

COURSE TEMPLATE

1.	Department/Centre proposing the course	Mechanical Engineering Department
2.	Course Title (<i>< 45 characters</i>)	DESIGN OF PRECISION MACHINES
3.	L-T-P structure	2-0-2
4.	Credits	3
5.	Course number	MEL 7xx
6.	Status (<i>category for program</i>)	DE for MEI, ME2, PE for MEM (A2)
7.	Pre-requisites (<i>course no./title</i>)	For UG: AML140, MEL211, MEL311 For PG: MEL732
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	NONE
8.2	Overlap with any UG/PG course of other Dept./Centre	NONE
8.3	Supercedes any existing course	N/A
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 Jitendra Khatait Sudipto Mukherjee	
12.	Will the course require any visiting faculty?	NO
13.	Course objective (<i>about 50 words</i>): The course gives an insight in the conceptual design of precision mechanisms used in products, tools and equipments. The course aims to enable the student to recognize problem areas, generate design alternatives and make the design choices to achieve precision.	
14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): The course contents will include lectures&hands-on experience covering: 1) Fundamental concepts in precision design, 2) Controlling Degrees of Freedom, Exact-constrained design, 3) Design of elastic mechanisms/ flexures/ compliant mechanisms, 4) Friction, hysteresis and micro-slip, 5) Actuators and Sensors for Precision Motion, 6) Materials Selection in Precision Mechanical Design,	

	7) Slideways for Long Range Precision Motion, 8) Dynamics of Precision Mechanisms.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction	1
2	Fundamental Concepts in Precision Design	3
3	Controlling Degrees of Freedom, Exact-constrained design	4
4	Flexure Mechanisms	4
5	Friction, Hysteresis and Microslip	3
6	Actuators and Sensors for Precision Motion	3
7	Materials Selection in Precision Mechanical Design	3
8	Slideways for Long Range Precision Motion	3
9	Dynamics of Precision Mechanisms	3
10	Conclusion	1
11		
12		
COURSE TOTAL (14 times 'L')		28

16. Brief description of tutorial activities

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17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Problem statement; Design requirements	2
2	Various concepts	2
3	Development and evaluation of concepts	4
4	Concept selection	2
5	Proof of concept	4
6	Detailed design	6
7	Integration and testing	4
8	Demonstration	2
9	Final Presentations	2
10		
COURSE TOTAL (14 times 'P')		28

18. Suggested texts and reference materials

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

1. Soemers H.M.J.R., Design Principles for Precision Mechanism, 978-90-365-3103-0, 2011
2. Smith S.T. and Chetwynd D.G., Foundations of Ultraprecision Mechanism Design, Volume 2 of Developments in Nanotechnology, CRC Press, 2003
3. Alexander H. Slocum, Precision machine design, Prentice Hall, 1992

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

19.1	Software	yes
19.2	Hardware	yes
19.3	Teaching aides (videos, etc.)	yes
19.4	Laboratory	prototyping facilities, machining lab
19.5	Equipment	yes

19.6	Classroom infrastructure	
19.7	Site visits	

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

20.1	Design-type problems	40
20.2	Open-ended problems	10
20.3	Project-type activity	50
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1. **Department Proposing the Course:** Mechanical Engineering
2. **Course number:** ME
3. **L-T-P structure:** 2-1-0
4. **Credits:** 3
5. **Course Title (< 45 characters):** NANOMECHANICS
6. **Pre-requisites:** Engg. Mechanics, Solid Mechanics
7. Status: Departmental Elective
8. Overlap with any existing course of the Department? NO
(If yes, please give course number)
9. Overlap with other UG/PG courses from other Departments/Centers?
(If yes, please give course number)
10. Frequency of offering: Either semester.
11. Faculty who will teach the course: Drs.S P Singh, S K Sinha, D K Dubey, J K Dutt
12. Will the course require any visiting faculty? No.
13. **Course objective (about 50 words):**
The course is designed to introduce to mechanical engineering students, the fundamentals of nano-mechanics which is needed for a twofold purpose. Firstly be able to analyze the behavior of nano structural components and secondly to impart the students with an ability to analyze materials behavior at molecular levels to estimate the gross material properties resulting from inter-molecular interactions. They would also understand the limitations of such an approach.
14. **Course contents (about 100 words):**
(Laboratory/design activities could also be included)

