

Program Structure: M.Tech (Mechanical Design)

The Mechanical Design program would consist of a 32 credit core, 12 credits of electives from the list marked A1 and 10 credit of other electives with at least two from the list marked A2. A thesis is deemed compulsory through inclusion of 18 credits of research in the core. Total credit would be 54.

The details are as follows:

Name	LTP	Credit
CORE		
Machine Design & Optimization	3-0-2	4
Analytical Dynamics	3-0-0	3
Continuum Mechanics	3-0-0	3
CAD and Finite Element Analysis	3-0-2	4
Major Project Part I	0-0-12	6
Major Project Part II	0-0-24	12
TOTAL		32
ELECTIVES (A1) Twelve Credit from the following list		
Control	3-0-2	4
Vibration and Noise	3-0-2	4
Design with new materials	3-0-2	4
Tribological System Design	3-0-2	4
Automotive Design	3-0-2	4
Robotics	3-0-2	4
ELECTIVES (A2)		
At least two from (A2)		10

A2 is the list of the following courses.

1	MEL744	MEL744	<u>Design for Manufacture and Assembly</u>	3-0-2	4
2	MEL746	MEL746	<u>Design for Noise Vibration and Harshness</u>	3-0-2	4
3	MEL748	MEL748	<u>Tribological Systems Design</u>	3-0-2	4
4	MEL749	MEL749	<u>Mechatronic Product Design</u>	2-0-2	3
6	MEL732	MEL737	<u>Machine Tool Design</u>	3-0-2	4
7	MEL743	MEL743	<u>Plant Equipment Design</u>	3-0-0	3
8	-	MEL750	<u>Biomechanics of trauma and automotive design</u>	3-0-0	3
9	-	MEL849	<u>Special Topics in Systems Design</u>	3-0-0	3
10	MEL738	MEL738	<u>Dynamics of Multibody Systems</u>	2-0-2	3
11	MEL739	MEL745	<u>Advanced Robotics</u>	2-0-2	3
12	MEL835	MEL835	<u>Special Topics in Design Analysis</u>	3-0-0	3
13	MEL731	MEL739	<u>Mechanics of Robots</u>	3-0-2	4
14	MEL836	MEL740	<u>Lubrication</u>	3-0-0	3
15	MEL837	MEL837	<u>Advanced Mechanisms</u>	2-0-2	3
16	MEL838	MEL838	<u>Rotor Dynamics</u>	3-0-2	4
17	MEL840	MEL840	<u>Experimental Modal Analysis and Dynamic Design</u>	2-0-2	3
18	MES830	MES830	<u>Independent Study</u>	0-3-0	3
19	-	MEL834	<u>Vibroacoustics</u>	2-0-2	3

COURSE TEMPLATE

(Please avoid changing the number of tables, rows and columns or text in dark black, but fill only the columns relevant to the template by editing the columns in grey letters or blank columns: this would help in automating the processing of template information for curricular use)

1.	Department/Centre/School proposing the course	Mechanical Engineering	
2.	Course Title	Geometric Modelling and Finite Element Method	
3.	L-T-P structure	3-0-2	
4.	Credits	4	Non-graded Units Please fill appropriate details in S. No. 21
5.	Course number	<Dept Code>L/P/D/S/R/V<No.>	
6.	Course Status (Course Category for Program) (list program codes: eg., EE1, CS5, etc.)		
	Institute Core for all UG programs		(Yes / No)
	Programme Linked Core for:		-
	Departmental Core for:		-
	Departmental Elective for:		-
	Minor Area / Interdisciplinary Specialization Core for:		-
	Minor Area / Interdisciplinary Specialization Elective for:		-
	Programme Core for:		MEM
	Programme Elective for:		
	Open category Elective for all other programs (No if Institute Core)		(Yes / No) YES
7.	Pre-requisite(s)	MCL211, AML140 / 150	
8.	Status vis-à-vis other courses		
8.1	List of courses precluded by taking this course (significant overlap)		(course number)
	(a)	Significant Overlap with any UG/PG course of the Dept./Centre/ School	MEL414 (new number needed)
	(b)	Significant Overlap with any UG/PG course of other Dept./Centre/ School	AM CAD and FE course (705, 706, 710)
8.2	Supersedes any existing course		MEL735
9.	Not allowed for	ME1, ME2, AM??	

