3. Prepare production drawings with geometrical dimensioning and tolerances
4. Assign machining and surface finish symbols.
5. Prepare production drawings with geometrical dimensioning and tolerances
6. Illustrate various machine components through drawings.

Module:1	Basics of Machine Drawing	4 hours

Introduction – Projections - Classifications of machine drawing- BIS specifications - Sectioning – Dimensioning methods: Counter Sink, Counter Bores, Spot Faces, Chamfers, Screw Threads, Tapered Features, Title block of Industrial drawing and Bill of Materials.

Module:2	Limits and Fits	2 hours

Classifications and of Fits, Selection of Fits, Representation on Drawings, Tolerance Grade, Computations of Tolerance, Positions of Tolerance, Fundamental of Deviations, Shaft and Hole Terminology, Method of placing limit dimensions.

Module:3	Geometrical Tolerances	2 hours

Need of Geometrical Tolerance, Geometrical Characteristics of Symbols, Indication of MMC, LMC, Interpretation and Indication of Geometrical Tolerance and Dimensioning.

Module:4	Conventional Representations	2 hours

Materials - Interrupted views and Braking of Shaft, Pipe, Bar - Surface finishing & Machining Symbols.

Module:5	**Screwed Fastenings and Joints**	**3 hours**
Screwed Fastenings - Screw Thread Nomenclature and types, Joints: Bolts and Nuts, Key, Cotter, Riveted, Pin, Welded joints. Pulleys and Couplings.		
Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**15 hours**

Text Book(s)	
1.	Bhatt, N.D., Machine Drawing, 50th edition, Charotar Publishing House Pvt. Ltd., India, 2014.
Reference Books	
1.	Ajeet Singh, Machine drawing, 2nd edition, Tata McGraw Hill, India, 2012.
2.	K.L. Narayana, Machine Drawing, 4th edition, New Age International publisher, India, 2014.
3.	K.C. John, Text book on Machine Drawing, 2nd edition, PHI Learning Pvt, Ltd, India, 2010.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)		
1.	Introduction to CAD Packages and demonstration of part modeling, assembly and detailed with simple examples to familiarize CAD Packages. Sketcher constraints, basic 3D commands to be used for drawing machine components.	4 hours
2.	Visualization of machine components and its assemblies.	2 hours
3.	CAD modeling of shaft, bearings, fasteners, couplings, gears, keys, rivets, springs and pulleys –user defined, customization using catalogues.	4 hours
4.	Part modeling, assembling and detailed drawing of Shaft joints: Cotter joint and Knuckle joint.	8 hours
5.	Part modeling, assembling and detailed drawing of Keys and Shaft coupling: Flanged and Universal coupling.	8 hours
6.	Part modeling, assembling and detailed drawing of Shaft Bearing: Plummer block and Footstep bearing.	8 hours
7.	Part modeling, assembling and detailed drawing of Pulleys: Belt pulley, V belt pulley, Fast and loose pulley and Speed cone pulley.	8 hours
8.	Part modeling, assembling and detailing of machine components: Tailstock and Bench Vice.	8 hours
9.	Part modeling, assembling and detailing of I.C engine connecting rods.	6 hours
10.	Part modeling, assembling and detailing of Real time machine components.	4 hours
	Total Laboratory Hours	**60 hours**

Mode of assessment:

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	47	Date	05-10-2017

Course code	Mechanics of Machines	L	T	P	J	C
MEE2004		2	2	2	0	4
Pre-requisite	MEE1002	Syllabus version				
		v. 2.2				

Course Objectives:

1. To impart students' knowledge about forces acting on machine parts.
2. To enable students to understand the fundamental concepts of machines.
3. To facilitate students to understand the functions of cams, gears and fly wheels.
4. To make students to get an insight into balancing of rotations and reciprocating masses and the concepts of vibration.

Expected Course Outcome:

Upon successful completion of the course the students will be able to

1. Apply different mechanisms for designing machines.
2. Compute velocity and acceleration of various plan mechanisms.
3. Apply the principles for analyzing cams, gears and gear trains.
4. Synthesize mechanisms for doing useful work.
5. Analyze dynamic forces acting on mechanism.
6. Balance rotating and reciprocating masses and reduce vibrations.
7. Analyze gyroscopic effects on aeroplanes, ships and automobiles.
8. Measure and analyze free, forced and damped vibrations of mechanical systems.

Module:1	Basics of Mechanisms	3 hours

Introduction - Terminologies, Degree of Freedom - Study of planar mechanisms and their inversions.

Module:2	Velocity and Accelerations in Mechanisms	5 hours

Velocity and accelerations in planar mechanisms, Coriolis component of acceleration

Module:3	Kinematics of Cams, Gears and Gear Trains	4 hours

Cams with different Follower Motion, Gear terminologies - Law of gearing - Interference and undercutting - Epicyclic gear train

Module:4	Synthesis of mechanisms	3 hours

Two position and Three position synthesis of planar mechanism - Graphical and analytical methods - Freudenstein equation

Module:5	**Dynamic Force Analysis**	**5 hours**
D'Alembert's Principle, Dynamic Analysis of planar Mechanism. Turning Moment Diagrams - Fly Wheels - Applications.		
Module:6	**Balancing and Vibration**	**5 hours**
Static and Dynamic Balancing of Rotating Masses, Balancing of Reciprocating Masses, Introduction to vibration - Terminologies - Single degree of freedom- damped and undamped- free and forced vibration		
Module:7	**Mechanisms for Control & Gyroscope**	**3 hours**
Governors- types and its characteristics, Gyroscopic Effects on the Movement of Air Planes and Ships – Gyroscope Stabilization		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)	
1.	S. S. Rattan, "Theory of Machines", Tata McGraw Hill, 2015
Reference Books	
1.	Joseph Edward Shigley and John Jospeh Uicker JR, Theory of Machines and Mechanisms SI Edition, Oxford University Press, 2014
2.	R L Norton, Kinematics and Dynamics of Machinery, McGraw-Hill Education, 2017
3.	R L Norton, Design of Machinery: An Introduction to the Synthesis and Analysis of Mechanisms and Machines, McGraw-Hill Higher Education, 2011

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)		
1.	Identification of kinematic links, pairs and chains in a mechanism	3 hours
2.	Determination of moment of inertia and angular acceleration of the flywheel	3 hours
3.	Static and dynamic analysis on geared system and gear train system	3 hours
4.	Analysis of Cam and plotting the Cam profile for different cam and follower	3 hours
5.	Free vibration of spring mass system and simple pendulum	3 hours
6.	Determination of Gyroscopic couple on a rotating disc	3 hours
7.	Determination of equilibrium speeds on Governors - Watt's, Porter and Proell Governor	3 hours
8.	Balancing of Rotating and reciprocating masses	3 hours
9.	Radius of Gyration of bifilar system	3 hours
10.	Whirling in different horizontal shafts with different fixings	3 hours
	Total Laboratory Hours	**30 hours**

Mode of assessment:			
Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	47	Date	05-10-2017

Course code	Thermal and Heat Transfer	L	T	P	J	C
MEE2038		2	2	0	0	3
Pre-requisite	MEE1003	Syllabus version				
		v. 1.1				

Course Objectives:

1. To enable the students understanding the working of air compressor, steam nozzles and various refrigeration and air-conditioning systems.
2. To teach the students to comprehend and evaluate various modes of heat transfer.
3. To familiarise the students with the design and operation of heat exchangers, fins etc.
4. To enable the students to understand the phenomena of boundary layers, condensation and boiling.

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1. Design and analyse reciprocating air compressors
2. Explain and analyse performance of steam nozzles under different back pressures
3. Design different components of refrigeration systems.
4. Calculate cooling load requirement for the conditioned space
5. Apply basic principles of fluid mechanics, thermodynamics and heat transfer for analysing heat transfer systems.
6. Select and use relevant correlations and charts for solving steady and transient heat transfer problems including automobile heat transfer.

Module:1	Reciprocating Compressors	4 hours

Reciprocating compressors – Construction – Working – Effect of clearance volume – Multi staging – Volumetric efficiency - Isothermal efficiency.

Module:2	Steam Nozzles	3 hours

Steam Nozzle – One-dimensional steady flow of steam through a convergent and divergent nozzle – Equilibrium and Meta stable flow.

Module:3	Refrigeration Systems	4 hours

Reverse Carnot cycle - Bell-Colman's cycle – Vapor compression cycle – Components – Working – P-H and T-S diagrams – Calculation of COP – Effect of sub-cooling and super-heating – Vapour absorption system.

Module:4	Air Conditioning Systems	4 hours

Psychometric - Processes – Chart – Summer and winter air conditioning – Cooling load calculations – SHF – RSHF – GSHF – ESHF components used in air conditioner – Types of air conditioning units.

Module:5	Conduction	4 hours

Basic modes of heat transfer, General heat conduction Equation in Cartesian Coordinates, Steady state heat transfer in simple geometries with and without heat generation. Unsteady state heat transfer, Extended surfaces. Heat exchangers, LMTD and NTU methods of calculations in heat

exchanger analysis.		
Module:6	**Convection**	**5 hours**
Convective heat transfer, Newton's law, Hydrodynamic and thermal boundary layer, External and internal flow heat transfer under fully developed laminar flow. Natural convection from vertical plates, Empirical relations in convective heat transfer.		
Module:7	**Radiation**	**4 hours**
Radiation Heat transfer, Fundamental laws of radiation, Radiation heat exchange between bodies of simple geometry. Electric network analogy in radiation heat transfer. Introduction to boiling and condensation.		
Module:8	**Contemporary issues:**	**2 hours**
Air Compressors in Automobiles, Heat Transfer in Vehicles.		
	Total Lecture hours:	**30 hours**

Text Book(s)	
1.	Yunus A. Cengel, "Introduction to Thermodynamics and Heat Transfer", 2nd Edition McGraw-Hill, 2008.
Reference Books	
1.	McConkey and Eastop, "Applied Thermodynamics", Adission Wesly, 1999.
2	P. K. Nag, "Heat Transfer", Tata McGraw Hill , New Delhi, 2003.
3	J.P., Holman, "Heat Transfer", Ninth Edition, Tata McGraw Hill, New Delhi, 2005.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course code	Automotive Transmission System	L	T	P	J	C
MEE2039		2	0	0	4	3
Pre-requisite	MEE1036	Syllabus version				
		v. 1.0				

Course Objectives:

1. To help students gain essential and basic knowledge of different transmission systems and components.
2. To develop skills in design and maintenance of transmission equipment.
3. To enable the students to apply the knowledge of energy conversions to come up with power saving potentials in transmission system components.
4. To gain knowledge of latest transmission system components.

Expected Course Outcome:

1. Describe the working of manual, automatic and semi-automatic transmission systems.
2. Assess the transmission systems required for the any given vehicle.
3. Estimate the transmission system efficiency and arrive at power saving opportunities.
4. Explain the role of transmission components in improving the performance of the vehicle.
5. Knowledge and design of hydrostatic and electric drives
6. Latest technology in transmission systems including hybrid vehicles

Module:1	Clutch	4 hours

Need and requirement of clutch, types of clutches, friction clutches – Single plate clutch, multi plate clutch, cone clutch, centrifugal clutch, electromagnetic clutch, hydraulic clutches, fluid coupling.

Module:2	Traction and Tractive Efforts	4 hours

Various Resistances to Motion of the Automobile, Traction, tractive effort Performance curves, acceleration grade ability, drawbar pull.

Module:3	Gear Box	4 hours

Necessity of gear box, 3-speed & 4-speed gear boxes, Constructional details of sliding-mesh gear box, constant-mesh gear box, synchromesh gear box, overdrive.

Module:4	Torque Converters	4 hours

Principal of torque conversion, single, multi stage and polyphase torque converters, performance characteristics, constructional and operational details of typical hydraulic transmission drives.

Module:5	Automatic Transmission	4 hours

Relative merits and demerits when compared to conventional transmission – epicyclic and hydromatic transmission – Ford T-model, Cotal and Wilson Gear box - continuously variable transmission – Semi automatic transmission.

Module:6	**Hydrostatic and Electric Drives**	**4 hours**
Hydrostatic Drives: Advantages and disadvantages, principles of hydrostatic drive systems, construction and working of typical hydrostatic drives, Janney Hydrostatic drive. Electric Drives: Advantages and limitations, principles of Ward Leonard system of control Modern electric drive for buses and performance characteristics.		
Module:7	**Latest technologies**	**4 hours**
Power transmission for hybrid vehicle – dual clutch transmission – automated manual transmission - Ford and Chevrolet drive.		
Module:8	**Contemporary issues:**	**2 hours**
Automatic control of gear box.		
	Total Lecture hours:	**30 hours**

Text Book(s)	
1.	Fischer and Pollack, “The Automotive Transmission Book”, Springer, 2014
Reference Books	
1.	Newton K and Steeds. W. “The Motor Vehicle”, Butter Worth’s & Co., Publishers Ltd, 2001.
2	Automatic vehicle transmission, John Wiley Publications 1995
3	Crouse. W.H., Anglin., D.L., "Automotive Transmission and Power Trains construction ",
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course code	Automotive Engines	L	T	P	J	C
MEE3015		3	0	2	0	4
Pre-requisite	MEE2038	Syllabus version				
		v. 1.0				

Course Objectives:

To help students to gain essential and basic knowledge of engine and working principle and their sub-systems with necessary instruments to measure performance as per the testing standards, so as to equip them with knowledge required for the engine development.

Expected Course Outcome:

1. Understand the construction and working of the engine.
2. Understand the fuel systems used in SI and CI engines
3. Gain knowledge on combustion in SI and CI engines
4. Understand the various types of combustion chambers used in SI and CI engines.
5. Understand the lubrication and cooling system in engines.
6. Knowledge about the instrumentation used to measure engine performance and testing standards.
7. Understand the recent development in the area of engines.

Module:1	Construction and Working	3 hours

Review of Otto, diesel and dual cycles. Construction and working: spark ignition (SI) and compression ignition (CI) engines - Two stroke SI and CI engines. Comparison of SI and CI engines and four stroke and two stroke engines. Engine classification, firing order.

Module:2	Fuel System for SI Engines	9 hours

Air fuel ratio requirements of SI engines, Air fuel ratio and emissions, Working of a simple fixed venturi carburetor, Constant vacuum carburetor and modern carburetor.

Module:3	Fuel System for CI Engines	7 hours

Diesel fuel injection systems-Jerk pumps, distributor pumps, pintle and multi-hole nozzles, Unit injector and common rail injection systems, Fuel Filters, Governors

Module:4	Combustion in Engines	4 hours

Combustion in SI and CI engines and stages of combustion, Ignition delay period, Knock in SI and CI engines.