Dynamics of a binary and ternary molecule. Dynamics of an N-atom chain. Lattice theory, Dynamic Interaction Potentials, Periodic Boundary Conditions, Evaluation of Specific Heat. Dissipation processes in nano-mechanical Systems, Dissipation in Nano-scale Mechanical resonators. Solutions for some classical Nano scale structural components, such as Carbon Nanotube, Nano rods and Nanowires. Correlation of Nano-mechanics to classical continuum theory of solids.
15. Lecture Outline (with topics and number of lectures):

Module no.	Topic	No. of lectures
1	Lagrangian methods for multibody systems	4

2	Dynamic Motion of a binary molecule.	2
3	Dynamics of a three atom molecule	2
3	Dynamics of an N-atom chain	2
4	Crystal Lattice Theory	3
5	Dynamic Interaction Potentials	2
6	Periodic Boundary Conditions, use in computations for Periodic Structures	2
7	Dissipation processes in nano-mechanical systems and resonators	2
8	Solutions for some classical Nano scale structural components,	3
9	Atomic Stress calculations	2
10	Connections of Nano-mechanics to classical continuum theory of solids, Introduction to Atomic Finite Element method	4
Total		28

16. Brief description of tutorial activities:
In tutorials, the students will solve some classic problems related to the lecture contents. For this purpose they would also involve programming. Also a Molecular Dynamics Package such as LAMMPS or Materials Studio can be utilized for this purpose.

17. Brief description of laboratory activities: NA

Module no.	Topic	No. of hours
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18. Suggested texts and reference materials
Books

Foundations of Nanomechanics : Andrew N Cleland, Springer International , 2003
Nanomechanics: an extension of Continuum Mechanics to the nanoscale, by Kaibin Fu, VDM verlag, 2009
Introduction to Micromechanics and nanomechanics by Shaofan Li and Gang Wang, World Scientific, 2008
Understanding Molecular Simulation: From Algorithms to Applications by Daan Frenkel and Berend Smit, Academic Press, 2001

19. Resources required for the course (*itemized & student access requirements, if any*):
Software: Matlab., LAMMPS, Materials Studio, NAMD
Hardware: Computers and Workstations
Teaching aides (videos, etc.):
Laboratory: No Specific lab, A Computer lab would be sufficient.
Site visits: Yes (1-2 off-campus visits during the semester)

20. **Design content of the course:**

(Percent of student time on the following, with examples (if possible))

Design-type problems: The course emphasis is on learning new methodologies for tackling dynamic behavior of nanostructures. Design content is not emphasized..

Open-ended problems: Some problems would be open-ended.

Project-type activity: Visit to Nano Research Facility at IITD and relevant short demonstrations related to nanomechanical experiments by an expert

Open-ended laboratory work: Nil.

Others (please specify): ---Most of the problems would be such which have a closed solution, which clarify the fundamentals learnt

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>)	Acoustics and Noise Control	
3.	L-T-P structure	3-0-2	
4.	Credits	4	
5.	Course number	MEL ???	
6.	Status (<i>category for program</i>)	DE for ME1 and ME2	

7.	Pre-requisites (<i>course no./title</i>)	First year engg. mechanics course	
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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 (to allow either this course or MEL746)	MEL733 (20%), MEL746 (50%)	
8.2	Overlap with any UG/PG course of other Dept./Centre (to allow either this course or ITL760)	ITL 760 (60%)	
8.3	Supercedes any existing course*	MEL314	

9.	Not allowed for (<i>indicate program names</i>)	-	
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☐ 2 nd sem ☒ Either sem	
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11.	Faculty who will teach the course S.V. Modak, A.K. Darpe, S.P. Singh, K. Gupta		
12.	Will the course require any visiting faculty?	No	