10.	Frequency of offering (check one box)	☐ Every semester ☐ I sem ☐ II sem ☐ Either semester
------------	---	---

11.	Faculty who will teach the course Dr D Dubey, A Chawla, S Mukherjee, ????
------------	--

12.	Will the course require any visiting faculty?	(Yes/no) NO
------------	--	-------------

13.	Course objectives (about 50 words. "On successful completion of this course, a student should be able to..."): The primary objective of the course is to impart knowledge of Finite Element and other CAD techniques in Mechanical Engineering. It is intended to be a first course on Finite Element Techniques and Cad tools like surface and solid modeling.
------------	---

14.	Course contents (about 100 words; Topics to appear as course contents in the Courses of Study booklet) (Include Practical / Practice activities): Introduction and overview. Need and Scope of Computer Aided Machine Design. Role of Geometric Modelling, FE and Optimization; 2D and 3D Geometric transformations, Obtaining 2D views from 3D representations: Orthographic and Perspective Projections. Windowing and view-porting; Geometric modeling; Modelling of curves, cubics, splines, beziers and b-splines; Modeling of surfaces; Modeling of solids—b-rep, CSG, octree, feature based modeling; Introduction to the Finite Element Method, principle of potential energy; 1D elements, Derivation of Stiffness and Mass matrices for a bar, a beam and a shaft, FEA using 2D and 3D elements; Plain strain and plain stress problems, plates / shell elements; Importance of Finite element mesh, Automatic meshing techniques; Interfacing with CAD software. Introduction to Dynamic and Non linear analysis; Limitations of FEM
------------	---

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

Module no.	Topic	No. of hours
1	Introduction and overview. Need and Scope of Computer Aided Machine Design. Role of Geometric Modelling, FE and Optimization;	2
2	2D and 3D Geometric transformations,	2
3	Obtaining 2D views from 3D representations: Orthographic and Perspective Projections. Euler angles Windowing, view-porting and viewing transformations	3
4	Modelling of cubic, Bezier and B-spline curves	5

5	Modeling of surfaces: ruled surfaces, surfaces of revolution, Bicubic, Bezier, B-splines;	3
6	Modeling of solids–b-rep, CSG, octree, feature based modeling.	5
7	Introduction to the Finite Element Method, principles of minimization of potential energy: Rayleigh Ritz and Galerkin Methods;	5
8	1D elements, Derivation of Stiffness and Mass matrices for a bar, a beam, trusses	5
9	FEA using 2D and 3D elements; Plain strain and plain stress problems, plate / shell elements;	6
10	Solution methods and Error Control in FE	2
11	Importance of Finite element mesh, Automatic meshing techniques. Introduction to Dynamic and Non linear analysis; Limitations of FEM	4
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities:

Module no.	Description	No. of hours
Total Tutorial hours (14 times 'T')		

17. Brief description of Practical / Practice activities

Module no.	Description	No. of hours
1	Solid Modeling using CAD Software	6
2	Assembly Modeling	2
3	Drawing / Orthographic View Generation	2
4	Transformations / Projections	2
5	1D problem using FE Solvers and convergence	2
6	2D problems using FE solver	4
7	3D meshing and FE solver	6
8	Interfacing CAD and FE packages	2
Total Practical / Practice hours(14 times 'P')		28

18. Brief description of module-wise activities pertaining to self-learning component

(Only for 700 / 800 level courses) (Include topics that the students would do self-learning from books / resource materials: Do not Include assignments / term papers etc.)

