

Department of Mechanical Engineering

Proposed structure of the Department Specialization in Automotive Design

- 1) Open to students of ME1 and ME2 programs.
- 2) Minimum number of students needed for running the DS for any batch: 20
- 3) Number of credits to be done by the student: 20 credits from the pool of courses given below.
- 4) Course structure:
 - a) Core courses: 2 core courses –
 - i) Automotive Systems (4 credits 3-0-2)
 - ii) BTP – II (7 credits): BTP to be done in the area of Automotive Design
 - b) Elective courses: (all 3 credits, 3-0-0 or 2-0-2)
 - i) Automotive Prime Movers
 - ii) Mechanical Design of prime mover elements
 - iii) Vehicle Dynamics
 - iv) Automotive structural design:
 - v) Biomechanics of Trauma and automotive design
 - vi) Power Train Design
 - vii) Design of Brake systems
 - viii) Design of Electronic Assist Systems in Automobiles
 - ix) Design of Steering Systems

Templates for the following courses are attached.

- i) Automotive Systems
- ii) Automotive structural design:
- iii) Design of Brake systems
- iv) Power Train Design

COURSE TEMPLATE

1.	Department/Centre proposing the course	Mechanical Engg
2.	Course Title (<i>< 45 characters</i>)	Automotive Systems
3.	L-T-P structure	3-0-2
4.	Credits	4
5.	Course number	??
6.	Status (<i>category for program</i>)	Core for DS in Automotive Design, DE for ME1,ME2

7.	Pre-requisites (<i>course no./title</i>)	
-----------	--	--

8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	MEL311 (10%),
8.2	Overlap with any UG/PG course of other Dept./Centre	No
8.3	Supercedes any existing course*	

For 2011 and earlier entry students, this course be considered equivalent to the old MEL737 course.

9.	Not allowed for (<i>indicate program names</i>)	-
-----------	---	---

10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☐ 2 nd sem ☒ Either sem
------------	------------------------------	---

11.	Faculty who will teach the course HH, PMVS, AC, SPS, JK	
12.	Will the course require any visiting faculty?	No

13.	Course objective (<i>about 50 words</i>): Impart an appreciation of science and technology that goes into automobiles.
------------	--

14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): Review of basic engine management systems, alternative fuel systems, fuel ignition systems, hybrid electric vehicles, exhaust emission systems, drivetrain systems, chassis, environmental management and service information systems. Introduction of torque converters, planetary gears, clutches, differentials, all-wheel drive, heating and air conditioning systems, and interaction of tire and road interface. History of engine technology. Detail of starting and charging systems. Details of steering and suspension systems. Details of bearing and lubrication systems.
------------	---

--	--

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	History of engine technology, Engine management systems, alternative fuel systems, fuel ignition systems, hybrid electric vehicles, exhaust emission systems,	8
2	Power train analysis, introduction of torque converters, planetary gears, clutches, differentials, all-wheel drive, heating and air conditioning systems.	10
3	Tire and road interaction	3
4	Analysis of steering and suspension systems	6
5	Bearing and lubrication systems	8
6	Chassis requirements	2
7	Environmental management and service information systems	5
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Engines	4
2	Power Train	4
3	Traction and braking	4
4	Suspension and steering	4
5	Selection of bearings	4
6	Maintenance Schedules	4
7	Fleet emission estimation	4
8		
9		
10		
COURSE TOTAL (14 times 'P')		28

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

To be decided

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	TK solver, Cambridge Engg Selector, FEM software,
------	----------	---

		CAD software, DFMA
19.2	Hardware	Dynamic testing equipment
19.3	Teaching aides (videos, etc.)	Machine element videos
19.4	Laboratory	Design research laboratory, CAGI
19.5	Equipment	LAP tops for students
19.6	Classroom infrastructure	LCD , OHP projectors
19.7	Site visits	Mech equipment manufacturing sites.

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	10
20.2	Open-ended problems	10
20.3	Project-type activity	10
20.4	Open-ended laboratory work	15
20.5	Others (please specify)	10 (term paper)

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department/Centre proposing the course	Mechanical Engg
2.	Course Title (<i>< 45 characters</i>)	AUTOMOTIVE STRUCTURAL DESIGN
3.	L-T-P structure	2 - 0 - 2
4.	Credits	3
5.	Course number	??
6.	Status (<i>category for program</i>)	DE for ME1 and ME2 and for DS in Automotive Design

7.	Pre-requisites (<i>course no./title</i>)	Automotive Systems??, MEL211??, Design of Machines
----	--	--

8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	MEL736 (40% - Students should be allowed to do only one of the two courses)
8.2	Overlap with any UG/PG course of other Dept./Centre	No
8.3	Supersedes any existing course*	No

9.	Not allowed for (<i>indicate program names</i>)	Nil
----	---	-----

10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☐ 2 nd sem ☒ Either sem
-----	------------------------------	---