13.	Course objective (<i>about 50 words</i>): To understand the principles of acoustics, covering generation and radiation of sound; to understand human response to noise; and to learn techniques for measurement and reduction of noise		
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>):		
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	The course covers: Fundamentals of acoustics, Reflection and transmission of waves, Sound sources and generation mechanisms, Human physiological response to noise, Sound measurement, Sound in enclosed spaces, Sound absorption, Acoustic enclosures and barriers, Sound propagation in ducts, Vibration control, Active noise control, Overview of Numerical acoustics.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Fundamentals of acoustics: The acoustic wave equation and its solution sound power, sound pressure, energy density and sound intensity plane and spherical waves, impedances sound pressure addition and subtraction noise reduction combination	5
2	Reflection and transmission of waves from one medium to another, transmission through a thin partition	2
3	Sound sources and generation mechanisms: Radiation from a pulsating sphere, radiation impedance, monopoles, dipoles and quadrupoles line sources, directivity, Sound radiation from vibrating structures, radiation from a plate, radiation efficiency, Aerodynamic noise, flow generated noise	6
4	Human response to noise: Ear, hearing mechanism, hearing threshold, Subjective response, hearing loss, hearing damage, hearing protectors, loudness and loudness contours, standards, measures to quantify occupational and environmental noise, noise criteria for hearing damage, speech interference, ambient and environmental noise	4
5	Noise measurement instrumentation: Microphones, weighting networks, sound level meters, calibration, data loggers, dose meters, frequency analysis, band-pass, 1/1 and 1/3 octave filters, spectrum analyzers, intensity probes	2
6	Sound measurement: sound pressure measurements, sound intensity measurements, surface vibration measurements. sound power measurements from pressure, intensity and vibration	4
7	Sound in enclosed spaces: Sound field in a room, reverberation time, reverberant and direct sound fields, Sabine's equation, sound absorbers, measurement of the room constant	3
8	Sound absorption: Porous sound absorbers, panel absorbers, measurement of sound absorption coefficients, impedance tube, flow resistivity and its measurement	3
9	Acoustic enclosures and barriers: sound transmission loss, STC rating, single and double walls acoustic enclosure design, acoustic barrier design	3
10	Sound propagation in ducts: Acoustic wave propagation in pipes, resonance, Helmholtz resonator, Absorptive and reactive Mufflers, transmission loss	4
11	Vibration control: Vibration isolators, vibration absorbers, damping of vibrating surfaces	3
12	Brief idea of Active noise control	1

13	Brief overview of Numerical acoustics	2
		42
COURSE TOTAL (14 times 'L')		

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Measurement of sound power of a noise source	2
2	Measurement of transmission loss of a panel	2
3	Sound radiation and directivity measurement on a loudspeaker	2
4	Frequency and octave analysis of sound	2
5	Performance evaluation of a muffler for reduction of exhaust noise from an IC engine	2
6	Vibration and acoustic measurement on a vibrating plate	2
7	Environmental noise measurement	2
8	Reverberation time measurement and estimation	2
9	Sound intensity measurement and sound source localization	2
10	Practical on Noise analysis software	2
11	Case study on numerical acoustics	4
12	Visit to a relevant industry	4
COURSE TOTAL (14 times 'P')		28

18. Suggested texts and reference materials

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

1) Fundamental of acoustics, Kinsler and Frey, fourth edition, wiley international. 2) Noise and vibration control engineering: principles and applications, I. VerandL. BeranekWiley, 2006
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19. Resources required for the course (itemized & student access requirements, if any)

19.1	Software	Noise analysis and planning software
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	Sound measurement, sound generation and analysis instruments
19.5	Equipment	----
19.6	Classroom infrastructure	----
19.7	Site visits	----

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

20.1	Design-type problems	Design content depends on the individual projects.
20.2	Open-ended problems	--
20.3	Project-type activity	--
20.4	Open-ended laboratory work	--
20.5	Others (please specify)	--

Date: 30/9/2014

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department/Centre proposing the course	Department of Mechanical Engineering	
2.	Course Title (<i>< 45 characters</i>)	RECIPROCATING INTERNAL COMBUSTION ENGINES	
3.	L-T-P structure	3-0-2	
4.	Credits	4	
5.	Course number	MEL3XX	
6.	Status (<i>category for program</i>)	UG Elective for ME1 & OPEN ELECTIVE ANY UG	