Module no.	Description
1	Matrix algebra and Gaussian Elimination
2	Truss analyses as an extension of 1D FE formulation using coordinate transformations
3	Numerical Integration
4	Analysis of Axisymmetric solids subjected to axisymmetric loading as an extension of 2D FE Formulation
5	Analysis of Beams on elastic supports
6	Thermal Analysis
7	Controlling Errors in FE
8	Implementation of Boolean CSG operators
9	Modeling of NURBS and advanced curves
10	Feature Based Modeling and Feature Recognition
11	Regular Boolean Operations and their implementation
12	Geometric algorithms in CAD & FE (convexity, triangulation)
(The volume of self-learning component in a 700-800 level course should typically be 25-30% of the volume covered in classroom contact)	

19. Suggested texts and reference materials

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

1.	Chandrupatla T. & Belegundu A, An Introduction to FE in Engineering, Prentice Hall, 1991.
2.	Kurowski PM, Finite Element Analysis for Design Engineers, SAE Internaional 2004
3.	Cook RD, Malcus DL, Plesha ME Concepts and Applications of Finite Element Method, John Wiley, 1989
4.	Bathe KJ, Finite Element Procedures, PHI, 1996
5.	Mortenson M. E., Geometric Modeling, John Wiley and Sons, 1985
6.	Roger D. F., Mathematical Elements of Computer Graphics, Tata Mc Graw Hill Publishing, 1990
7.	Hearn D. & Baker, Principles of Computer Graphics, Prentice Hall, 1997

20. Resources required for the course (itemized student access requirements, if any)

20.1	Software	ANsys / Abaqus, ProEngineer / SolidWorks / Catia, Matlab / Visual C++
20.2	Hardware	PCs / Workstations
20.3	Teaching aids (videos, etc.)	Videos on Utube / NPTEL.
20.4	Laboratory	CAGIL.
20.5	Equipment	PCs / Workstations
20.6	Classroom infrastructure	LCD , OHP projectors
20.7	Site visits	-
20.8	Others (please specify)	

--	--	--

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

21.1	Design-type problems	Eg. 25% of student time of practical / practice hours: sample Circuit Design exercises from industry
21.2	Open-ended problems	
21.3	Project-type activity	
21.4	Open-ended laboratory work	
21.5	Others (please specify)	

Date: (Signature of the Head of the Department/ Centre / School)

Date of Approval of Template by Senate	
---	--

The information on this template is as on the date of its approval, and is likely to evolve with time.

COURSE TEMPLATE

(Please avoid changing the number of tables, rows and columns or text in dark black, but fill only the columns relevant to the template by editing the columns in grey letters or blank columns: this would help in automating the processing of template information for curricular use)

1.	Department/Centre/School proposing the course	Mechanical Engineering		
2.	Course Title	Design and optimization		
3.	L-T-P structure	3-0-2		
4.	Credits	4	Non-graded Units	0
5.	Course number	<Dept Code>L/P/D/S/R/V<No.>		
6.	Course Status (Course Category for Program) (list program codes: eg., EE1, CS5, etc.)			
	Institute Core for all UG programs		(Yes / No) NO	
	Programme Linked Core for:		List of B.Tech. / Dual Degree Programs	
	Departmental Core for:		List of B.Tech. / Dual Degree Programs	
	Departmental Elective for:		List of B.Tech. / Dual Degree Programs	
	Minor Area / Interdisciplinary Specialization Core for:		Name of Minor Area / Specialization	
	Minor Area / Interdisciplinary Specialization Elective for:		Name of Minor Area / Specialization	
	Programme Core for:		MEM	
	Programme Elective for:		List of M.Tech. / Dual Degree Programs	
	Open category Elective for all other programs (No if Institute Core)		(Yes / No) NO	
7.	Pre-requisite(s)	Design (for UG)		
8.	Status vis-à-vis other courses			
8.1	List of courses precluded by taking this course (significant overlap)		(course number)	
	(a)	Significant Overlap with any UG/PG course of the Dept./Centre/ School	(course number)	
	(b)	Significant Overlap with any UG/PG course of other Dept./Centre/ School	(course number)	
8.2	Supersedes any existing course		MEL732 and MEL 742	
9.	Not allowed for	(indicate program names)		

10.	Frequency of offering (check one box)	☐ Every semester ☒ I sem ☐ II sem ☐ Either semester
------------	---	--

11.	Faculty who will teach the course Dr N Datla, A Chawla, JP Khatait, H Hirani, S Mukherjee
------------	--

12.	Will the course require any visiting faculty?	(Yes/no) NO
------------	--	-------------

13.	Course objectives (about 50 words. "On successful completion of this course, a student should be able to..."): Enhance expertise on design of Mechanical Systems with focus on mechanics based failure modes. Introduction to tools and principles of optimization appearing in context of mechanical engineering design.
------------	--