Module:5	Combustion Chambers	5 hours

Combustion chambers for SI and CI engines. Direct and indirect injection combustion chambers for CI engines. Importance of Swirl, squish and turbulence. Factors controlling combustion chamber design

Module:6	Engine Subsystem	5 hours

Need for cooling, types of cooling systems and its working, Properties of coolants. Requirements of lubrication systems. Types of lubricating systems and its working,

Properties of lubricants. Supercharging and Turbocharging – types - working – control			
Module:7	**Engine Testing**		**2 hours**
Dynamometers, Indicated thermal, brake thermal and volumetric efficiencies. Measurement of friction, Cylinder pressure measurement. Heat Balance, Engine performance maps, Engine testing standards**.**			
Module:8	**Contemporary issues:**		**2 hours**
Multi Point fuel injection systems, Variable GeometryTurbo charger, Multi fuel engines			
	Total Lecture hours:	**37 hours**	

Text Book(s)	
1.	John B Heywood, "Internal Combustion Engine Fundamentals", McGraw Hill Education, 2011
Reference Books	
1.	V. Ganesan, "Internal Combustion Engine",4th Edition McGraw Hill Education, 2012
2	Richard Stone, "Introduction to InternalCombustion Engines", Palgrave Macmillan, 4th
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

List of Challenging Experiments (Indicative)		
1.	Internal combustion engine handbook-basics, components, systems and perspectives	3 hrs
2.	The potential of di-methyl ether (DME) as an alternative fuel for compression-ignition engines	3 hrs
3.	Experimental and theoretical investigation of using gasoline– ethanol blends in spark-ignition engines	3 hrs
4.	Combustion control technologies for direct injection SI engine	3 hrs
5.	Adaptive neural network model based predictive control for air–fuel ratio of SI engines	3 hrs
6	Simultaneous attainment of low fuel consumption high output power and low exhaust emissions in direct injection SI engines	3 hrs
7	Performance and emission characteristics of a diesel engine using iso-butanol–diesel fuel blends	3 hrs
8	Ammonia/hydrogen mixtures in an SI-engine: Engine performanceand analysis of a proposed fuel system	3 hrs
9	Engine performance and pollutant emission of an SI engine usingethanol–gasoline blended fuels	3 hrs
10	An experimental study on performance and emission characteristics of a hydrogen fuelled spark ignition engine	3 hrs
	Total Laboratory Hours	**30 Hrs**

Mode of assessment:			
Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course code	Fuels and Combustion	L	T	P	J	C
CHE 2006		3	0	0	0	3
Pre-requisite	Nil	Syllabus version				
		1.2				

Course Objectives:

1.Develop the understanding levels of fuels and combustion fundamentals
2. Classify and introduce different types of fuel and fuel analysis techniques that assists the students to choose most convenient fuel for a process involving combustion`
3. Engage the students in designing various control techniques for handling various environmental issues resulting from combustion of fuels

Expected Course Outcome:

1. Understand the various types of fuels like liquid, solid and gaseous fuels available for firing in boilers and furnaces
2. Select the right type of fuel depends on various factors such as availability, storage, handling, pollution and cost of fuel
3. Understand the fuel properties and efficient use of the fuel
4. Know various analyses of exhaust and flue gases
5. Understand various combustion equipment

Module:1	Classification and Properties of Fuels 5 hours	5 hours

Fuels-Types and characteristics of fuels-Determination of properties of fuels-Fuel analysis-Proximate and ultimate analysis-Calorific value (CV)-Gross and net calorific values (GCV,NCV)-Bomb Calorimetry-empirical equations for CV estimation

Module:2	Solid Fuels	6 hours

Origin of coal-Ranking of coal-Washing, cleaning and storage of coal-Renewable Solid Fuelscomparative
study of Solid, liquid and gaseous fuels-selection of coal for different industrial applications-carbonization of coal

Module:3	Liquid fuels	6 hours

Origin of crude oil-composition of crude petroleum-classification of crude petroleum-Removal of salt from crude oil-processing of crude petroleum-Fractionation distillation-ADU and VDUCracking-
Hydrotreatment and Reforming

Module:4	Gaseous fuels	6 hours

Rich and lean gas-Wobbe index-Natural gas-Dry and wet natural gas-Foul and sweet NG-LPGLNG-CNG-Methane-Producer Gas-Water gas-Coal Gasification-Gasification Efficiency

Module:5	**Combustion**	**7 hours**
General principles of combustion-types of combustion processes-Combustion chemistry-Combustion equations-Kinetics of combustion-combustion of solid fuels-Combustion calculations-air fuel ratio-Excess air calculations		
Module:6	**Combustion Equipment**	**7 hours**
Analysis of flue gases by Orsat apparatus-Combustion of solid fuels-grate firing and pulverized fuel firing system-Fluidized bed combustion-Circulating fluidized bed boiler-Burners-Factors affecting burners and combustion		
Module:7	**Air Pollution**	**6 hours**
Types of pollution-Combustion generated air pollution-Effects of air pollution-Pollution of fossil fuels and its control-Pollution from automobiles and its control		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Kenneth K.K., Principles of Combustion, 2nd ed., Wiley Publications, USA, 2012
	2. Phillips H.J., Fuels-solid, liquid and gases–Their analysis and valuation, 1st ed., Foster
1.	Speight J.G., The Chemistry and Technology of Coal, 3rd ed., Taylor and Francis Ltd., USA,2016
2.	Sarkar S., Fuels and combustion, 3rd ed., Universities Press, India, 2009

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Mode of assessment:

Recommended by Board of Studies	15-04-2019		
Approved by Academic Council	No. 55th	Date	13-06-2019

Course code	Fuel Cells	L	T	P	J	C
MEE1013		3	0	0	0	3
Pre-requisite	PHY1001	Syllabus version				
		v. 1.1				

Course Objectives:

1. To help students gain essential and basic knowledge of various types of Fuel cells, so as to equip them with knowledge required for the design of component of Fuel cells.
2. To train the students with the performance evaluation of alternative energy systems.
3. To equip the students to analyse various components of Fuel cells.
4. To impart knowledge of environmental issues related to Fuel cells.
5. To understand the working of Standalone Fuel cells and hydrogen storage devices.

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1. Analyse the energy scenario of our country
2. Describe the working principles of Fuel cells and its component.
3. Estimate the performance parameters of Fuel cells
4. Develop clear understanding about functioning and types of Fuel cells
5. Design structural & thermo-chemical subsystems of Fuel cells.
6. Evaluate the cost of generation and economics of Fuel cells
7. Assess environmental impact of Fuel cells

Module:1	Introduction	5 hours

Basic structure, critical functions of components –fuel cell stacking- fuel cell systems types- advantages and disadvantages – applications and status

Module:2	Fuel Cell Performance	7 hours

Thermodynamic aspects of Electrochemical Energy conversion- Cell efficiency – Factors affecting the efficiency of Electrochemical Energy conversion

Module:3	Alkaline Fuel cells (AFC)	6 hours

Principle of operation – modules- fuel cell stacks-general performance characteristics- Attempts towards advancements-Ammonia as AFC fuel System issues Electrodes: materials and manufacturing- Stacks and systems- Factors affecting the performance of PAFC

Module:4	Solid Oxide Fuel Cells (SOFC) and Molten Carbonate Fuel Cells	6 hours

Cell components- Anode and Cathode materials- Interconnectsseals- Configurations and performance- Environmental impacts - General principle- Cell components- Mechanisms of Electrode
reactions

Module:5	**Direct Methanol Fuel cells and Proton Exchange and Membrane Fuel Cells (PEM)**	**6 hours**
Catalyst and Non catalyst aspects- Methanol cross over- Catalyst aspects and scale up- Engineering aspects - Scientific aspects and challenges- Modelling- Milestones in technology development- Approaches and challenges to high temperature operations.		
Module:6	**Fuel Processing and Hydrogen storage**	**6 hours**
Processing hydrogen from alcohols- producing hydrogen from hydrocarbons- Hydrogen from other sources- Gas clean up- Hydrogen storage- Methods of Hydrogen storage- Hydrogen as Engine storage		
Module:7	**Fuel Cell systems**	**7 hours**
Introduction to fuel cell power conditioning systems- Various options- Fuel cell systems fuelled by Natural gas (PEFC, PAFC, MCFC systems)- Coal fuelled fuel cell system-Combined fuel cell and Gas turbine system- Hybrid fuel cell systems-Hybrid electric vehicles		
Module:8	**Contemporary Discussions**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Viswanathan.B and Aulice Scibion (2008), Fuel Cells: Principles and applications, CRC Press
2.	Ryan O'Hayre, Suk-Won Cha, Whitney Colella, Fritz B. Prinz (2016), Fuel Cell Fundamentals, John Wiley & Sons. Print ISBN:9781119113805
Reference Books	
1.	Bent Sorensen (2011) Hydrogen and Fuel cells, Academic Press
2.	Noriko Hikosaka Behling (2012), Fuel cells, Elsevier Publishers

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	17/08/2017		
Approved by Academic Council	47	Date	05-10-2017

Course code	Industrial Engineering and Management	L	T	P	J	C
MEE1014		3	0	0	0	3
Pre-requisite	NIL	Syllabus version				
		v. 2.2				

Course Objectives:

1. To analyze different planning activities needed during the operations stage of a manufacturing or a service industry.
2. To apply productivity techniques for achieving continuous improvement.

Expected Course Outcome:

Upon successful completion of the course the students will be able to

1. Analyze the way price of a product affects the demand for a product for consequent actions and predict demand for a product by making use of different demand forecasting techniques.
2. Explain Break even analysis to determine safe production levels and costing of industrial products.
3. Apply productivity techniques for continuous improvement in different functionalities of an industry.
4. Analyze the existing operations that happen in factories for establishing time standards for different activities.
5. Demonstrate the knowledge of selection of location for the new plant & optimizing the layout within the plant for smooth production.
6. Apply cellular manufacturing concepts in industry.
7. Compute material requirement needed to satisfy the Master Production Schedule of a factory by having thorough understanding of MRP logic.

Module:1	Introduction to macro and micro economics	6 hours

Macro-economic measures – micro economics – Demand and supply – Determinants of demand and supply – Elasticity of demand – Demand forecasting techniques (short term & long term) – Problems.

Module:2	Elements of cost	6 hours

Determination of Material cost - Labour cost – Expenses - Types of cost – Cost of production – Over-head expenses–break even analysis - Problems.

Module:3	Productivity	6 hours

Definition – Factors affecting- Increasing productivity of resources - Kinds of productivity measures - Case study.

Module:4	Introduction to work study	6 hours

Method study – Time study – stopwatch time study – Work measurement - performance rating-allowances – Ergonomics.		
Module:5	**Plant location and Plant layout**	**7 hours**
Plant location –need - Factors – comparison – quantitative methods for evaluation Plant layout: objectives-principles – factors influencing – tools and techniques including computer based layout design – CRAFT, ALDEP, CORELAP.		
Module:6	**Cellular Manufacturing**	**6 hours**
Group Technology – Cellular layout – Machine-Part Cell Formation (MPCF) – Heuristic approaches – Hierarchical clustering for MPCF.		
Module:7	**Material requirement Planning (MRP)**	**6 hours**
Objectives – functions – MRP system – MRP logic – Management information from MRP – lot sizing consideration – Manufacturing resource planning – capacity requirement planning (CRP) – Bill of material.		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	R Dan Reid, and Nada R. Sanders, Operations Management, John wiley& Sons, 5th Edition, 2012.
Reference Books	
1.	William J Stevenson, Operations Management, McGrawHill, 12th Edition, India, 2017.
2.	R Panneerselavam, Production and Operations Management, PHI publications 3rd Edition, 2012.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Mode of assessment:			
Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	47	Date	05-10-2017

Course code	Operations Research	L	T	P	J	C
MEE1024		2	2	0	0	3
Pre-requisite	MAT2001	Syllabus version				
		v. 2.2				

Course Objectives:

1. To provide students the knowledge of optimization techniques and approaches.
2. To enable the students apply mathematical, computational and communication skills needed for the practical utility of Operations Research.
3. To teach students about networking, inventory, queuing, decision and replacement models.

Expected Course Outcome:

Upon successful completion of the course the students will be able to

1. Apply operations research techniques like L.P.P, scheduling and sequencing in industrial optimization problems.
2. Evaluate transportation problems using various OR techniques.
3. Explain various OR models like Inventory, Queuing, Replacement, Simulation, Decision etc. and apply them for optimization.
4. Use OR tools in a wide range of applications in industries.
5. Identify current topics and advanced techniques of Operations Research for industrial solutions.
6. Identify best techniques to solve a specific problem.
7. Analyse, consolidate and synthesise knowledge to identify and provide solutions to complex problems with intellectual independence.

Module:1	Linear Programming Problem	4 hours

Introduction to Operations Research – Linear Programming - Mathematical Formulation – Graphical method – Simplex method – Penalty methods: M-method, Two Phase method- Duality.

Module:2	Transportation Problem	4 hours

Introduction - Formulation - Solution of the transportation problem (Min and Max): Northwest Corner rule, row minima method, column minima method, Least cost method, Vogel's approximation method – Optimality test: MODI method.

Module:3	Assignment and Sequencing Models:	3 hours

Assignment problems – Applications - Minimization and Maximization; Sequencing - Problem with N jobs and 2 machines – n jobs and 3 machines problem - n jobs and m machines problem.

Module:4	Project Management	4 hours

Introduction - Phases of project management-Construction of Network diagrams- Critical path method (CPM) and Project evaluation and review technique (PERT) - Crashing of project network.

Module:5	**Inventory Control**	**4 hours**
Necessity for maintaining inventory - Inventory costs -Inventory models with deterministic demand - inventory models with probabilistic demand - Inventory models with price breaks - Buffer stock.		
Module:6	**Queuing Models**	**4 hours**
Poisson arrivals and Exponential service times – Single channel models and Multi-channel models - Simulation: Basic concepts, Advantages and disadvantages - Random number generation - Monte Carlo Simulation applied to queuing problems.		
Module:7	**Game theory and Replacement Models**	**5 hours**
Game theory: Competitive games - Useful terminology - Rules for game theory - Two person zero sum game – Property of dominance - Graphic solution – Algebraic method. **Replacement models:** Replacement of items that deteriorate with time: No changes in the value of money, changes in the value of money - Items that fail completely: Individual replacement and group replacement policies.		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)

1.	Hamdy A Taha, Operations Research: An Introduction, 9th edition, Pearson Education, Inc., 2014.

Reference Books

1.	Hira D S and Gupta P K, Operations Research, S. Chand & Sons, 2014.
2.	Kanti Swarup, Gupta P.K., and Man Mohan, Operations Research, 18th edition, S. Chand &Sons, 2015.
3.	Manohar Mahajan, Operations Research, Dhanpat Rai & Co, 2013.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Mode of assessment:			
Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	47	Date	05-10-2017

Course code	Solar Photovoltaic System Design	L	T	P	J	C
MEE 1038		2	0	0	4	3
Pre-requisite	Nil	Syllabus version				
		v. 1.0				

Course Objectives:

1. Understanding the basic concepts of photovoltaic cells, modules and array.
2. Understanding the performance and operating characteristics of PV systems and components.
3. To design a PV system suitable to a given location and end-use requirements.

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1. Explain the physics of photovoltaic energy conversion from light
2. Design PV systems to meet economic and functional requirements of any application
3. Analyze the performance of PV systems
4. Prepare a commercial quality Detailed Project Report (DPR)
5. Plan and execute PV projects

Module:1		4 hours

Estimation of Solar Radiation: Sun-earth angles; Estimation of solar radiation using Page-Angstrom method; Measurement of Solar radiation.

Module:2	Basics of photovoltaic cells and modules	4 hours

PV physics: Creating p-n junction; PV voltage and currents; IV curve; Performance parameters; STC and NOCT; Estimating module output at field conditions; Module selection; Cell and Module manufacture.

Module:3	Electrical concepts of Solar Cells	2 hours

Equivalent circuit: Cell equivalent circuit; Estimating VOC and ISC; Effect of shading; Use of diodes.

Module:4	System components	4 hours

Battery: Principle, types, operating parameters, performance analysis; Charge controller; Inverter; MPPT; System configurations.

Module:5	System sizing	7 hours

Sizing a stand-alone PV system: Load estimation; Array sizing; Battery sizing; Matching module and battery rating iteratively; Wire sizing; Sizing charge controller and Inverter; MPPT. Sizing a grid connected PV system: Array sizing; Sizing sub- arrays. Central Vs string inverters; Grid interfacing.

