Society of St. Francis Xavier, Pilar's

Fr. Conceicao Rodrigues College of Engineering

Fr. Agnel Technical Education Complex Bandstand,
Bandra Mumbai -400 050

Lesson Plan

Year: 2022-23

ranch: Mechanical Engineering
Semester VI

Course Title:	Machine Design 4 Hours – Theory & Oral/Practical Examination
Total Contact Hours: 48 Hours	Duration of ESE: 3 Hrs
ESE Marks: 80 (Theory) + 20 (IA)	
Lesson Plan Author: Dr. Ketaki Joshi	Date:
Checked By: Dr. Vasim Shaikh	Date: 16/01/2023

Prerequisites: strength of material, material science

Syllabus:

Module	Details	Hrs
1	Mechanical Engineering Design, Design methods, Aesthetic and Ergonomics consideration in design, Material properties and their uses in design, Manufacturing consideration in design, Design consideration of casting and forging, Basic principle of Machine Design, Modes of failures, Factor of safety, Design stresses, Theories of failures (Selection in the process of designing), Standards, I.S. Codes, Preferred Series and Numbers Thick Cylinders: Design of thick cylinders subjected to an internal pressure using Lame's equation	08
2	Design against static loads: Socket and Spigot Cotter joint, Knuckle joint, Bolted and welded joints under eccentric loading; Power Screw- Screw Jack.	08
3	Design against fluctuating loads: variables stresses, reversed, repeated, fluctuating stresses. Fatigue failure: static and fatigue stress concentration factors, Endurance limit- estimation of endurance limit, Design for finite and infinite life, Soderberg and Goodman design criteria, Design of Shaft: power transmitting, power distribution shafts, Module (excluding crank shaft) under static and fatigue criteria. Keys: Types of Keys and their selection based on shafting condition. Couplings: Classification of coupling, Design of Flange couplings, Bush pin type flexible couplings	12
4	Rolling Contact Bearings: Types of bearing and designation, selection of rolling contact bearings based on constant / variable load & speed conditions (includes deep groove ball bearing, cylindrical roller, spherical roller, taper roller, self-aligning bearing and thrust bearing) Sliding Contact Bearings: Design of hydro dynamically lubricated bearings (self-contained), Introduction to hydro static bearings,	08
5	Design and selection of Belts: Flat and V-belts with pulley construction. Design and selection of standard roller chains. Design of Flywheel – Introduction, Fluctuation of energy and speed, turning moment diagram, estimating inertia of flywheel for reciprocating prime movers and machines, Weight of the flywheel, flywheel for punches, rim constructions, stresses in rims and arms, Construction of flywheel.	08

6	Design of Springs: Helical compression, Tension Springs under Static and Variable loads, Leaf springs. Design of Clutches: Introduction, types, Basic theory of plate and cone type clutches, Design of single plate, multi-plate andwith spring, lever design andthermal, wear considerations. 6.2 Design of Brakes: Design of single shoe brake.	**08**

Course Outcomes (CO):

On successful completion of course learner will be able to:

MEC601.1. Use design data book/standard codes to standardise the designed dimensions
MEC601.2. Design Knuckle Joint, cotter joint, bolted and welded joints, and Screw Jack
MEC601.3. Design shaft under various conditions and couplings
MEC601.4. Select bearings for a given applications from the manufacturers catalogue.
MEC601.5. Select and/or design belts and flywheel for given applications
MEC601.6. Design springs, clutches and brakes

CO-PO Mapping: (BL – Blooms Taxonomy, C – Competency, PI – Performance Indicator)