11.	Faculty who will teach the course Prof. Chawla, Prof S Mukherjee, Prof SP Singh, Dr JP Khatait, Dr N Datla
-----	--

12.	Will the course require any visiting faculty?	No
-----	--	----

13.	Course objective (<i>about 50 words</i>): Familiarize students with requirements, methods and materials for automotive structural design. Design process for the vehicle structure, and the design principles for the different types of vehicle structures like the chassis, the monocoque body would be covered in the course.
-----	--

14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>):
-----	--

	History of automotive design, Design cycle for an Automobile, Styling, Loads on the chassis, Chassis and structural Design for static loads, Dynamic and impact loads, Energy absorption in the vehicle, Designing for NVH, Designing the suspension system, Designing the brake system.
--	--

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction of the course, History of automotive design, Design cycle for an Automobile,	3
2	Vehicle Styling,	2
3	Loads on the chassis, and Simple Structural Surfaces (SSS) Method based analysis of the integral body,	4
4	structural Design for static loads including sizing / design of body sub assemblies, sections and joints	5
5	Designing for impact loads: Energy absorption in the vehicle	6
6	Tools for thin sheet structural design, vehicle occupant system analysis and role of safety devices,	4
7	Designing for Vibration Isolation using mounts and suspensions	4
8		
11		
12		
COURSE TOTAL (14 times 'L')		28

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Load distribution in the vehicle	2
	SSS based structural analysis for different automotive bodies	6
2	Sizing of Sections	4
3	Estimation of energy requirements and Design of energy absorbing systems	6
4	Vehicle Occupant System Analysis	6
5	Design of engine vibration isolators	4
7		
8		
9		
10		
COURSE TOTAL (14 times 'P')		28

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Juian Happian-Smith, Introduction to Modern Vehicle Design, Butterworth-Heinemann, 2002. Brown J. C., Motor Vehicle Structure: Concepts and Fundamentals, Butterworth-Heinemann,

2002.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	Creo, Ansys, HYperworks
19.2	Hardware	PCs / Workstations
19.3	Teaching aides (videos, etc.)	Styling, automotive technology videos, Crash Testing Videos
19.4	Laboratory	CAGI Lab or any other lab with the stated infrastructure
19.5	Equipment	PCs / Workstations with software as above
19.6	Classroom infrastructure	LCD , OHP projectors
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	10
20.2	Open-ended problems	10
20.3	Project-type activity	10
20.4	Open-ended laboratory work	10
20.5	Others (please specify)	-

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department/Centre proposing the course	Mechanical Engg
2.	Course Title (<i>< 45 characters</i>)	DESIGN OF BRAKE SYSTEMS
3.	L-T-P structure	2 - 0 - 2
4.	Credits	3
5.	Course number	??
6.	Status (<i>category for program</i>)	DE for ME1 and ME2 and for DS in Automotive Design

7.	Pre-requisites (<i>course no./title</i>)	Automotive systems, MCL111, APL104
-----------	--	------------------------------------

8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	MEL736 (10%)
8.2	Overlap with any UG/PG course of other Dept./Centre	
8.3	Supersedes any existing course	

9.	Not allowed for (<i>indicate program names</i>)	Nil
-----------	---	-----

10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☐ 2 nd sem ☒ Either sem
------------	------------------------------	---

11.	Faculty who will teach the course Prof AChawla, Dr H Hirani	
------------	---	--

12.	Will the course require any visiting faculty?	No
------------	--	----

13.	Course objective (<i>about 50 words</i>): The primary objective of the course is to introduce the student to Design of Brake systems in automobiles. It would cover issues like locking of brakes and stability of the vehicle during braking, and optimizing brake performance by utilization of adhesion optimally.	
------------	---	--

14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): Types of brakes, Friction materials in brakes and their characteristics, Design of Brakes in Passenger cars / Vans: Weight transfer, effect of tire / road adhesion, wheel lock, brake efficiency / adhesion utilization; Design of Brakes in Vehicle – trailer combinations: in light trailers, overrun brakes, center axle trailer, chassis trailer; Brake-design Analysis: Brake and shoe Factors in different types of	
------------	---	--

	brakes, Comparison of estimation by analytical and FE methods; Thermal Effects in Friction Brakes (Thermal analysis and Heat Dissipation); Issues in Electronic Control of brakes: Features of Anti lock brake system, Traction Control System, Electronic Stability Control, Adaptive Cruise Control, trailer Sway Control; Brake Noise: Sources, its analysis (using analytical and FE based approaches) and control
--	--