14.	Course contents (about 100 words; Topics to appear as course contents in the Courses of Study booklet) (Include Practical / Practice activities): Review of machine element design based on strength and distortion criterion; review of choice of materials and their treatment: Designing for fatigue, creep; Design criterion for fracture; Application of advanced design criterion to machine elements (like shafts, spur / bevel / worm gears); Design of structures, machines and equipment; Classical methods of unconstrained optimization (single variable and multi variable), classical methods of constrained optimization, Numerical optimisation techniques including i. genetic algorithms, (binary and real coded)ii.. simulated annealing. Case studies of Optimum Design (Gear Box, Power Transmission, shape and topology using FE)
------------	---

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

Module no.	Topic	No. of hours
1	Introduction (Failure principles recap, feasible and optimal design)	3
2	Design of Mechanical Systems - structures, machines and equipment; formulating system constraints, requirements,	3
3	Designing for fatigue, creep	4
4	Design for fracture	4
5	Stochastic principles in design	2
6	Application of advanced design criterion to machine elements (like shafts, spur / bevel / worm gears)	5
7	Classical methods of unconstrained optimization (single variable and multi variable)	5
8	Classical methods of constrained optimization (transformational, direct search, linearization methods); Kuhn Tucker Conditions	7

9	Advanced optimisation techniques including i. genetic algorithms, (binary and real coded)ii.. simulated annealing	5
10	Case studies of Optimum Design (Gear Box, Power Transmission, shape and topology using FE)	4
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities:

Module no.	Description	No. of hours
Total Tutorial hours (14 times 'T')		

17. Brief description of Practical / Practice activities

Module no.	Description	No. of hours
	Design of combined statically loaded components and assemblies	2
	Design of combined fatigue loaded components and assemblies	4
	Formulating system and sub-system constraints	4
	Implementations of single variable optimization	2
	Implementation of unconstrained multi variable optimization techniques	4
	Formulating Design case studies as optimization problems and solving using implemented tools	12
Total Practical / Practice hours (14 times 'P')		28

18. Brief description of module-wise activities pertaining to self-learning

component (Only for 700 / 800 level courses) (Include topics that the students would do self-learning from books / resource materials: Do not Include assignments / term papers etc.)

Module no.	Description
	Quadratic Programming
	Integer and Discrete Optimization problems
	Multi objective optimization and Pareto Optimal fronts
	Designing for wear and corrosion
	Dynamic modeling of mechanical systems
	Selection practice of bearings
	Material selection principles
(The volume of self-learning component in a 700-800 level course should typically be 25-30% of the volume covered in classroom contact)	

19. Suggested texts and reference materials

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

1. Mech Engg Design, Shigley, Mischke, Budynas, Nisbett, 8th Edn, 2010, McGraw Hill
2. Machine Design Handbook, Shigley and Mischke, McGraw Hill
3. Dieter:
4. Engineering Optimization, S.S.Rao, 3rd enlarged ed, New Age International publishers, 2010
5. Materials selection in Mechanical Design, M.F.Ashby, 3rd Edn, 2005, Elsevier\
6. Optimization for engineering design, Kalyanmoy Deb, PHI Learning, 2004

20. Resources required for the course (itemized student access requirements, if any)

20.1	Software	TK Solver, CES, FE Solvers, CAD tools
20.2	Hardware	PCs and Workstations
20.3	Teaching aids (videos, etc.)	Machine design videos
20.4	Laboratory	CAGI
20.5	Equipment	PCs
20.6	Classroom infrastructure	LCD projecto
20.7	Site visits	Possibly
20.8	Others (please specify)	

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

21.1	Design-type problems	75% of lab time
21.2	Open-ended problems	Yes
21.3	Project-type activity	Yes
21.4	Open-ended laboratory work	Yes
21.5	Others (please specify)	

Date:

(Signature of the Head of the Department/ Centre / School)

Date of Approval of Template by Senate	
---	--

The information on this template is as on the date of its approval, and is likely to evolve with time.