7.	Pre-requisites (<i>course no./title</i>)	MCL 140	
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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	<10% with PG I.C. Engine course	
8.2	Overlap with any UG/PG course of other Dept./Centre	None	
8.3	Supercedes any existing course	None	

9.	Not allowed for (<i>indicate program names</i>)		
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☐ 2 nd sem ☒ Either sem	
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11.	Faculty who will teach the course Prof. M R Ravi, Prof. P M V Subbarao, Prof. Anjan Ray and any other interested faculty from the Thermal Group		
12.	Will the course require any visiting faculty?	No	

13.	Course objective (<i>about 50 words</i>): The main objective of this course is to develop engineering skills in an UG student in the field of reciprocating I.C. engines used as power units for automobile and other stationary generator applications. The course starts with cration of a thermodynamic cycle and development of hardware to satisfy the cycle and other needs of a power unit.		
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): Introduction, Engine Design and Operating Parameters, Ideal Properties Models of Engine Processes and Cycles, Combustion Thermodynamics , Fuel/Air Cycle Analysis, Spark-Ignition Engine Combustion, Spark-Ignition Engine Combustion, SI and Diesel Engine Emissions, IC Engines: The Future.		
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction Engine classification	1
2	Engine Design and Operating Parameters Engine geometry Brake Performance, Indicated Performance, Friction Relationships among performance parameters	2
3	Ideal Properties Models of Engine Processes and Cycles Constant volume (Otto) Constant pressure (Diesel) Limited pressure (Dual) Comparisons of ideal cycle results Ideal intake/exhaust processes Open Cycle calculation with residual mass.	4
4	Combustion Thermodynamics Air and Fuels Combustion Stoichiometry Dissociation Equilibrium combustion products Practical chemical equilibrium First law analysis of closed reacting systems	3
5	Thermodynamic Properties of Engine Working Fluids Working fluids for engine processes Ideal gas mixtures Tables for species properties Curve fits for species properties Computer routines for properties and composition	2
6	Fuel/Air Cycle Analysis Fuel/air cycle computer simulation Fuel/air cycle results: efficiency and performance Comparison with actual cycles Deviation from Ideal Cycle Behavior	5
7	Spark-Ignition Engine Combustion Features of process Flame structure and propagation Factors affecting burning rate Abnormal combustion and knock Combustion chamber design	8
8	Diesel Engine Combustion Features of diesel combustion process Ignition delay Knock in diesel engines	8
9	SI and Diesel Engine Emissions Nature and extent of problem Nitrogen oxides Carbon monoxide Hydrocarbons Particulates Emissions control strategies	3
10	IC Engines: The Future Engine development prospects Stratified charge, direct injection systems Homogeneous charge, compression ignition Low temperature diesel combustion Advanced electronic-controlled engines Hybrids and fuel cells	6
11		
12		
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	Study of Engine Parts	2
2	Performance Test on Engines	6
3	Testing of engine parts	4
4	Design of SI & CI Engines using Ideal Cycle Models	4
5	Design of SI & CI Engines using Improved Cycle Models	6
6	Design of Engine sub-systems	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.

- Internal Combustion Engine Fundamentals – John B Heywood.
- The Internal Combustion Engine in Theory and Practice: Vol. 1 & 2 – Charles Fayette Taylor.
- Engineering Fundamentals of the Internal Combustion Engine—Willard W. Pulkrabek
- Fundamentals of Internal Combustion Engines -- Gill P W., J H. Smith, E J. Ziurys
- Internal Combustion Engines – V Ganesan

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

19.1	Software	MATLAB
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	I.C. Engine Laboratory
19.5	Equipment	
19.6	Classroom infrastructure	LCD and blackboard
19.7	Site visits	

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

20.1	Design-type problems	40% (Design of two wheeler engines, Engines for LCVs & HCVs, Generator units).
20.2	Open-ended problems	
20.3	Project-type activity	10% (Analysis of New Technologies.
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date:

(Signature of the Head of the Department)