Module:6	System installation	4 hours

Site identification; Module orientation; Ground and roof installation of modules; Standard practices in system installation; Module row spacing; Electric codes and practices; Islanding, grounding, and other safety practices.

Module:7	**Economics, Policy and DPR**	**4 hours**
PV economics and project payback; Calculating cost of electricity; National and State PV policies; Renewable Portfolio Standard (RPS); Renewable Energy Certificate (REC); Preparing a Detailed Project Report (DPR)		
Module:8	**Contemporary issues:**	**1 hours**
Recent developments in the area of photovoltaic power generation by an industry expert		
	Total Lecture hours:	**30 hours**

Text Book(s)

1.	Gilbert M. Masters (2013), Renewable and Efficient Electric Power Systems, 2nd Edition, Wiley-IEEE Press, Inc.

Reference Books

1.	Heinrich Haberlin(2012), Photovoltaics - System Design and Practice, John Wiley & Sons, Ltd.
2	G.N.Tiwari and Swapnil Dubey (2010), Fundamentals of Photovoltaic Modules and their Applications, The Royal Society of Chemistry Publishing, UK.
3	Roger A. Messenger and, Amir Abtahi (2013), Photovoltaic Systems Engineering, 3rd Edition, CRC Press, USA.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course code	Automotive Fuels and Energy	L	T	P	J	C
MEE1039		3	0	2	0	4
Pre-requisite	MEE3015	Syllabus version				
		v. 1.0				

Course Objectives:

1. To understand the essential characteristics of alternative fuels and possibilities of their production, refinement and utilization.
2. To infer the impact of alternative fuel usage on environment and socioeconomic aspects.

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1. Analyse the global fuel and energy challenges
2. Describe the technical, socioeconomic, environmental and legal aspects related to the alternative fuel – energy system.
3. Estimate the production-property-performance relationship of fuels
4. Evaluate the cost of generation and economics of production of alternative fuels
5. Assess the impact of alternative fuel usage on environment and socioeconomic aspects
6. Design structural & electro-mechanical subsystems of fuel cells % electric vehicles.

Module:1	Introduction	5 hours

Estimation of conventional fuels , Advantages and disadvantages of conventional fuels Need for alternate fuel - Availability and properties of alternate fuels, general use of alcohols, LPG, hydrogen, ammonia, CNG and LNG, vegetable oils and biogas, Relative merits and demerits of various alternate fuels

Module:2	Alcohol and Its Suitability	7 hours

Manufacture of Alcohols; Properties as engine fuels Alcohols and Gasoline blends; Performance in S.I. Engines: Methanol and gasoline blends; Effect of compression ratio; Alcohols in Stratified charge engines; Combustion characteristics in engines; Reformed alcohols use in CI Engines; Ignition accelerators; Alcohol Diesel emulsions; Dual fuel systems.

Module:3	Vegetable oils	5 hours

Vegetable Oils: Various vegetable oils for engines, esterification, performance in engines, performance and emission characteristics, bio diesel and its characteristics

Module:4	Gaseous Fuels	6 hours

Availability of CNG - Production methods; Storage and handling- Properties Modification required using in Engines; Performance and Emission characteristics of CNG, LPG in SI and CI Engines, Performance and Emission data for LPG- Safety aspects.

Module:5	Gaseous Fuels	7 hours

Sources of hydrogen, Production methods, Storage and handling, Economics of hydrogen, Hydrogen Induction Techniques in IC engines, Performance and emission characteristics, Safety aspects, Biogas - Availability- their properties as engine fuels, Producer gas - properties- Merits and demerits

Module:6	**Biofuels and Ethers**	**5 hours**
DME, DEE properties performance analysis, performance in SI & CI Engines, Low Viscous Low Cetane Biofuels(LVLC) - Applications- Suitability- Synthetic fuels and its suitability in engines		
Module:7	**Fuel Cells**	**4 hours**
Hydrogen, methanol fuel cells, power rating and performance. Heat dissipation, layout of a fuel cell vehicle		
Module:8	**Alternate Energy Sources**	**6 hours**
Electric- Layout of an electric vehicle, advantage and limitations, specifications, system components, electronic control system, high energy and power density batteries, hybrid vehicle- Types, solar powered vehicles.		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	S.S.Thipse, Alternative Fuels, Jaico Publications, 2010.
2.	Richard.L.Bechfold, Alternative Fuels Guide Book, SAE International Warrendale - 1997.
Reference Books	
1.	Keith Owen and Trevor Eoley, Automotive Fuels Handbook, SAE Publications, 1990.
2	Osamu Hirao and Richard K.Pefley, Present and Future Automotive Fuels, John Wiley and Sons, 1988.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)		
1.	Compare the crude oil consumption of India versus America. Also discuss about the critical properties of diesel and petrol.	
2.	Create a Matlab program to calculate the stoichiometric air fuel ratio for ALCOHOLS & ESTERS.	
3.	Fuel property testing (Calorific value, Density and Viscosity)	
4.	Fuel property testing (Flash, Fire point, Pour point, Cloud point)	
	Total Laboratory Hours	hours

Mode of assessment:

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course code	Auto Certification and Homologation	L	T	P	J	C
MEE1040		3	0	0	0	3
Pre-requisite		Syllabus version				
		v. 1.0				

Course Objectives:

1. To help students gain essential and basic knowledge on Auto Certification and Homologation for various types of vehicles, so as to equip them with knowledge required for getting certification and homologation for different classification of vehicles.
2. To train the students on vehicle classification with respect to certification and homologation.
3. To impart knowledge on vehicle testing procedures and norms for steering certification, engine certification, glasses and seat belts, brakes and wheels and lighting and signalling devices.
4. To teach students about the importance of advances and trends in certification and homologation.

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1. Describe the vehicle classification with respect to certification and homologation
2. Identify the regulations governing for each vehicle type
3. Gain proficiency in testing methodologies for vehicle level testing
4. Perform and analyze system level testing for certification of the engine, braking, steering and lighting systems,
5. Obtain know-how in testing methodologies for certification of components testing
6. Evaluate the environmental impact, cost and economics of homologation and certification

Module:1	Vehicle Classification:	7 hours

Specification & Classification of Vehicles (including M, N and O layout), Regulations overview (ECE, EEC, FMVSS, AIS, CMVR, ADR), Type approval and Conformity of Production, Engine and Vehicle specifications, Two Wheeler certification

Module:2	Vehicle Testing:	6 hours

Vehicle Testing - Photographs, CMVR physical verification, Vehicle weightment, Coast down test, Brake test, ABS, Turning circle diameter test, Steering effort test, Speedometer calibration, Pass by noise test, External projection test, Gradability test, Acceleration control system

Module:3	Steering Certification:	6 hours

Steering Impact test (GVW<1500 kg), Body block test, Head form test, Fixtures charges, Crash test with dummies, OBD I, Bumper testing, Documentation SHL, Certification charges

Module:4	Engine Certification:	5 hours

Engine power test (petrol & diesel), Indian driving cycle, Vehicle mass emission, Evaporative emission (petrol vehicles), Broad band / Narrow band EMI test.

Module:5	Glasses and Seat Belts	6 hours

Safety Glasses: Windscreen laminated safety glass, Side window / door glass, Back light / Rear toughened glass, Wind screen wiping system, Wiper Blade, Safety belt assemblies, Safety belt

anchorages, Seat anchorages & head restraints, door locks & door retention.		
Module:6	**Brakes and Wheels:**	**6 hours**
Hydraulic brake hose, Hydraulic brake fluid, Rear view mirror specification (Exterior), Rear view mirror specification (Interior), Wheel rims, Wheel nut, Wheel discs & hub caps, Size and Ply rating of tyres		
Module:7	**Lighting and Signaling Devices:**	**7 hours**
Performance requirement for lighting & signaling devices - Vertical orientation of dipped beam-head lamp, driver's field of vision, Head lamp assembly (glass lens & plastic lens), Head lamp + Front position lamp / Front indicator lamp / front fog lamp, Rear combinational lamp (each additional function), Independent front position lamp / Front direction indicator lamp / Front fog lamp, Rear combination lamp (single function), Warning triangles, Fuel tank: Metallic & Plastic (excluding fire resistance test).		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Raymond M. Brach and R. Matthew Brach, "Vehicle Accident Analysis and Reconstruction Methods", SAE International, 2011
Reference Books	
1.	Ulrich Seiffert and LotharWech, "Automotive Safety Handbook", SAE International, 2007
2.	ISO Standards, ICS: 43.020, 43.040, 43.100
3.	Automotive Industry Standards, AIS

Recommended by Board of Studies	17/08/2017		
Approved by Academic Council	47	Date	05.10.2017

Course code	Automotive Safety Systems	L	T	P	J	C
MEE1041		3	0	0	0	3
Pre-requisite	Nil	Syllabus version				
		v. 1.0				

Course Objectives:

1. To help the students to acquire in-depth knowledge of automotive safety systems.
2. To make students to understand the underlying concepts and methods of automotive safety.
3. To make students to differentiate the different active and passive safety systems.
4. To make the students to be familiar with latest safety systems.
5. To enable the students to apply the knowledge of safety systems to develop less accident-prone vehicles

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1. Comprehend the steps involved in the automotive body design to improve safety.
2. Differentiate the active and passive safety systems and their impact on passengers.
3. Explain the construction and working principle of various safety equipments employed in automobiles.
4. Evaluate the behaviour of various safety systems on improving safety, comfort and convenience.
5. Assess the performance of different testing procedures involved in passenger and occupant safety.

Module:1	Introduction:	8 hours

Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone, safety sandwich construction.

Module:2	Active Safety:	4 hours

Driving safety, conditional safety, perceptibility safety, operating safety

Module:3	Passive Safety:	5 hours

Exterior safety, interior safety, deformation behavior of vehicle body, speed and acceleration characteristics of passenger compartment on impact.

Module:4	Safety Equipments:	9 hours

Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, tiltable steering wheel, air bags, electronic system for activating air bags,
bumper design for safety.

Module:5	Collision Warning and Avoidance:	9 hours

Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions

Module:6	**Comfort and Convenience:**		**7 hours**
Steering and mirror adjustment, central locking system , Garage door opening system, tyre pressure control system, rain sensor system, environment information system			
Module:7	**Recent Trends**		**3 hours**
Passenger and Occupant Safety - Testing			
	Total Lecture hours:	**45 hours**	
Text Book(s)			
1.	Bosch - "Automotive Handbook" - 9th edition - SAE publication - 2014 Reference Books		
Reference Books			
1.	1. Ronald.K.Jurgen - "Automotive Electronics Handbook" - Second edition- McGraw-Hill Inc., - 1999.		
2	J.Powloski - "Vehicle Body Engineering" - Business books limited, London - 1969.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course code	Ergonomics and Styling	L	T	P	J	C
MEE1042		3	0	0	0	3
Pre-requisite		Syllabus version				
		v. 1.0				

Course Objectives:

1. To help students gain essential and basic knowledge of styling and ergonomics.
2. To equip the students to analyse impact of styling on vehicle safety.
3. To familiarize the students with the procedures of styling and ergonomics
4. To make students understand the different packing techniques and its impact on driver fatigue.

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1. Possess the knowledge of various styling and ergonomic techniques.
2. Design and develop a new styling in a given vehicle model.
3. Understand the importance of ergonomics in reducing the driver fatigue.
4. Explain the role of styling and ergonomics in look and safe operation of the vehicle.
5. Knowledge of visibility, mirror design and logical formation of cockpit

Module:1	Introduction to styling	6 hours

Vehicle Design, Fundamentals of perspective drawing, Automotive Sketching, Styling process, Car proportions, Aerodynamics, Crashworthiness and its influence on body design, Designing of Interiors

Module:2	Form Studies:	5 hours

Form studies, Speed Forms, Clay Modeling, 2D systems, 3D systems

Module:3	Fundamentals of Ergonomics:	7 hours

Dimension Determination, Anthropometry – Need, Data collection methodology, Different postural considerations

Module:4	Measurement:	7 hours

Measuring Procedures Subject and Sampling size selection, Measurement of Hands/Feet/Full posture, Applying Anthropometry data, Application of percentile curves.

Module:5	Vehicle Ergonomics:	7 hours

Passenger Compartment, Floor Pan, Technical requirements, Dash board equipments arrangement, Positioning of operational controls, Force Analysis, Seating and position - ECE Regulations, Human Factors, Navigation systems, pedal positioning.

Module:6	Vehicle Packaging:	6 hours

R-Point, AHP, Manikin positioning of 2-D pattern, car entry/exit, Boot lid packaging, Loading/Unloading analysis.

Module:7	Visibility:	4 hours

Sight – All round visibility, View of Instruments, Mirror design, Logical formation of cockpit.			
Module:8	**Contemporary topics**		**3 hours**
Recent developments in ergonomics and styling.			
	Total Lecture hours:	**45 hours**	
# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical cut section models to lecture, Visit to Industry, Min of 2 lectures by industry experts			
Text Book(s)			
1.	Julian Happian-Smith, "An introduction to modern vehicle design", Butterworth Heinmenn, 2001		
Reference Books			
1	Tony Lewin, "How to Draw Cars like a Pro", Motorbooks International, 2003		
2	Thom Taylor, Lisa Hallett, "How to Draw Cars like a Pro", Motorbooks International; 2Rev Ed edition, 2006		
3	Fenton John, "Handbook of automotive body and system design", Wiley-Blackwell, 1998		
4	J. Brian Peacock, WaldemarKarwowski, "Automotive ergonomics", Taylor & Francis ltd, 1993		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	17/08/2017		
Approved by Academic Council	47	Date	05/10/2017

Course code	Machining Processes and Metrology	L	T	P	J	C
MEE2006		2	0	2	0	3
Pre-requisite	MEE1007	Syllabus version				
		v. 2.2				

Course Objectives:

1. To create awareness on the basic concepts of machining Processes.
2. To give an insight on conventional machining principles and operations.
3. To impart students the fundamental knowledge of unconventional machining and finishing processes.
4. To familiarize the students with basic and advanced metrology concepts.

Expected Course Outcome:

1. Apply the basic concepts of metal cutting, identify various tool materials that can be used and familiarize with calculations of tool life estimation.
2. Explain the constructional details and working principle of different machine tools.
3. Describe the gear cutting process using indexing concept.
4. Develop the concept of unconventional machining and finishing processes and working principle of different unconventional machines.
5. Plan for linear and angular measurements using basic metrology instruments.
6. Make use of advanced measuring instruments.

Module:1	Metal Cutting	4 hours

Mechanics of metal cutting - cutting tool materials, temperature, wear, and tool life considerations, geometry and chip formation, surface finish and machinability, optimization.

Module:2	Basic Machine Tools	4 hours

Lathe and its types - Constructional details including accessories and attachments, operations, types of lathe, Contructional and operational details of Shaping - Planing - Slotting – Drilling - Boring – Reaming – Tapping – Broaching.

Module:3	Milling machine and Gear Generation	4 hours

Cutters - Milling operations - Indexing.

Gear generating principles - Gear Hobber - Gear finishing methods - Bevel gear generator.

Module:4	Grinding machine	4 hours

Operations and applications of surface, cylindrical and centreless grinding processes, dressing, truing and balancing of grinding wheels, grading and selection of grinding wheels, micro-finishing (honing, lapping, super-finishing).