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction to the course, Types of brakes, Friction materials in brakes and their characteristics,	2
2	Design of Brakes in Passenger cars / Vans: Weight transfer, effect of tire / road adhesion, wheel lock, brake efficiency / adhesion utilization	4
3	Design of Brakes in Vehicle – trailer combinations: in light trailers, overrun brakes, center axle trailer, chassis trailer	4
4	Brake design Analysis: Brake and shoe Factors in different types of brakes, Estimation by analytical and FE methods.	6
5	Thermal Effects in Friction Brakes (Thermal analysis and Heat Dissipation)	4
6	Issues in Electronic Control of brakes: Features of Anti lock brake system, Traction Control System, Electronic Stability Control, Adaptive Cruise Control, trailer Sway Control	4
7	Brake Noise: Sources, its analysis (using analytical and FE based approaches) and control	4
8		
9		
10		
11		
12		
COURSE TOTAL (14 times 'L')		28

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Brake locking, efficiency and adhesion utilization in passenger cars	4
2	Design of brake parameters for light trailers	4
3	Brake and Shoe Factor Analysis	4
4	Estimating Thermal Effects in Brake Systems	6
5	Design of Brake System for a given passenger car	10
6		
7		
8		
COURSE TOTAL (14 times 'P')		28

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

- | |
|--|
| <ol style="list-style-type: none">1. Julian Happian-Smith, Introduction to Modern Vehicle Design, Butterworth-Heinemann, 2002.2. Day A, Braking of Road Vehicles, Butterworth Heinmann (Elsevier), 2014 |
|--|

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	ANsys / Abaqus, ProEngineer / SOLidWorks / Catia, Matlab / Visual C++
19.2	Hardware	PCs / Workstations
19.3	Teaching aides (videos, etc.)	-
19.4	Laboratory	CAGI
19.5	Equipment	PCs / Workstations
19.6	Classroom infrastructure	LCD , OHP projectors
19.7	Site visits	Mech equipment manufacturing sites.

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	10
20.2	Open-ended problems	10
20.3	Project-type activity	10
20.4	Open-ended laboratory work	10
20.5	Others (please specify)	

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department/Centre proposing the course	Mechanical Engg	
2.	Course Title (<i>< 45 characters</i>)	Power Train Design	
3.	L-T-P structure	3 - 0 - 0	
4.	Credits	3	
5.	Course number	??	
6.	Status (<i>category for program</i>)	Core for MEM elective for ME1,ME2	

7.	Pre-requisites (<i>course no./title</i>)	MEL311 for UG Students	
-----------	--	------------------------	--

8.	Status vis-à-vis other courses (<i>give course number/title</i>)		
8.1	Overlap with any UG/PG course of the Dept./Centre	MEL311 (10%),	
8.2	Overlap with any UG/PG course of other Dept./Centre	No	
8.3	Supercedes any existing course*	MEL412	

For 2011 and earlier entry students, this course be considered equivalent to the old MEL737 course.

9.	Not allowed for (<i>indicate program names</i>)	-	
-----------	---	---	--

10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☐ 2 nd sem ☒ Either sem	
------------	------------------------------	---	--

11.	Faculty who will teach the course HH, JPK		
------------	---	--	--

12.	Will the course require any visiting faculty?	No	
------------	--	----	--

13.	Course objective (<i>about 50 words</i>): Introduction to methodology for design powertrain system for automobiles considering safety, cost, performance, energy consumption, and environmental issues.		
------------	---	--	--

14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): Introduction of components (engines, transmission, clutches and brakes) of automotive powertrain system. Engine Characteristics. Throttle system, Turbochargers, History and design of valve train. Design of variable valve timing system, Exhaust gas recirculation. Materials in powertrain components. Lubrication systems to minimize life cycle costs. Modelling and design of gearbox. Role of control system in advanced (i.e. direct injection, active boosting, camless) powertrain system.		
------------	---	--	--

--	--

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction of components (engines, transmission, clutches and brakes) of automotive powertrain system.	5
2	Engine Characteristics.	3
3	Throttle system	2
4	Turbochargers	2
5	History of valve train. Design of valve train. Design of variable valve timing system.	6
6	Exhaust gas recirculation. (turbocharging?)	2
7	Specialised materials in powertrain.	4
8	Lubrication systems to minimize the maintenance requirement.	2
9	Modelling and design of gearbox.	6
10	Role of control system in advanced (i.e. direct injection, active boosting, camless) powertrain system.	10
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL (14 times 'P')		28

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

--

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	TK solver, Cambridge Engg Selector, FEM software, CAD software, DFMA
19.2	Hardware	Dynamic testing equipment
19.3	Teaching aides (videos, etc.)	Machine element videos
19.4	Laboratory	Design research laboratory, CAGI
19.5	Equipment	LAP tops for students
19.6	Classroom infrastructure	LCD , OHP projectors
19.7	Site visits	Mech equipment manufacturing sites.

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	10
20.2	Open-ended problems	10
20.3	Project-type activity	10
20.4	Open-ended laboratory work	15
20.5	Others (please specify)	10 (term paper)

Date:

(Signature of the Head of the Department)