COURSE TEMPLATE

(Please avoid changing the number of tables, rows and columns or text in dark black, but fill only the columns relevant to the template by editing the columns in grey letters or blank columns: this would help in automating the processing of template information for curricular use)

1.	Department/Centre/School proposing the course	Mechanical Engineering	
2.	Course Title	Designing with Advanced Materials	
3.	L-T-P structure	3-0-2	
4.	Credits	4	Non-graded Units Please fill appropriate details in S. No. 21
5.	Course number	<Dept Code>L/P/D/S/R/V<No.>	
6.	Course Status (Course Category for Program) (list program codes: eg., EE1, CS5, etc.)		
	Institute Core for all UG programs		(Yes / No)
	Programme Linked Core for:		List of B.Tech. / Dual Degree Programs
	Departmental Core for:		List of B.Tech. / Dual Degree Programs
	Departmental Elective for:		List of B.Tech. / Dual Degree Programs
	Minor Area / Interdisciplinary Specialization Core for:		Name of Minor Area / Specialization Program
	Minor Area / Interdisciplinary Specialization Elective for:		Name of Minor Area / Specialization Program
	Programme Core for:		List of M.Tech. / Dual Degree Programs
	Programme Elective for:		MEM
	Open category Elective for all other programs (No if Institute Core)		(Yes / No) Yes
7.	Pre-requisite(s)	MCL211 (or equivalent)	
8.	Status vis-à-vis other courses		
8.1	List of courses precluded by taking this course (significant overlap)		(course number)
	(a)	Significant Overlap with any UG/PG course of the Dept./Centre/ School	(course number)
	(b)	Significant Overlap with any UG/PG course of other Dept./Centre/ School	(course number)
8.2	Supersedes any existing course		MEL844
9.	Not allowed for	(indicate program names)	

10.	Frequency of offering (check one box)	☐ Every semester ☐ I sem ☒ II sem ☐ Either semester
------------	---	--

11.	Faculty who will teach the course N.V. Datla, S.K. Sinha
------------	---

12.	Will the course require any visiting faculty?	(Yes/no) No
------------	--	-------------

13.	Course objectives: Introduction to design with polymers, composites, and other advanced materials in the context of mechanical systems design. Students completing this course successfully should be able to design mechanical systems/components utilizing the specialized mechanical response of these material.
------------	---

14.	Course contents (about 100 words; Topics to appear as course contents in the Courses of Study booklet) (Include Practical / Practice activities): Introduction to polymers, composites and smart materials. Polymer microstructure and mechanical properties. Thermosets and thermoplastics. Viscoelastic creep and relaxation behavior, mechanical models, and polymer failure. Design considerations and practices for polymeric components with case studies. Composite materials and their applications. Micro and macro mechanics of lamina, failure criteria of lamina, classical laminate theory, strength of laminates. Design considerations and practices for composite structures with case studies. Structure, applications and design considerations of smart materials such as shape memory alloys and piezoelectric materials.
------------	---

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

Module no.	Topic	No. of hours (not exceeding 5h per topic)
1	Introduction to polymers, composites and smart materials	2
2	Polymer microstructure, classification, and mechanical properties	4
3	Viscoelastic creep and relaxation behavior, mechanical models, superposition and correspondence principles, dynamic mechanical analysis	5
4	Failure mechanisms in polymers	3
5	Design considerations and practices for polymeric components with case studies	5
6	Composite materials and their applications	3
7	Micro and macro mechanics of lamina, classical laminate theory	5
8	Failure criteria of lamina, strength of laminates	4
9	Design considerations and practices for composite structures with case studies	5

10	Structure, applications, and design considerations of smart materials such as shape memory alloys and piezoelectric materials.	6
Total Lecture hours (14 times 'L')		42

16. Brief description of tutorial activities:

Module no.	Description	No. of hours
Total Tutorial hours (14 times 'T')		

17. Brief description of Practical / Practice activities

Module no.	Description	No. of hours
1	Material selection using CES package	4
2	Numerical modelling of systems with viscoelastic polymers	4
3	Composite laminate analysis using Commercial FE solver	6
4	Superelastic behavior modeling using FE solver	4
5	Realization of shape memory effect systems	4
6	Case studies for systems with advanced materials : numerical modelling and performance prediction.	6
Total Practical / Practice hours (14 times 'P')		28

18. Brief description of module-wise activities pertaining to self-learning component (Only for 700 / 800 level courses) (Include topics that the students would do self-learning from books / resource materials: Do not Include assignments / term papers etc.)