Module:5	Unconventional methods	4 hours

Electro-chemical, electro-discharge, ultrasonic, LASER, electron beam, water jet machining.		
Module:6	**Introduction to Metrology**	**4 hours**
Linear and angular measurements – taper measurement, threads, surface finish, inspection of straightness, flatness and alignment-– Comparators - Gear testing.		
Module:7	**Advances in Metrology**	**4 hours**
Precision Instrumentation based on Laser Principals, Coordinate measuring machines, Optical Measuring Techniques: Tool Maker's Microscope, Profile Projector. Nano-measurements: Scanning Electron Microscope-Atomic Force Microscopy-Transmission Electron Microscopy.		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)	
1.	Serope Kalpakjian; Steven R. Schmid (2013), Manufacturing Engineering and Technology, 6th Edition, Publisher: Prentice Hall, ISBN-10 0-13-608168-1, ISBN- 13 978-0-13-608168-5.
Reference Books	
1.	P.N.Rao, Manufacturing Technology, McGraw Hill Education, New Delhi, 2013.
2	R.K. Rajput, A Textbook of Manufacturing Technology, Laxmi publications, New Delhi, 2015.
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

List of Challenging Experiments (Indicative)		
MACHINING EXPERIMENTS		
1.	Determination of cutting force measurement using Lathe Tool Dynamometer.	2 hours
2.	Prepare the part shown in the sketch from a mild steel rod on a Lathe.	2 hours
3.	Prepare and check the dimensions of the sample by Surface Grinding.	1.5 hours
4.	Machine the hexagonal head shown in the sketch on the specimen.	1.5 hours
5.	Machining a keyway by using slotting machine.	1.5 hours
6.	Machining a V-block by using shaper.	1.5 hours
7.	Gear cutting using milling and gear hobbing machines.	2 hours
8.	Grinding of single point cutting tool as per given specifications (to check the tool angles) in a Tool and Cutter Grinder	2 hours
METROLOGY EXPERIMENTS		
9.	Calibration of Micrometer, Mechanical Comparator, Vernier Caliper and Dial Gauge.	2 hours
10.	Measurement of taper angle using Bevel Protractor, Dial Gauge and Sine-Bar.	2 hours
11.	Measure the flatness of the object using dial gauge.	2 hours
12.	Measurement of bores by using Micrometer and Dial bore indicator.	2 hours
13.	Measurement of Screw threads Parameters using Three-wire method and Profile Projector.	2 hours

14.	Measurement of Gear tooth thickness by using Gear tooth Vernier.	2 hours
15.	Surface roughness measurement of machined component.	2 hours
16.	Measurement of single point tool by using Tool Makers Microscope.	2 hours
	Total Laboratory Hours	**30 hours**

Mode of assessment:			
Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	47	Date	05-10-2017

Course code	CAD/CAM	L	T	P	J	C
MEE2007		2	0	4	0	4
Pre-requisite	MEE1007	Syllabus version				
		v. 2.2				

Course Objectives:

1. Demonstrate basics of CAD/CAM concepts.
2. Explain computer graphics and solid modelling techniques.
3. Demonstrate part programs and group technology techniques.
4. Discuss latest advances in the manufacturing perspectives.

Expected Course Outcome:

1. Apply design concepts.
2. Utilise CAD standards for geometrical modelling.
3. Demonstrate Solid modelling techniques.
4. Develop part programs for solid models.
5. Apply group technology concept in manufacturing product.
6. Make use of FEA concept for analysis.
7. Explain FMS and CIM wheel for manufacturing industry
8. Develop the model for analysing and manufacturing structural member.

Module:1	Introduction	4 hours

Definition and scope of CAD/CAM- Computers in industrial manufacturing, design process- Computer Aided Design (CAD)-Computer Aided Manufacturing (CAM)-Computer Integrated Manufacturing (CIM) - Introduction to Computer graphics -Raster scan graphics-Co-ordinate systems.

Module:2	Graphics and computing standards	4 hours

Data base for graphic modeling-transformation geometry-3D transformations –Clipping-hidden line removal-Colour-shading-Standardization in graphics- Open GL Data Exchange standards – IGES, STEP - Graphic Kernal system (GKS).

Module:3	Geometric modelling	4 hours

Geometric construction methods-Constraint based modeling- Wireframe, Surface and Solid – Parametric representation of curves, solids & surfaces.

Module:4	CNC Machine Tools	4 hours

Introduction to NC, CNC, DNC - Manual part Programming – Computer Assisted Part Programming – Examples using NC codes- Adaptive Control – Canned cycles and subroutines – CAD/ CAM approach to NC part programming – APT language, machining from 3D models.

Module:5	**Role of information systems in manufacturing**	**4 hours**
Discrete part manufacture-information requirements of a production organization-manufacturing strategies-Integration requirement - Group technology-coding-Production flow analysis-computer part programming-CAPP implementation techniques.		
Module:6	**Introduction to FEA concepts**	**4 hours**
Nodes -Meshing – Pre and Post processing – Modal analysis – Stress analysis – Steady state and Transient analysis.		
Module:7	**Automated manufacturing systems**	**4 hours**
Flexible Manufacturing systems (FMS) – the FMS concepts – transfer systems – head changing FMS – Introduction to Rapid prototyping, Knowledge Based Engineering, Virtual Reality, Augmented Reality –automated guided vehicle-Robots-automated storage and retrieval systems - computer aided quality control-CMM-Non contact inspection methods.		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)	
1.	P.N.Rao, CAD/CAM: Principles and Applications-3rd Edition, Tata McGraw Hill, India, 2010.
Reference Books	
1.	Mikell P. Groover, Automation, Production Systems and Computer Integrated Manufacturing, Pearson Education, 2005.
2	James A. Rehg, Henry W. Kraebber, Computer Integrated Manufacturing, Pearson Education, 2002.
3	Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw Hill International Edition,2005.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)		
1.	2D Geometry –Splines.	2 hours
2.	Surface Modelling –NURBS.	2 hours
3.	Solid Modelling-CSG, Brep.	2 hours
4.	Preparing solid models for analysis-Neutral files.	2 hours
5.	Real time component analysis-STRESS, STRAIN Analysis.	2 hours
6	Model analysis of different structures.	2 hours
7	Tolerance analysis of any mechanical component.	2 hours
8	CNC Milling program involving linear motion and circular interpolation.	2 hours
9	CNC Milling program involving contour motion and canned cycles.	2 hours
10	CNC Milling program involving Pocket milling.	2hours

11	Diagnosis and trouble shooting in CNC machine.	2 hours
12	Route sheet generation using CAM software.	2 hours
13	Generation of CNC programming using DXF file format using Wire EDM.	2 hours
14	Generation of CNC programming and machining using Master Cam.	2 hours
15	Generation of STL file format for the given component.	2 hours
	Total Laboratory Hours	**30 hours**

Mode of assessment:			
Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	47	Date	05-10-2017

Course code	Product Design for Manufacturing	L	T	P	J	C
MEE2008		2	0	0	4	3
Pre-requisite	MEE1007/MEE2031	Syllabus version				
		v. 2.2				

Course Objectives:

1. To apply the role of DFM in product specification and standardization
2. To analyze methods of material, shape and process selections
3. To assess the design rules for manufacturing and assembly processes
4. To use approach towards robust design

Expected Course Outcome:

1. Evaluate constraints of manufacturing processes that limit design possibilities with respect to cycle time, material handling and other factory costs
2. Apply various design rules in manufacturing processes
3. Evaluate the process by design guidelines for optimum design and analyze the design alternatives in the manufacture of components
4. Apply quantitative methods to assess DFA between different designs Contents
5. Utilize CAD, CAM, CIM concepts to assess DFMA.
6. Analyze the new product development.

Module:1	Product Design	4 hours

Introduction to Product design: Asimow's Model - Product design practice in Industry - Industrial design - Aesthetics in product design. Need Identification and Problem Definition, Concept Generation and Evaluation, Embodiment Design.

Module:2	Material Selection	4 hours

Physical and Mechanical Properties of Engineering Materials, Selection of Materials, Selection of Shapes, Strength consideration in product design, Design for stiffness and rigidity: Material savings in design - Ribs, corrugations, Laminates and Members. Case Studies- I.

Module:3	Manufacturing Process Selection	4 hours

Review of Manufacturing Processes, Design for Casting, Design for Bulk Deformation Processes, Design for Sheet Metal Forming Processes, Design for Machining, Design for Powder Metallurgy, Co-selection of Materials and Processes, Case Studies – II.

Module:4	Assembly Process Selection	4 hours

Review of Assembly Processes, Design for Welding, Design for Brazing and Soldering, Design for Adhesive Bonding, Design for Joining of Plastics, Design for Heat Treatment. Case Studies-IV.

Module:5	Use of Computer Aided Tools	4 hours

Role of computers in Product design and manufacturing: CAD/CAM softwares - product life cycle - design process – CIM - Collaborative manufacturing. Computer aided process planning.

Module:6	Design for Manufacture and Assembly	4 hours

Design for manufacturing and Assembly - principles of DFMA and applications. (Boothroyd/

Dewhurst Method – case studies using DFMA software.)		
Module:7	**New Product Development**	**4 hours**
Supporting techniques for new product development processes such as quality function deployment and quality engineering and Taguchi Method.		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)	
1.	A.K. Chitale, R.C. Gupta, Product Design and Manufacturing, Sixth Edition, Prentice –Hall of India, 2013.
Reference Books	
1.	Boothroyd, G.,Peter Dewhurst, Winston A. Knight, Product Design for Manufacture and Assembly, Third Edition, CRC Press, Taylor & Francis, 2010.
2	Michael Ashby., Materials Selection in Mechanical Design, 5th edition, Butterworth-Heinemann, U.K, 2016.
3	Karl T. Ulrich, Ateven D. Eppinger, Product Design and Development, 6th edition, Tata McGraw-Hill,
4	O. Molloy, S. Tilley and E. A. Warman., Design for Manufacturing and Assembly: Concepts, Architectures and Implementation. Springer. USA, 2012.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)	
Guidelines for Project: • The project will be a group project with a maximum of 3 members in a group. The size will reflect the complexity of the project. Students should make sure that the concepts to be studied are reflected in the project. • There will be a minimum of three reviews conducted in a semester and the marks will be awarded and taken for final assessment. The marks distribution for 3 reviews will be 20:30:50. • Minimum pass marks for project is 50%. If the student fails to get 50%, he/she has to re-register and redo in a subsequent semester. • If the student has got >= 50% in project, and fails in Theory, then the same marks can be taken up for grading purposes after he/she completes the Theory FAT. • Evaluation is through continuous assessment with 3 reviews. No separate FAT. Sample Projects: 1. Design of Products by implementing Design for manufacturing and assembly principles. 2. Design of home appliances using DFMA principle. 3. Design of engineering components for concurrent costing. 4. Design of automobile components using DFMA software. 5. DFMA of any new products.	**60** hours

Mode of assessment:

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	47	Date	05-10-2017

Course code	Non-Destructive Testing	L	T	P	J	C
MEE2015		3	0	2	0	4
Pre-requisite	MEE1005	Syllabus version				
		v. 2.2				

Course Objectives:

1. Teach different surface inspection techniques.
2. Impart knowledge on different Non-destructive testing methods
3. Demonstrate various special Non-destructive testing methods.

Expected Course Outcome:

1. Identify appropriate surface inspection techniques for various engineering component.
2. Select suitable radiography testing methods for different applications.
3. Apply eddy current and ultrasonic testing methods suitably for detecting internal defects.
4. Apply acoustic emission techniques for suitable engineering applications
5. Select suitable special non-destructive technique for various applications.
6. Detect the defects using non-destructive testing methods

Module:1	Introduction to NDT	3 hours

Procedure,testing and evaluation, Visual examination.

Module:2	Surface NDT Techniques	5 hours

Liquid penetrant testing - Dye penetrant testing,Basic principle, Types of dye and methods of application, Developer; Magnetic particle testing - Magnetic particle testing,Basic theory of magnetism, Magnetization methods, Field indicators, Particle application, Inspection. Advantages and limitations of techniques.

Module:3	Radiographic Testing	6 hours

Radiography principle, X-ray films, exposure, penetrameter, radiographic imaging, inspection standards and techniques, Radiography applications, limitations and safety.

Module:4	Eddy Current Testing	6 hours

Principle, depth of penetration, eddy current response, eddy current instrumentation, probe configuration, applications and limitations.

Module:5	Ultrasonic Testing	6 hours

Properties of sound beam, ultrasonic transducers, inspection methods, flaw characterization technique, immersion testing.

Module:6	Acoustic emission testing	6 hours

Theory of AE sources and Waves, Equipment, Signal Features, Data display, source location,

Barkhausen noise, Applications.		
Module:7	**Special / Emerging Techniques**	**7 hours**
Leak testing, Holography, Thermography, Magnetic resonance Imaging, Magnetic Barkhausen Effect. In-situ metallography.		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)	
1.	Wong B Stephen, Non-Destructive Testing - Theory, Practice and Industrial Applications, 1st edition, LAP Lambert Academic Publishing, USA, 2014.
Reference Books	
1.	Ravi Prakash, Nondestructive Testing Techniques, 1st rev. edition, New Age International Publishers, 2010.
2.	J. Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, 2nd edition, Tata McGraw-Hill Education, 2011.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)		
1.	Inspection of welds/samples using solvent removable visible dye. penetrant.	2 hours
2.	Inspection of welds using solvent removable fluorescent dye. penetrant.	2 hours
3.	Familiarization and calibration of eddy current equipment.	2 hours
4.	Inspection on non magnetic/magnetic materials by eddy current. method.	2 hours
5.	Detection of surface flaws in bore holes using eddy current..testing.	2 hours
6.	Conductivity variation measurement using eddy current testing.	3 hours
7.	Dimensional variations measurement using eddy current testing.	3 hours
8.	Inspection of welds/samples by Magnetic Particle Testing - Drymethod	3 hours
9.	Inspection of welds/samples by Magnetic Particle Testing- Wetmethod	3 hours
10.	Inspection of a welded plate by radiographic single wall single image technique- X rays.	3 hours
11.	Corrosion survey using Ultrasonic testing.	3 hours
12.	Detection of surface flaws using eddy current testing in nonferrous material.	2 hours
	Total Laboratory Hours	**30 hours**

Mode of assessment:			
Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	47	Date	05-10-2017

Course code	Turbomachines	L	T	P	J	C
MEE2026		2	2	2	0	4
Pre-requisite	MEE1003,MEE1032/MEE1004/CHE1003,CHE1005	Syllabus version				
		v.2.2				

Course Objectives:

1. To enable the students understand the operation of Turbomachines for compressible fluids
2. To enable the students understand the operation of Turbomachines for incompressible fluids
3. To equip students to apply velocity triangles, thermodynamic plots in turbo-machinery
4. To facilitate the students to contrast various types of Turbomachines
5. To infer the characteristics various Turbomachines under variable operating conditions

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1. Define Euler's equation for Turbomachines from second law of motion
2. Apply Euler's equation of motion to various types turbo machines
3. Demonstrate the knowledge of working and stages of Turbomachines
4. Analyze stage parameters and performance characteristics of various Turbomachines
5. Suggest suitable compounding technique for muti-stage operation of Turbines
6. Identify governing and selection of turbomachinery
7. Solve analytical problems in turbo-machines for both compressible and incompressible fluid flows.
8. Experimentally determine the performance characteristics of both power absorbing and power generating Turbomachines.

Module:1	Energy Transfer	4 hours

Definition and classification of Turbomachines, Specific work - T-s and H-s diagram - Equation of energy transfer - Losses - Various efficiencies - Effect of reheat - Preheat

Module:2	Cascading	5 hours

Aero–Foil section - Cascading of compressor and Turbine blades - Energy Transfer in terms of lift and drag co-efficient for compressor and turbine blades - Variation of lift - Deflection and stagnation pressure loss with incidence.

Module:3	Centrifugal Compressors	5 hours

Centrifugal fans - Blowers and Compressors - construction details - Inducers - Backward and Radial blades - Diffuser - volute casing stage work - Stage pressure rise - Stage pressure co-efficient - Stage efficiency - Degree of reaction - Various slip factors H-S diagram for centrifugal compressor.

Module:4	Axial Compressors	5 hours

Axial flow Fans and Compressors – Stage velocity triangles - Blade loading and flow co-efficient – Static pressure rise - H-S diagram - Degree of reaction - Work done factors - Free and Forced Vortex flow performance - Stalling and Surging		
Module:5	**Radial Turbines**	**6 hours**
Inward flow radial turbine stages - IFR Turbine - T-s diagram - and degree of reaction - Steam turbine governing – Features of Steam turbine and Gas turbine		
Module:6	**Axial Turbines**	**6 hours**
Axial turbine stages - Stage velocity triangle – Work - Single stage Impulse Turbine - Speed ratio maximum utilization factor - Multistage velocity compounded impulse - Multi stage pressure compounded impulse - reaction stages - Degree of reaction - Zero reaction stages - Fifty percent reaction stages – Hundred percent reaction - Negative reaction - Free and Forced vortex flow		
Module:7	**Hydraulic Machines**	**7 hours**
Centrifugal pumps – Work done – Head developed - Pump output and Efficiencies - priming – minimum starting speed - performance of multistage pumps - Cavitation - methods of prevention - Pump characteristics - Classification of hydraulic turbines - Pelton wheel - Francis turbine - Kaplan and Propeller turbines - Velocity triangles - Specific speed - Theory of draft tube - Governing - Performance characteristics - Selection of turbines, P model and prototype , unit quantities.		
Module:8	**Contemporary issues:**	**4 hours**
Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry, Min of 2 lectures by industry experts		
	Total Lecture hours:	**42 hours**

Text Book(s)	
1.	. S.M. Yahya (2002), Turbine, Fans and Compressors, TMH
Reference Books	
1.	1. Dixon, S.L. (2014), Fluid Mechanics and Thermodynamics of Turbomachinery, 7th edition, Elsevier
2	Kadambi and Prasad (2011), Energy conversion Vol. III – Turbomachines, New Age
3	A.H. Church and Jagadish Lal (2000), Centrifugal Pumps and Blowers; Metropolitan Book Co,

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)		
1.	To study the performance of Gear Pump at different discharge pressures.	
2.	To study the performance of Reciprocating Pump at different discharge	

	pressures	
3.	To study the performance of Constant Speed Centrifugal Pump at different discharge pressures.	
4.	To study the performance characteristics of Variable Speed Centrifugal Pump at different speeds and different discharge pressures.	
5.	To study the performance of Jet Pump at different discharge pressures	
6	To study the performance of Submersible Pump at different discharge pressures.	
7	To study the performance of Kaplan Turbine at constant speed, constant load and different vane and blade positions.	
8	To study the performance of Francis Turbine at constant speed, constant load and different vane positions	
9	To study the performance of Pelton Turbine at constant speed and constant load conditions.	
10	To study the impact of jet on vanes.	
	Total Laboratory Hours	**30 hours**

Mode of assessment:			
Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course code	Automotive Aerodynamics	L	T	P	J	C
MEE2028		2	2	0	4	4
Pre-requisite	MEE1032 Mechanics of solids and fluids/ MEE1004 Fluid Mechanics	Syllabus version				
		1.2				

Course Objectives:

1. To provide the students with sufficient background to understand the fundamentals and drag of cars applied during development of cars.
2. To enable the students to understand stability, safety and comfort.
3. To help the students to understand high performance vehicle characteristics.
4. To teach students about transmission systems, braking systems and electrical systems.

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1. Possess the knowledge of basic of flow over vehicles and resistance to vehicle motion.
2. Gain the knowledge of drag over the car, its aerodynamics and optimization of car bodies.
3. Compute and predict the wind force and calculate wind noise.
4. Design and development of very low drag cars and high efficiency radiators using simulations.
5. Explain the measurement of pressure, velocity and force in an automobile wind tunnel.
6. Simulation of car, buses and trucks using computational fluid Dynamics technique.

Module:1	Fundamentals	4 hours

Scope – Development trends – Flow phenomena related to vehicles – External and internal flow problems – Performance of cars and light vans – Resistance to vehicle motion

Module:2	Drag	4 hours

Drag – Types of drag – Flow field around a car – Aerodynamic development of cars – Optimization of car bodies for low drag

Module:3	Stability, Safety and Comfort	4 hours

The origin of forces and moments – effects – vehicle dynamics under side wind – Force and moment coefficients – Safety limit – Dirt accumulation on vehicles – Wind noise – Air flow around individual components

Module:4	High Performance Vehicles	4 hours

High performance vehicles – very low drag cars – Design alternatives – High efficiency radiator arrangement – Development and simulation methods

Module:5	Measurement and Testing Techniques	4 hours

Principles of wind tunnel technology – Limitations of simulation – Scale models – Existing automobile wind tunnels – Climatic wind tunnels – Measuring equipment and transducers – Pressure measurements- Velocity measurements – Flow visualization techniques – Road testing methods – Wind noise measurements.

Module:6	Computational Fluid Dynamics and	4 hours

	Applications	
Methods to solve Navier-Stokes equations – Forces acting on a fluid element – Compressibility effects in a flow field – Inviscid flow – Governing equations – Irrotational flow field and consequences – Potential flows – Boundary layer methods – Numerical modeling of flow flow around vehicle body		
Module:7	**Vehicle Aerodynamic Simulation**	**4 hours**
Development and simulation methods – cars, buses and trucks.		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)

1.	T. Yomi Obidi, 'Theory and Applications of Aerodynamics for Ground Vehicles', SAE Publications, 2014..

Reference Books

1.	W.H. Hucho, 'Aerodynamics of Road Vehicles', SAE Publications, 6th edition, 2012.
2	R. McCallen, Ross Browand, 'The Aerodynamics of Heavy Vehicles', Springer, 2014.
3	Smits, Lim, 'Flow Visualization: Techniques and Examples', 2nd edition, Imperial College, 2012.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course code	Vehicle Body Engineering	L	T	P	J	C
MEE2041		3	0	0	0	3
Pre-requisite	MEE1036	Syllabus version				
		v. 1.0				

Course Objectives:

1. The students can learn basic knowledge about construction of car body, design, and safety aspects.
2. The students able to impart the construction, specifications and safety aspects of bus body.
3. The students can know the different types, design of cab and visibility of commercial vehicles.
4. The student will be well versed in the design and construction of external body of the vehicles and materials used in vehicles.

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1. To impart basic knowledge about the design of car body and identify the diffent body parts in a vehicle.
2. To acquire the different specification of bus body and commercial vehicle bodies.
3. To analyze the body material for car, bus and commercial vehicle bodies.
4. To develop modern safety system for car, bus and commercial vehicle
5. To analyze the effects of various aerodynamic forces and moments.
6. To develop modern vehicle body to meet the current requirements.

Module:1	Car Body:	6 hours

Types Saloon, convertibles, Limousine, Estate Van, racing and sports car – Visibility: regulations, driver's visibility, tests for visibility – Methods of improving visibility and space in cars –Car body construction.

Module:2	Bus Body:	7 hours

Types: Mini bus, single decker, double decker, two level, split level and articulated bus – Bus body lay out – Constructional details: Types of metal sections used – Regulations – Conventional and integral type construction.

Module:3	Commercial Vehicle Body:	7 hours

Different types of commercial vehicle bodies – Light commercial vehicle body types – Construction details of flat platform body, Tipper body & Tanker body – Dimensions of driver's seat in relation to controls – Drivers cab design.

Module:4	Body Materials and Trims	7 hours

:

Steel sheet, timber, plastics, GRP, properties of materials – Corrosion – Anticorrosion methods – Selection of paint – Modern painting process in details – Body trim items – Body mechanisms.

Module:5	**Safety:**	**7 hours**
Safety: safety design, safety equipment's for car, bus and commercial vehicles.		
Module:6	**Vehicle Aerodynamics:**	**7 hours**
External and Internal flow problems – Performance of cars and light vans – Resistance to vehicle motion – Drag – Types of drag – Flow field around car – Aerodynamic development of cars – Optimization of car bodies for low drag.		
Module:7	**Recent Trends**	**4 hours**
Car Body construction and Safety aspects		

	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	Dieler Anselm, "The passenger car body", SAE International, 2000.
Reference Books	
1.	John Fenton, "Handbook of Vehicle Design Analysis", SAE International, 1996.
2	Geoffrey Davies,"Materials for Automobile Bodies", Elsevier, 2012
3	Powloski,J., "Vehicle Body Engineering", Business Books Ltd., 1989.
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	
Mode of assessment:	

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course code	Two and Three Wheelers	L	T	P	J	C
MEE2042		3	0	0	0	3
Pre-requisite	MEE1036	Syllabus version				
		v. 1.0				

Course Objectives:

1. To introduce different types of two and three wheelers.
2. To broaden the understanding of various systems and components of two and three wheelers.
3. To explain the significance of steering, braking and suspension system on vehicle performance
4. To impart the knowledge of service and maintenance of the vehicles.

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1. Identify a wide variety of two and three wheelers
2. Analyze the various systems and components of two and three wheelers.
3. Evaluate the impact of steering, braking and suspension system on vehicle performance.
4. Explain the importance of proper service and maintenance.
5. Knowledge of vehicle stability and riding characteristics.

Module:1	Introduction:	3 hours

Development, Classification & layouts of two wheelers (motorcycles, scooters, mopeds) and Three wheelers, applications & capacity – goods & passengers, study of technical specification of Two & Three wheelers.

Module:2	Frames and body:	6 hours

Types of frame, construction, loads, design consideration, materials, driver & pillion seating arrangement, ergonomics & comfort, Types of three wheeler bodies, layout, RTO regulations, aerodynamic, aesthetic & ergonomics considerations for body work.

Module:3	Power Plants:	7 hours

Two stroke engine, Scavenging, Selection of engine, Design considerations, special systems requirements for ignition, lubrication, cooling, starting systems.

Module:4	Transmission and Steering Systems:	7 hours

Clutch – special requirements, Types, need of primary reduction, selection of transmission - gear transmission, gear shift mechanism, belt transmission, automatic transmission (Continuous Variable Transmission - CVT), final drive & differential for three wheeler, wheel drive arrangement. Steering: Steering geometry, steering column construction.

Module:5	Braking and Suspension System:	7 hours

Design consideration of brake, types of brakes – disc, drum; braking mechanism – mechanical, hydraulic & servo, Combi-brake, ABS in two-wheeler. Suspension requirements, design considerations, trailing & leading link, swinging arm, springs , & shock absorbers, Nitrox suspension.

Module:6	**Vehicle Handling Characteristics:**	**7hours**
Wheels and Tyres, Handling characteristics, road holding & vehicle stability, riding characteristic.		
Module:7	**Performance and Maintenance:**	**5 hours**
Road Performance: Factors affecting fuel economy & emission safety arrangements, and Racing bikes – special requirements. Maintenance: Preventive & brake down maintenance.		
Module:8	**Contemporary issues:**	**3 hours**
I3S system, DTSI, Recent advancements.		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Gaetano Cocco, "Motorcycle Design and Technology", Giorgio Nada Editor, 2013
Reference Books	
1.	Mick Walker, "Motorcycle: Evolution, design and Passion", Johns Hopkins, 2006
2	Marshall Cavensih, "Encyclopedia of Motor cycling, 20 volumes", New York and London, 1989
3	John Robinson, "Motorcycle Tuning: Chasis", Butterworth-Heinemann, 2001
4	Service Manuals of Manufacturers of Indian Two & Three wheelers.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course code	Vehicle Inspection and Maintenance	L	T	P	J	C
MEE2043		3	0	0	0	3
Pre-requisite	MEE1036	Syllabus version				
		v. 1.0				

Course Objectives:

1. To gain fundamental knowledge about various vehicle maintenances
2. To gain basics knowledge for preparing the inspection schedule
3. To acquire knowledge about the various engine faults and recovery methods
4. To impart the fundamental knowledge in fuel, cooling and lubrication systems.
5. To make the students to understand the common problem arises in transmission systems and rectification procedure.
6. To familiarize the students with the servicing procedures of braking, electrical and modern vehicle systems

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1. Understand the importance of vehicle inspection and maintenance.
2. Diagnose the causes of Engine problem and provide the remedial action
3. Implement the knowledge to rectify the fuel, cooling and lubrication systems defects
4. Identify the causes, servicing the clutch, gear box, universal joints, propeller shaft, and differential.
5. Apply the basic knowledge and rectify the transmission systems problems
6. Possess the knowledge about the inspection and maintenance of vehicle braking, electrical and modern vehicle systems.

Module:1	Maintenance Basics	2 hours

Need for maintenance, types of maintenance: preventive and breakdown maintenance, requirements of maintenance, preparation of check lists.

Module:2	Inspection Schedules	4 hours

Inspection schedule, maintenance of records, log sheets and other forms, safety precautions in maintenance: General safety, tool safety.

Module:3	Engine Service:	6 hours

Tools used for engine disassembly, dismantling of engine components: cylinder head, valve train, cylinder block, connecting rod, piston and crankshaft assembly; cleaning and inspection of engine components, reconditioning of components.

Module:4	Fuel and Lubrication Systems:	4 hours

Servicing and maintenance of fuel system, Engine tune-up, cooling system: water pump, radiator, thermostat. Lubrication system maintenance, Anticorrosion and anti-freeze additives

Module:5	Transmission Systems:	4 hours

Servicing and maintenance of clutch, gear box, universal joints, propeller shaft, differential system.		
Module:6	**Braking Systems:**	**4 hours**
Service and maintenance of brake – disc and drum brakes, steering wheel and suspension systems, wheel alignment, vehicle body maintenance		
Module:7	**Electrical Systems:**	**4 hours**
Servicing and maintenance of battery, starter motor, alternator and generator, ignition system, lighting system, electric horn, and wiper motor		
Module:8	**Contemporary issues:**	**2 Hours**
Modern vehicle systems		
	Total Lecture hours:	**30 hours**

Text Book(s)	
1.	Knott and Phil Knott, "An Introductory Guide to Motor Vehicle Maintenance: Light Vehicles", EMS publishing, 2010.
Reference Books	
1.	William H. Crouse and Donald L. Anglin, "Automotive Mechanics", 10th edition, 2007
2	Tim Giles, "Automotive service: Inspection, maintenance and repair", 3rd edition, 2007
3	Jack Erjavec, "Automotive technology: A systems approach", 5th edition, 2009

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course code	Instrumentation and Vehicle Diagnostics	L	T	P	J	C
MEE2044		3	0	0	0	3
Pre-requisite	MEE1037	Syllabus version				
		v. 1.0				

Course Objectives:

1. To help the students to get familiar with the basics of instrumentation.
2. To make students to understand the mechanical and digital instrumentation systems.
3. To make students to be conversant with the basics and different types of diagnostics.
4. To enable the students to understand the working of different diagnostic tools and scanners.
5. To make students to be familiar with latest trends in the field of instrumentation and vehicle diagnostics

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1. Explicate the basics of instrumentation systems.
2. Differentiate the characteristics of diverse instrumentation types with their relative merits and demerits.
3. Explain the basics of diagnostic systems.
4. Evaluate the performance of different diagnostic systems.
5. Identify the different diagnostic tools and scanners employed in automobiles.
6. Comprehend the recent trends followed in the field of instrumentation and vehicle diagnostics.