Module no.	Description
1	Processing techniques for polymeric and composite materials
2	Fracture and fatigue failures in polymers
3	Micromechanics of discontinuous reinforcements
4	CLT applied to special laminate sequences
5	Viscoelastic behavior of composites
6	Design for aggressive environments
(The volume of self-learning component in a 700-800 level course should typically be 25-30% of the volume covered in classroom contact)	

19. Suggested texts and reference materials

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

1. Gerdeen and Rorrer, Engineering Design with Polymers and Composites, 2nd Ed., CRC Press, 2012.
2. Jones and Ashby, Engineering Materials 2: An introduction to Microstructure and Processing, 4th Ed., Butterworth-Heinemann, 2012.
3. Brinson and Brinson, Polymer Engineering Science and Viscoelasticity, 2nd Ed., Springer, 2015.
4. Jones, Mechanics of Composite Materials, 2nd Ed., CRC Press, 1999.

20. Resources required for the course (itemized student access requirements, if any)

20.1	Software	ANSYS, SolidWorks, Matlab
20.2	Hardware	PC's
20.3	Teaching aids (videos, etc.)	
20.4	Laboratory	CAGIL
20.5	Equipment	PC's
20.6	Classroom infrastructure	LCD projector
20.7	Site visits	
20.8	Others (please specify)	

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

21.1	Design-type problems	Eg. 25% of student time of practical / practice hours: sample Circuit Design exercises from industry
21.2	Open-ended problems	
21.3	Project-type activity	
21.4	Open-ended laboratory work	
21.5	Others (please specify)	

Date: _____ (Signature of the Head of the Department/ Centre / School)

Date of Approval of Template by Senate	
---	--

The information on this template is as on the date of its approval, and is likely to evolve with time.

COURSE TEMPLATE

(Please avoid changing the number of tables, rows and columns or text in dark black, but fill only the columns relevant to the template by editing the columns in grey letters or blank columns: this would help in automating the processing of template information for curricular use)

1.	Department/Centre/School proposing the course	MECHANICAL ENGINEERING		
2.	Course Title	TRIBOLOGICAL SYSTEMS DESIGN		
3.	L-T-P structure	3 - 0 - 2		
4.	Credits	4	Non-graded Units	N/A
5.	Course number	MEL748		
6.	Course Status (Course Category for Program)			
	Institute Core for all UG programs			
	Programme Linked Core for:			
	Departmental Core for:			
	Departmental Elective for: UG and PG		Yes	
	Minor Area / Interdisciplinary Specialization Core for:			
	Minor Area / Interdisciplinary Specialization Elective for:			
	Programme Core for:		MTech (Mechanical Design)	
	Programme Elective for:		ME1, ME2, MEP, MET	
	Open category Elective for all other programs (No if Institute Core)		Yes	
7.	Pre-requisite(s)	Course in Machine Design (MCL211 or equivalent)		
8.	Status vis-à-vis other courses			
8.1	List of courses precluded by taking this course (significant overlap)			
	(a)	Significant Overlap with any UG/PG course of the Dept./Centre/ School	NIL	
	(b)	Significant Overlap with any UG/PG course of other Dept./Centre/ School	20 % with	
8.2	Supersedes any existing course			
9.	Not allowed for	Nil		

10.	Frequency of offering (check one box)	☐ Every semester ☐ I sem ☐ II sem ☒ Either semester
------------	--	--

11.	Faculty who will teach the course (Minimum 2 names for core courses / 1 name for electives) Dr. R K Pandey, Prof. H Hirani, Dr. Sujeet K. Sinha
------------	---