Module:1	Introduction:	7 hours

Input and output signal conversion, multiplexing, Need of Instrument cluster(IC), different types, analog and digital clusters, different types of telltale signals in modern cluster

Module:2	Mechanical Instrumentation:	6 hours

Analog indicators, Analog gauges, Speedo meter, fuel level indicator, temperature indicator, Oil Pressure Indicator, Case studies in mechanical instrumentation.

Module:3	Digital Instrumentation	6 hours

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Internal architecture of digital cluster, cluster ECU, communication of IC with other control units, trip distance calculation, average fuel economy calculation, current gear, fuel quantity measurement, coolant temperature and oil pressure measurement, etc. Head up display, Night vision system

Module:4	Basics of Diagnostics System:	7 hours

Need of diagnostic system, types, Monitoring, Fault Recognition, Fault diagnosis and detection, fault isolation, freeze frame data, fault codes, types of codes, architecture of diagnostic system, Sources of diagnostic data, Error Detection and
Correction, Safety Logic, Functional Software Safety

Module:5	**Diagnostics System for ECU:**	**7 hours**
Off-board Diagnostic Functions, Onboard Diagnostic Functions, Diagnostics for Setpoint Generators and Sensors, Diagnostics for Actuators, Fault Memory Manager, Off-board Diagnostic Communications, Model-Based Fault Recognition and Diagnostic (Eg: Air intake, Misfire detection, exhaust leakage, etc), knowledge based diagnostic, signal based diagnostic, data based diagnostic. Chassis system diagnostic		
Module:6	**On Board Diagnostics:**	**5 hours**
OBD II (Fuel system leakage, Exhaust emission limit,), OBD II standard fault codes, EOBD, OBD Scanners, OBD Port, OBD indications in cluster.		
Module:7	**Diagnostic Tools and Scanners**	**5 hours**
Breakout boxes, Diagnostic tools that connect to ECU (EMS, Airbag ECU, ABS ECU, etc), Diagnostic tools, oscilloscope diagnostic, PC based diagnostic system, diagnostic software and interfaces.		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Tom Denton, "Advanced Automotive Fault Diagnosis". Third edition, 2014.Taylor and Francis eBooks

Reference Books

1.	Barry Hollembeak, "Automotive Electricity and Electronics", Delmar Cengage Learning, 5th edition, 2011
2	William, B. Ribbens, "Understanding Automotive electronics", ButterWorth Heinemann 1998.
3	Uwe Kiencke, and Lars Nielsen, "Automotive Control Systems, For Engine, Driveline, and Vehicle". 2nd edition Springer Verlag, 2005.
4	Tracy Martin, "How to diagnose and repair automotive electrical systems", First Edition, 2005, MBI Publishing company

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course code	Automotive Control Systems	L	T	P	J	C
MEE2045		2	0	0	4	3
Pre-requisite		Syllabus version				
		v. 1.0				

Course Objectives:

1. The students can learn basic knowledge about control system and automotive systems.
2. The students able to impart the response of a system and its stability concepts.
3. The students can know the modeling of physical systems.
4. The student will be well versed in the recent trends of automotive systems

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1. To impart basic knowledge about the open loop and close system and modeling of a system
2. To acquire the different order of a system with response and its stability concepts.
3. To analyze the PID controller and design a system with lead and lag compensator.
4. To develop the state space model for automotive systems.
5. To analyze the model of vehicle control system.
6. To understand modern automotive systems and its requirements.

Module:1	Introduction:	7 hours

Open loop and closed loop systems-Transfer function of elements - Modeling of physical systems - Mechanical systems - Translational and Rotational systems - Thermal systems - Introduction to Block Diagrams - Signal Flow Graphs.

Module:2	System Response:	3hours

First order, Second order control system response for Step, Ramp and Impulse inputs - Characteristic Equation, Poles and Zeroes concept.

Module:3	Stability Analysis:	4 hours

Stability analysis- Routh Hurwitz stability criteria – stability in the frequency domain –gain and phase margins.

Module:4	Control System Design:	5hours

Proportional, Integral, Derivative controllers, P, PI, and PID control - Design in the frequency domain- lead, lag compensator design

Module:5	Modeling of Physical Systems:	4 hours

Fundamentals of State Space representation - State Models .Modeling of Suspension System- Power steering System

Module:6	Vehicle Control System:	4hours

ABS control systems –control of yaw dynamics – engine model for lambda control - knock control.

Module:7	Recent Trends	3hours

Airbags, collision avoiding system, low tire pressure warning system			
	Total Lecture hours:	**30 hours**	

Text Book(s)	
1.	Uwe Kiencke and Lars Nielsen, "Automotive Control Systems: For Engine, Driveline, and Vehicle", 2nd Edition, Springer, 2010.
Reference Books	
1.	I.J. Nagrath and M. Gopal, "Control Systems Engineering", 4th Edition, New Age International (P) Limited, 2006
2	Norman S. Nise, "Control Systems Engineering", 6th Edition, Wiley, 2010
3	Katsuhiko Ogata, "Modern Control Engineering", 5th Edition, Prentice Hall, 2009
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course code	Automotive Braking Systems	L	T	P	J	C
MEE2046		2	0	0	4	3
Pre-requisite	MEE1036	Syllabus version				
		v. 1.0				

Course Objectives:

1. To enable students to gain essential and basic knowledge of various types of brake system, so as to equip them to design the brake systems.
2. To train students with sufficient fundamentals to understand the kinematic and kinetic functionality of brake system.
3. To equip students to perform the stability analysis of brake system.
4. To impart knowledge of conducting experiments as per standardised procedures and protocols to test the brake system.
5. To provide students with sufficient knowledge to select the correct braking materials relevant to the operating conditions.

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1. Identify, select and design the appropriate brake among the mechanical, hydraulic, air and vacuum brake systems based on the suitability to the vehicle.
2. Analyse the kinematic and kinetic performance of brake system.
3. Analyse the stability of brake system.
4. Design and conduct experiments as per procedures and protocols to test the brake system.
5. Recognize and choose the correct braking materials relevant to the applications.

Module:1	Introduction:	4 hours

Types of brakes - Principles of shoe brakes - Constructional details - Materials - Braking torque developed by leading and trailing shoes - Disc brake theory - Constructional details - Advantages - Brake actuating system - Mechanical brakes - Factors affecting brake performance viz. operating temperature, area of brake lining, brake clearance

Module:2	Hydraulic Brakes:	4 hours

Power and power assisted brakes - Hydraulic principles and their application to vehicle - Master cylinders - Wheel cylinders - Split braking systems - Brake fluid - Brake pipes and hoses - Brake adjustment - Bleeding of brakes. Vehicle - Master cylinders - Wheel cylinders - Split braking systems - Brake fluid - Brake pipes and hoses - Brake adjustment - Bleeding of brakes.

Module:3	Air and Vacuum Brakes:	4 hours

Air brakes - Wagner air brake - Vacuum brakes - Brake valve - Unloader valve - Diaphragm - Air-hydraulic brakes - Vacuum boosted hydraulic brakes – trouble shooting.

Module:4	Brake System Analysis:	4 hours

Functional Requirements - System design methodology - Kinematic analysis of braking - kinetics of braking vehicle - Braking proportion and adhesion utilization - Material requirements.

Module:5	Brake Stability Analysis:	4 hours

Load Distribution, Stability on Curved Track and on slope, Gyroscopic Effect, weight Transfer

during Acceleration, Cornering and Braking, Overturning and Sliding.			
Module:6	**Testing of Brakes:**		**4 hours**
Instrumentation and Data Acquisition in Experimental Brake Testing- Experimental Design, Test Procedures and Protocols for Brake Testing - Wear Test Procedures - Standardised Test procedures - Brake Test Data Interpretation and Analysis.			
Module:7	**Advanced Braking Materials:**		**4 hours**
Composite materials in transport friction applications - Thermally sprayed surface coatings for automotive brake applications - Modelling of disc-brake squeal and brake judde**r.**			
Module:8	**Contemporary issues:**		**2 hours**
	Total Lecture hours:	**30 hours**	

Text Book(s)	
1.	Braking of Road Vehicles - Andrew Day, Butterworth-Heinemann, 2014
Reference Books	
1.	Automotive Engineering - Powertrain, Chassis System and Vehicle Body - David A. Crolla, Butterworth- Heinemann, First Edition, 2009
2	A Practical Approach to Motor Vehicle Engineering and Maintenance - Allan Bonnick, Derek Newbold, Butterworth-Heinemann, Third Edition, 2011
3	The Automotive Chassis: Engineering Principles - Prof. Dipl. Ing. Jörnsen Reimpell, Dipl. Ing. Helmut Stoll, Prof. Dr. Ing. Jürgen W. Betzler, Butterworth-Heinemann, Second Edition, 2001
4	Automotive mechanics – Joseph I Heintner, Affiliated East West Press, New Delhi/Madras,1967
5	Automobile Engineering – G.B.S. Narang, Khanna Publications, New Delhi, 1982

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course code	Automotive Suspension and Steering Systems	L	T	P	J	C
MEE2047		2	0	0	4	3
Pre-requisite	MEE1036	Syllabus version				
		v. 1.1				

Course Objectives:

To provide the students with sufficient background to understand the steering and suspension systems so as to enable them to design a steering and suspension system for better ride and comfort.

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1. Understand the construction and mechanism of steering system components
2. Gain knowledge on various suspension systems used in automotive vehicles
3. Gain knowledge on computer controlled suspension systems
4. Understand the mechanisms involved in the stability of vehicle
5. Study of various steering and suspension system used in automotive vehicles
6. Understand the recent development in the area of suspension and steering systems

Module:1	Steering System	6 hours

Axle parts and materials - Loads and stresses - Front axle loads - Steering heads - Factors of wheel alignment - Wheel balancing - Centre point steering - Correct steering angle - Steering mechanisms - Cornering force - Self-righting torque - Under steer and over steer - Lift off over steer - Torque steer

Module:2	Mechanism and Linkages	6 hours

Condition for perfect rolling - Ackermann mechanism - Davis Mechanism - Steering linkage for rigid axle suspension - Steering linkage for independent suspension - Steering gears - Special steering columns

Module:3	Power Assisted Steering	5 hours

Hydraulic power assisted steering - Integral piston linkage - Rack and pinion - External cylinder power assisted, Electric and electronic power assisted steering

Module:4	Introduction to Suspension Systems	6 hours

Basic considerations - Types of suspension springs - Rubber springs - Plastic springs - Pneumatic suspension - Hydraulic suspension -Telescopic shock absorbers - Independent suspension - Front wheel independent suspension - Rear wheel independent suspension - Types - Stabilizer Rod

Module:5	Computer – Controlled Suspension Systems	6 hours

Introduction - Programmed ride control system - Electronic air suspension system - Air suspension system design variations - Vehicle dynamic suspension system - Electronic suspension control (ESC) system, Integrated electronic systems and networks

Module:6	**Stability Control**	**6 hours**
Vehicle stability control - Active roll control systems - Active cruise control - Lane departure warning systems - Collision mitigation systems - Telematics		
Module:7	**Case Studies in Steering and Suspension**	**6 hours**
Bose suspension system - Continental electronic air suspension - Nissan 4 WAS - Hydraulic tiller steering control -Integrated steering shaft lock for motorcycles		
Module:8	**Recent Trends**	**4 hours**
TrendsFour wheel steering systems - Electronically controlled four wheel steering - Input sensors - Quadra steer four wheel steering system operation – Rear active steering system.		

	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	Automotive Engineering - Powertrain, Chassis System and Vehicle Body - David A. Crolla, Butterworth-Heinemann, First Edition, 2009
Reference Books	
1.	A Practical Approach to Motor Vehicle Engineering and Maintenance - Allan Bonnick,
2	Derek Newbold, Butterworth-Heinemann, Third Edition, 2011
3	The Automotive Chassis: Engineering Principles - Prof. Dipl. Ing. JörnsenReimpell,
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course code	Applied Hydraulics and Off Road Vehicles	L	T	P	J	C
MEE2048		3	0	0	0	3
Pre-requisite	MEE1032	Syllabus version				
		v. 1.0				

Course Objectives:

1. To know the advantages and applications of fluid power engineering and power transmission system.
2. To learn the applications of fluid power system in the automation.
3. To make students to be familiar with circuit components and the circuit design.
4. To make students to be conversant with different off road vehicles.
5. To enable the students to recognize the different maintenance procedures of off-road vehicles.
6. To make students to be familiar with latest trends in the field of off road vehicles.

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1. Comprehend the different pumps and actuators
2. Explain the construction and working of different control circuit components.
3. Devise a suitable control circuit for actuating components.
4. Identify the suitable off road vehicle for the intended application and able to evaluate their merits and demerits.
5. Elucidate the different maintenance procedures of off road vehicles.
6. Explicate the recent trends in the field of off road vehicles.

Module:1	Pumps and Actuators:	6 hours

Fluid power – advantages, pumps – classification, construction and working, performance, Linear Hydraulic Actuators and its Mechanics, Hydraulic Rotary Actuators, Gear motors, vane motors, piston motors, hydraulic motor performance, hydraulic fluids

Module:2	Control Circuit Components:	5 hours

Directional Control Valves – Symbolic representation, Constructional features, pressure control valves – direct and pilot operated types, flow control valves.

Module:3	Circuit Design:	7 hours

Control of single and double – acting Hydraulic Cylinder, regenerative circuit, pump unloading circuit, Double pump Hydraulic system, Counter Balance Valve application, Hydraulic cylinder sequencing circuits. Locked cylinder using pilot check valve, cylinder
synchronizing circuits, speed control of hydraulic cylinder, speed control of hydraulic motors, accumulators and accumulator circuits.

Module:4	Tractors:	7 hours

Tractors, Chassis and Transmission, Rating of Tractors, Wheeled and Crawler tractor, Crawler track, running and steering gears. Power Take Off units,
Platform lift trucks, Fork lift trucks

Module:5	Earth Moving Machines:	7 hours

Bulldozers, cable and hydraulic dozers, scrapers, drag and self-Powered types - dump trucks and

dumpers - loaders, single bucket, multi bucket and rotary types - power and Capacity of earth moving machines,			
Module:6	**Scrapers, Graders:**		**7 hours**
Scrapers, elevating graders, self-powered scrapers and graders. Shovels and Ditchers: Power shovel, revolving and stripper shovels - drag lines - ditchers - capacity of shovels. Land clearing machines: Bush cutter, stampers, tree dozer, rippers.			
Module:7	**Maintenance of Off Road Vehicles**		**4 hours**
Maintenance of Tractors, Earth Moving Machines, Scrapers, Graders and Land clearing machines			
Module:8	**Recent Trends**		**2 hours**
	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	Mahesh Varma, "Construction Equipment and its Planning and Application", Metropolitan Books Co., Delhi, 2004
Reference Books	
1.	Anthony Esposito, "Fluid Power with applications", Fifth edition Pearson education, Inc. 2000
2	Abrosimov. K. Bran berg.A. and Katayer.K., "Road making Machinery", MIR Publishers, Moscow, 1971
3	Wang.J.T., "Theory of Grand vehicles", Jhn Wiley & Sons, New York, 1987.
4	S.R. Majumdar, "Oil Hydraulic Systems - Principles and Maintenance", Tata Mc Graw Hill publishing company Ltd. 2001.
5	R.L. Peurifoy, "Construction Planning Equipment and Methods", McGraw Hill Publishers, 1956

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course code	Manufacturing of Automotive Components	L	T	P	J	C
MEE2049		3	0	0	0	3
Pre-requisite	MEE1007	Syllabus version				
		v. 1.0				

Course Objectives:

1. To acquaint the students with the basic concepts of manufacturing process.
2. To make the students to be familiar with different techniques of surface coatings.
3. To introduce the students the potential of plastics and their implications in making automotive components.
4. To make the students to be familiar with latest manufacturing techniques adopted in automobile industries.

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1. Comprehend the steps involved in the manufacturing of engine components through casting and forging with their relative merits and demerits.
2. Identify the optimal material and manufacturing process for making the transmission system and other chassis components.
3. Analyze and make a selection out of different forming and welding techniques for manufacturing automotive components.
4. Evaluate the performance of different coating techniques
5. Explicate the importance of plastics and their fabrication techniques.
6. Comprehend the recent manufacturing techniques followed in automotive industries.

Module:1	Casted Engine Components	7 hours

Material selection and Manufacturing methods for Piston, Piston rings, Cylinder block, wet and dry liners, Engine head, Oil pan, Carburetors. Thermal barrier coating of Engine head and valves.

Module:2	Forged Engine Components	6 hours

Material selection and Manufacturing methods for Crank shaft, Connecting rod, Cam shaft, valve, Piston pin, Push rod, Rocker arm, tappets, spark plug

Module:3	Transmission System	7 hours

Material selection and Manufacturing methods for Clutch – Clutch lining – Gear Box – Gear – Propeller Shaft – Differential – Axle Shaft – Bearing – fasteners – Wheel drum. Methods of Gear manufacture – Gear hobbing and gear shaping machines - gear generation - gear finishing and shaving – Grinding and lapping of hobs and shaping cutters – gear honing – gear broaching

Module:4	Vehicle Chassis	7 hours

Material selection and manufacturing methods for chassis, dead axle, leaf spring, coil spring and shock absorbers – wheel housing – steering system, Brake shoes, wheel rim, Tyres.

Module:5	Body Components	7 hours

Introduction, thermoforming and hydro forming, press forming, welding of body panels,

resistance, welding and other welding processes. Introduction - moulding of instrument panel, moulding of bumpers, reinforced reaction injection moulding, tooling and tooling requirements, manufacture of metal/polymer/metal panels. Adhesives and sealants, leaf spring manufacturing, composite leaf springs, wrap forming of coil springs			
Module:6	**Surface Coatings**		**4 hours**
Chemical vapour deposition, physical vapour deposition, sol-gel processing, spraying, plating, paining in paint booth.			
Module:7	**Plastics**		**5 hours**
Plastics – Plastics in Automobile vehicles – Processing of plastics - Emission control system – catalytic converter – Hydro forming of exhaust manifold and lamp housing – stretch forming of Auto body panels – MMC liners –Selection of materials for Auto components. Use of Robots in Body weldment			
Module:8	**Recent Trends**		**2 hours**
	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	Serope Kalpakjian and Steven R. Schmid, Manufacturing Processes for Engineering Materials, Fourth Edition, Pearson Education publications – 2013.
Reference Books	
1.	Philip F. Ostwald & Jairo Munuz, Manufacturing Processes and Systems, John Wiley & Sons, New York, 1998.
2.	Degarmo E.P., Materials and process in Manufacturing, Macmillan Publishing Co., 1997.
3.	Heldt P.M., High Speed Combustion Engines, Oxford IBH publishing Co., Calcutta, 1996.
4.	Kalpakjian, Manufacturing and Engineering and Technology, Addison Wesloy Publishing Company, 1995.

Recommended by Board of Studies	17/08/2017		
Approved by Academic Council	47	Date	05/10/2017

Course code	Vehicle Dynamics	L	T	P	J	C
MEE2050		2	2	0	0	3
Pre-requisite	MEE1002- Engineering Mechanics	Syllabus version				
		v. 1.1				

Course Objectives:

1. To make the students understand the fundamentals of vibration and its application in vehicles
2. To make the students understand the behavior of tyres
3. To make the students learn about the stability of the vehicles
4. To make the students learn about the roll stability and vehicle handling characteristics

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1. Evaluate the natural frequency of a single and multi-degree freedom systems
2. Predict the stability of vehicle at different operating conditions
3. Predict the behavior of tyres during braking, acceleration and cornering
4. Discuss the roll stability of a vehicle
5. Analyse the directional stability of the vehicle during cornering

Module:1	Vibration	4 hours

Vibration System and human comforts, One DOF, Two DOF, Free and Forced Vibration, Random Vibration, Magnification and Transmissibility, Vibration Absorber.

Module:2	Vehicle Vibrations	4 hours

Multi DOF systems, Modal Analysis, Vehicle Vibration Models- Quarter Car and Half Car Model

Module:3	Stability of Vehicles	4 hours

Load Distribution, Stability on Curved Track and on slope, Gyroscopic Effect, weight Transfer during Acceleration, Cornering and Braking, Overturning and Sliding. Cross wind stability and Equations of motions

Module:4	Tyre Dynamics	4 hours

Rolling Radius, Rolling Resistance – Factors, Forces acting on tyres – Tractive and Braking efforts, Dynamic Tyre Stiffness, Vibration Characteristics, Noise Levels of Tyres

Module:5	Cornering Behavior:	4 hours

Behavior while Cornering, Slip angle, Cornering force, Cornering Properties, Camber Thrust, Camber Scrub and Camber Steer

Module:6	Suspension and Roll Stability:	4 hours

Road irregularities, Suspension Angles, Roll Center, Roll Axis, Roll Center Height, Roll Stability, Suspension Roll and Bump steer.

Module:7	**Vehicle Handling:**		**4 hours**
Steady State Handling Characteristics- Under steer, Over steer, Directional stability of vehicles. Steady state response to steering input, handling Diagram			
Module:8	**Contemporary issues:**		**2 hours**
Active Suspension Systems, Suspension Optimization			
	Total Lecture hours:	**30 hours**	

Text Book(s)	
1.	Rao V. Dukkipati, Jian Pang, "Road Vehicle Dynamics problems and solution",SAE,2010.
Reference Books	
1.	Thomas D.Gillespie, "Fundamentals of vehicle dynamics",SAE,1992
2	J.G. Giles, "Steering, Suspension and Tyres", Illiffe Books Ltd., 1968.
3	J. Y. Wong, "Theory of Ground Vehicles", John Wiley and Sons Inc., New York, 2001.
4	David Corolla, "Automotive Engineering: Power-train, chassis system and Vehicle Body', Butterworth Heinmann, 2009

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course code	Design of Chassis Components	L	T	P	J	C
MEE3016		2	0	0	4	3
Pre-requisite	MEE1036, MEE1032	Syllabus version				
		v. 1.0				

Course Objectives:

1 To acquaint the students with the basic concepts of design process.
2 To make the students understand the importance of various types of loads in designing in the automotive chassis components.
3 To introduce the students the systematic design procedure adopted in the design of suspension and transmission components in a vehicle.
4 To make the students to be familiar with latest design tools adopted in industries.

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1 Comprehend the steps involved in the design process and analyze the influence of different factors influencing the design process.
2 Compute the dimensions of chassis components subjected to static and fatigue loads considering different failure theories.
3 Compute the critical dimensions of chassis components involved in the suspension and transmission systems of a vehicle.
4 Comprehend the modern design tools being followed in industries.
5 Gain the knowledge and design of real axle housing and final drive.

Module:1	Introduction to Design Process	4 hours

Introduction to Design process – Factors – Materials selection, Direct, Bending and Torsional stress equation - Impact and Shock loading - Stress concentration factor - Size factor - Surface limits factor - Factor of safety - Design stress - Theories of failures.

Module:2	Fatigue Strength	3 hours

Variable and cyclic loads – Fatigue strength – S- N curve – Continued cyclic stress – Soderberg and Goodman equations. Study of loads-moments and stresses on frame members.

Module:3	Frames and Springs	4 hours

Design of frame for passenger and commercial vehicle - Design of Helical – Leaf - Disc springs under Constant and Varying loads.

Module:4	Clutch	5 hours

Design of single plate clutch, multiplate clutch and cone clutch. Torque capacity of clutch. Design of clutch components, Design details of roller and sprag type of clutches.

Module:5	Gear Box	4 hours

Gear train calculations, layout of gearboxes. Calculation of bearing loads and selection of bearings. Design of three speed and four speed gearboxes.

Module:6	Drive Line	4 hours

Design of propeller shaft. Design details of final drive gearing. Design details of full floating, semi-floating and three quarter floating rear shafts.			
Module:7	**Axles**		**4 hours**
Design of rear axle housings and design aspects of final drive. Design of front axle.			
Module:8	**Recent Trends**		**2 hours**
Advanced Design Tools used in Industry			
	Total Lecture Hours	**30 hours**	

Text Book(s)	
1.	Giri, N.K., Automobile Mechanics, Khanna publishers, New Delhi, 2007
Reference Books	
1.	Khurmi. R.S. & Gupta. J.K., A textbook of Machine Design, Eurasia Publishing House (Pvt) Ltd, 2001.
2.	Heldt, P.M., Automotive Chassis, Chilton Book Co., 1992.
3.	Dean Averns, Automobile Chassis Design, Illife Book Co., 2001.

Recommended by Board of Studies	17/08/2017		
Approved by Academic Council	47	Date	05/10/2017

Course code	Automotive HVAC	L	T	P	J	C
MEE3017		3	0	0	0	3
Pre-requisite	MEE2038	Syllabus version				
		v. 1.0				

Course Objectives:

1. To help students gain essential and basic knowledge on requirement, design and analysis Automotive HVAC system, so as to equip them with knowledge required for getting exposure on HVAC systems for different classification of vehicles.
2. To train the students with the performance evaluation parameters of HVAC systems.
3. To equip the students to analyse various components of HVAC systems.
4. To impart knowledge of environmental issues related to HVAC systems.
5. To impart knowledge on testing and troubleshooting procedures for HVAC systems.
6. To teach students about the importance of advances and trends in HVAC systems.

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1. Understand the requirement and suggest a suitable type HVAC system for a vehicle
2. Explain the air-conditioning refrigeration cycle and describe the operation of the system
3. Develop clear understanding about functioning of the HVAC system
4. Perform heating and air conditioning system inspection, maintenance, adjustments and repair
5. Gain proficiency in load analysis, distribution systems and control devices
6. Evaluate the environmental impact, cost and economics of a HVAC system

Module:1	Introduction:	5 hours

Methods of refrigeration - Applications of refrigeration & air conditioning -Automobile air conditioning -Air conditioning for passengers, isolated vehicles, transport vehicles-Applications related with very low temperatures. Thermoelectric cooling and Thermo acoustic refrigeration. .

Module:2	Refrigerants	5 hours

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Classification, properties and selection criteria - Commonly used refrigerants - Alternative refrigerants - Eco-friendly refrigerants - Applications of refrigerants -Refrigerants used in automobile air conditioning.

Module:3	Psychometry:	5 hours

Psychometric properties, tables, charts - Psychometric processes - Comfort charts - Factor affecting comfort - Effective temperature - Ventilation requirements

Module:4	Air Conditioning Systems	7 hours

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Classification and layouts - Central / unitary air conditioning systems - Components like compressors, evaporators, condensers, expansion devices, fan blowers, heating systems etc.

Module:5	Load Analysis:	7 hours

Outside & inside design consideration - Factors forming the load on refrigeration & air

conditioning systems - Cooling & heating load calculations - Load calculations for automobiles - Effect of air conditioning load on engine performance		
Module:6	**Distribution Systems:**	**7 hours**
Distribution duct system, sizing, supply / return ducts - Types of grills, diffusers, ventilation, air noise level - Layout of duct systems for automobiles and their impact on load calculation.		
Module:7	**Control Devices:**	**7 hours**
Air Routine & Temperature Control: Objectives - evaporator care air flow - Through the dash re-circulating unit - Automatic temperature control - Controlling flow - Control of air handling systems, Air Conditioning Control: Common control such as thermostats- Humidistat us - Control dampers - Pressure cutouts and relays		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Mark Schnubel, “Automotive Heating and Air Conditioning”, Today’s Technician, 5th edn, 2013
Reference Books	
1.	Steven Daly, “Automotive Air Conditioning and Climate Control Systems”, Butterworth-Heinemann; 1 edition (2006)
2	Norman C. Harris, “Modern Air-Conditioning Practice”, McGraw-Hill Education 1984
3	R.J. Dossat, “Principles of Refrigeration”, Prentice Hall, 5th ed, 2001.
4	Paul Lung, "Automotive Air Conditioning", C.B.S. Publisher & Distributor, (Delhi. 1991)
5	W.F. Stoecker and J.W. Jones, “Refrigeration and Air-Conditioning”, Tata McGraw Hill Pub, 1982

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Approved by Academic Council	No. 47	Date	05-10-2017

Course code	Noise, Vibration and Harshness	L	T	P	J	C
MEE3018		3	0	0	0	3
Pre-requisite	MEE2004	Syllabus version				
		v. 1.0				

Course Objectives:

1. To help the students to acquire in-depth knowledge of vibration and its control of an automobile.
2. To make students to understand the different sources of engine and mechanical noises.
3. To enable the students with the knowledge of noise, harshness and vibration control.

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1. Evaluate the single and two degree of freedom systems all types of vibrations and determining the natural frequencies.
2. Possess the knowledge of vibration control through dampers, isolators in IC Engines and calculating the modal analysis of the shock absorbers
3. Prediction and measurement of engine and mechanical noise of an automobile.
4. Gain the knowledge of controlling the various sources of noise by different methods.
5. Ability to measure and control harshness, vibration using various methods.

Module:1	Vibration	7 hours

Free and forced vibration, un-damped and damped vibration, linear and non linear vibration, response of damped and un-damped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.

Module:2	Vibration Control	6 hours

Vibration isolation, tuned absorbers, untuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers

Module:3	Engine Noise	6 hours

Introduction noise dose level, legislation, measurement and analysis of noise in engines, Noise characteristics, overall noise levels, assessment of combustion noise, engine radiated noise.

Module:4	Mechanical Noise	6 hours

Assessment of mechanical noise, intake and exhaust noise, engine accessory contributed noise, transmission noise, aerodynamic noise, tyre noise, brake noise.

Module:5	Noise Control:	6 hours

Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers

Module:6	Harshness:	6 hours

Harshness, sources. its effects, measurement and control		
Module:7	**Measuring Instruments**	**6 hours**
Vibration Instruments- Vibration Exciters, Analyzers, Principle, Free and Forced Vibration test, Frequency and Domain Analysis, Sound Intensity and mapping and introduction to array technique. Digital Signaling Process		
Module:8	**Recent Trends**	**2 hours**
# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical cut section models to lecture, Visit to Industry, Min of 2 lectures by industry experts		

	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	Malcom J. croker, "Noise and Vibration Control", Wiley, 2007
Reference Books	
1.	Norton MP "Fundamental of Noise and Vibration", Cambridge University Press, 2003.
2.	Boris and Korney, "Dynamic Vibration Absorbers", John Wiley,1993.
3.	Lewis L, "Industrial Noise Control", McGraw Hill Inc,1991.

Recommended by Board of Studies	17/08/2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course code	Computational Fluid Dynamics	L	T	P	J	C
MEE4006		2	2	2	0	4
Pre-requisite	MEE1004, MEE2005, MAT3005 (or) MEE1032, MEE1033/MEE2005, MAT3005	Syllabus version				
		v. 2.2				

Course Objectives:

1. To provide the students with sufficient background to understand the mathematical representation of the governing equations for fluid flow and heat transfer problems.
2. To equip the students to address complex fluid flow and heat transfer problems by approximating the governing differential equations with boundary conditions through Finite difference and finite volume discretization methods.
3. To enable students to understand different types of grid and its attributes and their suitability for different engineering applications
4. Develop the students to use appropriate turbulence model for solving engineering problems.