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

13.	Course objectives (about 50 words. "On successful completion of this course, a student should be able to..."): On successful completion of this course, a student will be able to, analyze tribological systems for the design of load bearing surfaces under dynamic loading. Evolve analytical formulations relating surface conditions, different types of lubrications, bearing design, clutches, brakes etc. and conduct lubricant, materials and design selection for any given tribological requirement.
------------	---

14.	Course contents (about 100 words; Topics to appear as course contents in the Courses of Study booklet) (Include Practical / Practice activities): Lubrication, Friction and Wear aspects in Design; Tribological Surfaces – Measures of Roughness and associated mechanisms of Lubrication, Regimes of Lubrication; Boundary lubrication and lubricants. Friction and wear at different length scales. Viscosity - its representation and measurement, apparent viscosity. Selection of Bearings - Rubbing, Fluid Film, Rolling Element. Lubricants - Types and Selection, Bearing Design - Rubbing, Fluid Film Journal and Thrust, Dynamically Loaded, Rolling Element, Design of lubrication Systems. Introduction to maintenance of Bearings, Seals, Linear Bearing Design, Slideways. Material considerations for selected tribological applications.
------------	---

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

Module no.	Topic	No. of hours (not exceeding 5h per topic)
1	Lubrication, Friction and Wear consideration in Design	3
2	Tribological Surfaces - Roughness	3
3	Mechanisms of Lubrication, Friction & Wear, Regimes of Lubrication	6
4	Boundary lubrication and lubricants,	4
5	Viscosity - its representation and measurement, Apparent Viscosity	3
6	Selection of Bearings - Rubbing, Fluid Film, Rolling Element	4
7	Lubricants - Types and Selection	3
8	Bearing Design - Rubbing, Fluid Film Journal and Thrust,	7

	Dynamically Loaded, Rolling Element, Linear Bearing Design, Slideways, Seals	
9	Lubrication Systems - Selection and Design Considerations, Maintenance of Bearings	5
10	Material Considerations for Various Tribological Applications	4
Total Lecture hours(14 times 'L')		42

16. Brief description of tutorial activities:

Module no.	Description	No. of hours
Total Tutorial hours(14 times 'T')		0

17. Brief description of Practical / Practice activities

Module no.	Description	No. of hours
	Bearing design	4
	Lubricant tester	7
	Tribometry	7
	Surface metrology	5
	Friction and wear mechanism study	5
Total Practical / Practice hours(14 times 'P')		28

18. Brief description of module-wise activities pertaining to self-

learning component (Only for 700 / 800 level courses) (Include topics that the students would do self-learning from books / resource materials: Do not Include assignments / term papers etc.)

Module no.	Description
1	Physics of adhesion and surface forces
2	Tribological issues in micro/nano levels

(The volume of self-learning component in a 700-800 level course should typically be 25-30% of the volume covered in classroom contact)

19. Suggested texts and reference materials

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

Applied Tribology - Bearing Design and Lubrication 2nd edition, Michael M Khonsari, Wiley 2008

Engineering Tribology, John William, Cambridge University Press, 2005

Tribology - Friction and Wear of Engineering Materials, I M Hutchings, Butterworth Heinemann, 1992.

Tribology on the Small Scale: A Bottom Up Approach to Friction, Lubrication, and Wear, C. Mathew Mates, Oxford University Press, 2007

Nano-tribology and Materials in MEMS, Sujeet K. Sinha, N. Satyanarayana and Seh Chun Lim (eds.), (ISBN 978-3-642-36934-6) Springer Berlin, 2013.

20. Resources required for the course (itemized student access requirements, if any)

20.1	Software	
20.2	Hardware	
20.3	Teaching aids (videos, etc.)	Projector and screen for powerpoint presentations
20.4	Laboratory	
20.5	Equipment	
20.6	Classroom infrastructure	
20.7	Site visits	
20.8	Others (please specify)	

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

21.1	Design-type problems	20
21.2	Open-ended problems	20
21.3	Project-type activity	10
21.4	Open-ended laboratory work	
21.5	Others (please specify)	

Date: _____ (Signature of the Head of the Department/ Centre / School)

Date of Approval of Template by Senate	
---	--

The information on this template is as on the date of its approval, and is likely to evolve with time.