Expected Course Outcome:

Upon successful completion of the course the students will be able to

1. Apply mathematics and engineering fundamentals to recognize the type of fluid flow and heat transfer that occur in a particular physical system and to use the appropriate model equations to investigate the problem.
2. Solve governing equations using finite difference discretization technique
3. Solve governing equations using finite volume method
4. Generate appropriate type of grids required for solving engineering problems accurately.
5. Apply suitable turbulence model for the chosen real world engineering problems.
6. Solve fluid flow and heat transfer problems using commercial CFD tools

Module:1	Introduction	1 hour

CFD overview - Applications of CFD.

Module:2	Governing Equations of Fluid Dynamics and Heat Transfer:	6 hours

Models of Flow – Conservation and Non-conservation form - Continuity, Momentum and Energy Equation in conservation and non-conservation form (differential equations only) - Characteristics of PDE's - elliptic, parabolic and hyperbolic.

Module:3	Discretization and Finite Difference method	7 hours

Discretization: Basic aspects of Discretization – Comparison of finite difference, finite volume and finite element techniques.

Finite Difference method: Forward, Backward and Central difference schemes, Transient one and two dimensional conduction - Explicit, implicit, semi-implicit and ADI methods - Stability analysis and error estimation.		
Module:4	**Grid Generation**	**3 hours**
Grid Generation: Choice of grid, grid oriented velocity components, Cartesian velocity components, staggered and collocated arrangements.		
Module:5	**Convection and Diffusion**	**7 hours**
Convection and Diffusion: Steady one-dimensional convection and diffusion - Central difference, upwind, quick, exponential, hybrid and power law schemes- False diffusion, SIMPLE – Algorithm.		
Module:6	**Turbulence Modeling**	**4 hours**
Turbulence Modeling : Introduction – Types of Turbulence modeling – Reynolds Time Averaging – Reynolds Time Averaged conservation equations – Boussinesq approach – One equation k - ε model.		
Module:7	**Contemporary issues**	**2 hours**
	Total Lecture hours:	**30hours**

Text Book(s)	
1.	John D Anderson, Computational Fluid Dynamics – The Basics with Applications, 1st Edition, McGraw Hill, 2012.
Reference Books	
1.	Chung T.J, Computational Fluid Dynamics, Cambridge University Press, 2014.
2.	Muralidhar K and Sundararajan T, Computational Fluid Flow and Heat Transfer, Narosa Publications, New Delhi, 2014.
3.	Versteeg H.K and Malalasekara W, An Introduction to Computational Fluid Dynamics - The Finite Volume Method, 2nd Edition, Pearson, 2010.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)		
1.	Modeling of simple and complex geometries.	3 hours
2.	Hexahedral meshing for simple geometries like square duct, circular pipe.	3 hours
3.	O-grid hexa meshing for circular pipe.	3 hours
4.	Tetrahedral meshing for simple geometries including fluid and solid domains.	3 hours
5.	Preprocessing in FLUENT – Case setup and analyzing for already mesh generated model.	3 hours

6.	Steady state temperature distribution in a rectangular plate (ANSYS Fluent and FDM).	3 hours
7.	Diffuser for a hydropower turbine.	3 hours
8.	Flow over an airfoil - Laminar and turbulent flow.	3 hours
9.	Supersonic flow past a wedge in a channel.	3 hours
10.	Exercise (for each student – different exercise) from FLUENT tutorial (case setup, analyzing, and post-processing).	3 hours
	Total Laboratory Hours	**30 hours**

Mode of assessment:			
Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	47	Date	05-10-2017

Course code	Engine Testing and Certification	L	T	P	J	C
MEE4008		3	0	0	0	3
Pre-requisite	NIL	Syllabus version				
		v. 1.1				

Course Objectives:

1. To make students to understand the background of engine testing and calibration.
2. To enable the students to understand the methods of testing the equipment.
3. To familiarize the students to understand the engine testing and calibration.
4. To familiarize the students how to measure and test vehicle parameters.

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1 Acquire the knowledge to understand engine testing and calibration.
2 Explain the principles of engine testing and calibration.
3 Demonstrate different techniques to measure and test engine testing and calibration.
4 Apply engine testing and calibration techniques in real-time.
5 Impart knowledge about advanced special equipment for testing

Module:1	Engine Test Facilities	5 hours

Test cell requirements, cell console & control room, ventilation, air conditioning & exhaust, cooling, lubrication/fuel supply systems, noise & vibration control in test cells, electrical.

Module:2	Engine Dynamometer	7 hours

Engine dynamometers, types of dynamometers, dynamometer panels, engine controllers, data acquisition, engine dynamometer coupling

Module:3	Tests Equipment	7 hours

Fuel consumption meter, air fuel ratio measurement, oil consumption measurement, temperature & pressure measurement, humidity measurement, calibration & maintenance program/ durability

Module:4	In-Cylinder Combustion pressure measurement	6 hours

Dynamic cylinder pressure and volume measurement

Module:5	Engine Measurements	5 hours

Engine test standards, full throttle & part throttle performance, road load testing, ISO mapping, interpolation, heat balance, friction measurement

Module:6	Engine Emission Measurements in various modes	7 hours

Emission analyzers, emission cycles for diesel commercial vehicles, tractors &gensets, steady state and transient cycles, dilution tunnel, particulate emissions, calibration and maintenance.

Module:7	Advanced Engine Testing	5 hours

Use of special equipment, fuel injection pressure, combustion pressure and analysis of data.

Module:8	**Contemporary issues:**		**2 hours**
	Total Lecture hours:	**45 hours**	

Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical cut section models to lecture, Visit to Industry, Min of 2 lectures by industry experts.

Text Book(s)

1.	A.J.Martyr, M.A.Plint, Engine Testing Theory and Practice, SAE International, Third Edition,2007.

Reference Books

1.	J.G. Giles, 'Engine and Vehicle Testing', Illiffe books Ltd., London,1968.
2.	Statistics for Engine Optimization, Edwards, S P, Professional Engineering Publishing Limited, 2000.
3.	Introduction to engine testing and development SAE R-344, Atkins, Richard D, SAE Publisher, 2009.
4.	Automotive Engine Performance: Tune up, Testing and Service, Layne, Ken, Prentice Hall,1986.

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course code	Engine Design and Development	L	T	P	J	C
MEE4009		2	2	0	0	3
Pre-requisite	MEE3015, MEE1032	Syllabus version				
		v. 1.1				

Course Objectives:

1. To provide the students with sufficient background to understand the importance of engine design and development.
2. To equip the students to design various components of an I.C. engine.
3. To teach the students the latest trends in design and development of automotive engines.

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1. Understand the I.C. Engine design requirements.
2. Analysis the various sub systems of an I.C. Engine.
3. Develop theoretical knowledge to design I. C. Engine components.
4. Explain various design parameters considerations in sub systems of engine.
5. Recognize the material requirement for the design of I.C engine components.
6. Understand latest trends in designing and development of automotive engines.

Module:1	Design Requirements	5 hours

Customer & Functional requirements, Overall engine system parameters & configuration, General design considerations, Forces generated within engine, Duty cycle, Downsizing.

Module:2	Cylinder Block	2 hours

Functional requirement, Block materials, Design layout, Basic block, Block head design, Cylinder liner design approach and Thermal loads.

Module:3	Cylinder Head	5 hours

Functional requirement, Cylinder head materials, 2 Valve & 4 valve cylinder heads. Bolts loads and gasket design.

Module:4	Piston Assembly	4 hours

Functional Requirements, Materials – Piston, Piston rings, Piston pin.

Module:5	Connecting Rod	3 hours

Functional Requirements, Materials, Forces acting on Connecting rod assembly.

Module:6	Crank Shaft	4 hours

Functional requirements, Materials, Bearing Pressures and Stresses in crankshaft, Center Crankshaft design, Side or Overhung crankshaft design.

Module:7	Valve Trains	5 hours

Different Configurations of Valve Trains, Functional Requirements, Design of Valves, rocker arms, Valve springs.

Module:8	**Recent Trends in Engines**		**2 hours**
	Total Lecture hours:	**30 hours**	
	Total Tutorial Hours	**15 hours**	

Text Book(s)	
1.	RS Khurmi and J K Gupta, “Machine Design”, 2012.
Reference Books	
1.	Design Of Automotives Engine, Kolchin A. &Demidov V; MIR Publishers,1984.
2.	Goetze, “Piston Rings Manual”, 2008.
3.	Kevin Hoag, “ Vehicular Engine Design”, Springer, 2006.

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course code	Engine Emissions and Control	L	T	P	J	C
MEE4010		3	0	0	0	3
Pre-requisite	MEE3015	Syllabus version				
		v. 1.1				

Course Objectives:

1 To introduce students the sources of pollutants from the SI and CI engines.
2 To impart knowledge of environmental issues related to engine pollution.
3 To train the students to measure pollutants and relate it with various emission norms and driving cycles.
4 To help students gain knowledge about latest technologies in both SI and CI engines.

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1 Analyze the pollution scenario in India and the whole world.
2 Identify the different types of pollutants and its ill effects on environment and human beings.
3 Evaluate the strategic options available to reduce pollutants from engines.
4 Develop an newer technology to reduce pollution from the SI and CI engines.
5 Gain the knowledge on engine emission norms and driving cycles.

Module:1	Introduction:	3 hours

Pollutant - Sources and types - Effects of Automotive Pollutants – Green house effect – Global warming - Effect of emissions on Environment and human beings .

Module:2	Emission Formation in SI engine:	6 hours

Hydrocarbon Emission Mechanism – Flame quenching- crivice volume- valve oevrlap, Carbon Monoxide Formation – PEffects of opearting variables on emission formation in SI engines - Zeldovich Mechanism - - Formation of NOx emissions – Formation of aldehyde emissions.

Module:3	Methods of Controlling SI Engine Emissions :	7 hours

Controlling Techniques – Thermal reactors – Catalytic Converters – Evaporative loss emission and its control device - Charcoal Canister, Positive crankcase ventilation system for unburned hydrocarbon emission- Exhaust gas recirculation.

Module:4	Emission Formations in CI engine:	7 hours

CO and HC Formation in CI engine - NOx formation in CI Engines- Smoke –Types of smoke, Diesel engine Particulates – Carbon Soot- Soluble Organic Fractions(SOF) – Effect of operating variables on CI engine emissions - Chemical delay significance- Cetane number effect- Noise Emission.

Module:5	Emission Controlling Techniques for CI engine:	7 hours

Selective Catalytic Reduction(SCR)- Exhaust gas recirculation – Hot/ Cold, intercooling - Air injection - Particulate Traps-Regenerative Trap - Diesel Oxidation Catalyst(DOC)-Diesel

Particulate Filter(DPF) – Water injection.		
Module:6	**Emission Measurements**	**7 hours**
Methods of measurements – Carbon monoxide and Carbon dioxide measurement by NDIR-Flame Ionization Detector(FID) for HC measurement – NOx measurement by Chemiluminesent detector – Smoke measurement-Types- Soot measurement – Constant volume sampling procedure – Gas Chromatography.		
Module:7	**Emission Norms , Driving Cycles**	**5 hours**
Emission Norms – National and International Standards - Driving Cycles for emission meauremnt – Transeint dynamometers - Chassis dynamometer, Constant Volume Sampling procudure (CVS) system.		
Module:8	**Contemporary Topics**	**3 hours**
Common Rail Direct Injection Diesel Engine – GDI Technology – HCCI Concept – PCCI engine		
# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical cut section models to lecture, Visit to Industry, Min of 2 lectures by industry experts.		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	John B Heywood, “Internal Combustion Engine Fundamentals”, McGraw Hill Education, 2011
2.	Patterson D.J. and Henein N.A,“Emissions from combustion engines and their control,” Ann Arbor Science publishers Inc, USA, 1978
Reference Books	
1.	V. Ganesan, “Internal Combustion Engine”,4th Edition McGraw Hill Education, 2012
2.	Crouse William, Automotive Emission Control, Gregg Division /McGraw-Hill, 1994
3.	James D Halderman, “Automotive Fuel and Emissions Control Systems”, Prentice Hall, 4th Edition, 2015
4.	Klingenberg H, “Automobile Exhaust Emission Testing”, Springer, 2012

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Mode of assessment:			
Recommended by Board of Studies	17/08/2017		
Approved by Academic Council	47	Date	05-10-2017

Course code	Advanced Automotive Power Plants	L	T	P	J	C
MEE4011		3	0	0	0	3
Pre-requisite	MEE3015	Syllabus version				
		v. 1.0				

Course Objectives:

1. To help students gain essential and basic knowledge of various types of energy systems, so as to equip them with knowledge required for the design of component of work producing devices.
2. To train the students with the performance evaluation of energy systems.
3. To equip the students to analyse various components of energy systems.
4. To impart knowledge of environmental issues related to conventional engines.

Expected Course Outcome:

Upon Successful Completion of this course ,Students will be able to

1 Analyse the alternative energy sources of our country
2 Describe the working principles of various energy systems and its component.
3 Estimate the performance parameters of work producing devices
4 Develop clear understanding about functioning of engines and hybrid systems
5 Design structural & electro-mechanical subsystems of electric vehicles.

Module:1	Modern SI Engines	7 hours

Petrol injection systems – Types – Components of Fuel Injection systems – Working principle of TBI, D-Jetronic, L-Jetronic, K-Jetronic, KE-Jetronic systems and Gasoline Direct Injection(GDI) systems.

Module:2	Modern CI Engines	7 hours

Common Rail Direct Injection(CRDI) systems, Low heat rejection engines, Homogeneously Charged Compressed Ignited Engines, Stratified Charged Engine, Multi Fuel Engines, CNG engines

Module:3	Batteries for Electric Vehicles	6 hours

Battery Basics and Types – VRLA, NiMH, Li-ion; Battery Efficiency, Battery Capacity and tests, Battery Charging – VRLA, NiMH, Fast Charging.

Module:4	Fuel Cells for Electric Vehicles	7 hours

Fuel Cell Technology - Types, Ultra Capacitors, Electric Vehicle Battery Performance

Module:5	Electric Motor and Drive Controllers for EV	7 hours

Brushless DC Motor, Brushless PM motor, high frequency motor characteristics – Induction motors, Control strategies, Battery Car conversion technology – Honda EV, Ford E- KA

Module:6	Hybrid Vehicles	7 hours

Hybrid Drive Prospects, Hybrid car types, components and layouts, plug in hybrid vehicles, case studies

Module:7	**Recent Trends**		**4 hours**
Solar cars- photovoltaic cells, tracking, efficiency.			
	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	Mehrdad Ehsani, Yimin Gao, sebastien E. Gay and Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRS Press, 2004.
Reference Books	
1.	Ron Hodkinson and John Fenton, "Light Weight Electric/Hybrid Vehicle Design", Butterworth-Heinemann, 2001.
2.	Heinz Heizler, "Advanced Engine Technology" , Butterworth –Heinemann, 1995
3.	James Larminie and John Loury, "Electric Vehicle Technology-Explained", John Wiley & Sons Ltd., 2003.
4.	Sandeep Dhameja, "Electric Vehicle Battery Systems", Butterworth –Heinemann, 2002.
5.	Ronald K Jurgen, "Electric and Hybrid – Electric Vehicles", SAE, 2002.
6.	Robert Bosch Handbook

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