CO	BL	C	PI	PO	Mapping
MEC601.1 MEC601.2	3	1.3 1.4	1.3.1 1.4.1	PO1	3
MEC601.3 MEC601.4 MEC601.5 MEC601.6		2.1 2.2 2.41	2.1.2 2.1.3 2.2.1 2.4.1	PO2	3
		3.2 3.3 3.4	3.2.3 3.3.2 3.4.1	PO3	3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MEC601.1.	3	3	3	-	-	-	-	-	-	-	-	-
MEC601.2.	3	3	3	-	-	-	-	-	-	-	-	-
MEC601.3.	3	3	3	-	-	-	-	-	-	-	-	-
MEC601.4.	3	3	3	-	-	-	-	-	-	-	-	-
MEC601.5.	3	3	3	-	-	-	-	-	-	-	-	-
MEC601.6.	3	3	3	-	-	-	-	-	-	-	-	-

CO-PSO Mapping:

	PSO1	PSO2
MEC601.1.		2
MEC601.2.		2

MEC601.3		2
MEC601.4		2
MEC601.5		2
MEC601.6		2

CO attainment value for students above targets values:

CO	Tool	Target Value %		Attainment
		Marks	Students	
MEC601.1 MEC601.2 MEC601.4 MEC601.5	Test	50%	60 70 80	1 2 3
	ESE	40%	60 70 80	1 2 3
	CES	60%	60 70 80	1 2 3
MEC601.3 MEC601.6	ESE	40%	60 70 80	1 2 3
	CES	60%	60 70 80	1 2 3

CO Measurement Weightages for Tools:

	Direct Method					Indirect Method
	80%					Course Exit Survey 20%
	Test	Lab	Assignment	ESE (O)	ESE (T)	
MEC601.1	40%				60%	
MEC601.2	40%				60%	
MEC601.3	-				100%	
MEC601.4	40%				60%	
MEC601.5	40%				60%	
MEC601.6	-				100%	

Attainment:

CO MEC601.1:

Direct Method

$CO_{MEC601.1DM}$ = 0.4 * Test + 0.6* ESE(T)

Indirect Method

$CO_{MEC601.1IM}$ = CES

Final CO $CO_{MEC601.1}$ = 0.8 * $CO_{MEC601.1DM}$ + 0.2* $CO_{MEC601.1IM}$

CO MEC601.2:
Direct Method
$CO_{MEC601.2DM}$ = 0.4 * Test + 0.6* ESE(T)
Indirect Method
$CO_{MEC601.2IM}$ = CES
Final CO $CO_{MEC601.2}$ = 0.8 * $CO_{MEC601.2DM}$ + 0.2* $CO_{MEC601.2IM}$

CO MEC601.3:
Direct Method
$CO_{MEC601.3DM}$ = ESE(T)
Indirect Method
$CO_{MEC601.3IM}$ = CES
Final CO $CO_{MEC601.3}$ = 0.8 * $CO_{MEC601.3DM}$ + 0.2* $CO_{MEC601.3IM}$

CO MEC601.4:
Direct Method
$CO_{MEC601.4DM}$ = 0.4 * Test + 0.6* ESE(T)
Indirect Method
$CO_{MEC601.4IM}$ = CES
Final CO $CO_{MEC601.4}$ = 0.8 * $CO_{MEC601.4DM}$ + 0.2* $CO_{MEC601.4IM}$

CO MEC601.5:
Direct Method $CO_{MEC601.5DM}$ = 0.4 * Test + 0.6* ESE(T)
Indirect Method
$CO_{MEC601.5IM}$ = CES
Final CO $CO_{MEC601.5}$ = 0.8 * $CO_{MEC601.5DM}$ + 0.2* $CO_{MEC601.5IM}$

CO MEC601.6:

Direct Method
$CO_{MEC601.6DM}$ = ESE(T)
Indirect Method
$CO_{MEC601.6IM}$ = CES
Final CO $CO_{MEC601.6}$ = 0.8 * $CO_{MEC601.6DM}$ + 0.2* $CO_{MEC601.6IM}$

Course Level Gap (if any):
-

Content beyond Syllabus:
-

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Text Books:

1. Design of Machine Elements - V.B. Banadari, Tata McGraw Hill Publication
2. Design of Machine Elements - Sharma, Purohil. Prentice Hall India Publication
3. Machine Design -An Integrated Approach - Robert L. Norton, Pearson Education
4. Machine Design by Pandya & Shah, Charotar Publishing
5. Mechanical Engineering Design by J.E.Shigley, McGraw Hill
6. Machine Design by Reshetov, Mir Publication
7. Machine Design by Black Adams, McGraw Hill
8. Fundamentals of Machine Elements by Hawrock, Jacobson McGraw Hill
9. Machine Design by R.C.Patel, Pandya, Sikh, Vol-I & II C. Jamnadas& Co
10. Design of Machine Elements by V.M.Faires
11. Design of Machine Elements by Spotts
12. Recommended Data Books – Design Data: Data Book of Engineers by PSG College, KalaikathirAchchagam

Links for online NPTEL/SWAYAM courses:

https://nptel.ac.in/courses/112/105/112105124/ - Design of Machine Elements, IIT Kharagpur
https://nptel.ac.in/courses/112/106/112106137/ - Machine Design-II, IIT Madras

Evaluation Scheme

CIE Scheme

Internal Assessment: 20 (Average of two tests)

Internal Assessment Scheme

Module		Lecture Hours	No. of questions in		
			Test 1	Test 2	Test 3*
1	Introduction to Design	8	5 marks	-	--
2	Design of joints	8	15 marks	-	--
3	Shafts, keys and couplings	12	-	-	--
4	Bearings	8	-	10 marks	--
5	Belt and flywheel design	8	-	10 marks	--
6	Springs, brakes, clutches	8	-	-	--

Note: Four to six questions will be set in the Test paper

Verified by:

Programme Coordinator **Subject Expert**

Lecture Plan:

Week	Duration (Hrs.)	Topic	Module
1 (9.01.23 - 15.01.23)	4	Mechanical Engineering Design, Design methods, Aesthetic and Ergonomics consideration in design, Material properties and their uses in design, Manufacturing consideration in design, Design consideration of casting and forging, Basic principle of Machine Design,	1
2 (16.01.23 - 22.01.23)	4	Modes of failures, Factor of safety, Design stresses, Theories of failures (Selection in the process of designing), Standards, I.S. Codes, Preferred Series and Numbers Thick Cylinders: Design of thick cylinders subjected to an internal pressure using Lame's equation Design against static loads: Socket and Spigot Cotter joint,	1 and 2
3 (23.01.23 - 29.01.23)	4	Knuckle joint, Bolted and welded joints under eccentric loading;	2
4 (30.01.23 - 5.02.23)	4	Bolted and welded joints under eccentric loading;	2
5 (6.02.23 - 12.02.23)	4	Power Screw- Screw Jack. Keys: Types of Keys and their selection based on shafting condition.	2 and 3
6 (13.02.23 - 19.02.23)	4	Couplings: Classification of coupling, Design of Flange couplings, Bush pin type flexible couplings	3
7 (20.02.23 - 26.02.23)	4	Design of Shaft: power transmitting, power distribution shafts, Module (excluding crank shaft) under static and fatigue criteria	3
8 (27.02.23 - 5.03.23)		**Unit Test I**	
9 (6.03.23 – 12-03.23)	4	Design and selection of Belts: Flat and V-belts with pulley construction. Design and selection of standard roller chains.	5
10 (13.03.23 - 19.03.23)	4	Design of Flywheel – Introduction, Fluctuation of energy and speed, turning moment	5
11 (20.03.23 – 26.03.23)	4	Rolling Contact Bearings: Types of bearing and designation, selection of rolling contact bearings based on constant / variable load & speed conditions (includes deep groove ball bearing, cylindrical roller, spherical roller, taper roller, self-aligning bearing and thrust bearing)	4
12 (27.03.23 - 2.04.23)		Euphoria	

13 (3.04.23 - 9.04.23)	4	Design of Springs: Helical compression, Tension Springs under Static and Variable loads Leaf springs. Design of Clutches: Introduction, types, Basic theory of plate and cone type clutches, Design of single plate, multi-plate and with spring, lever design and thermal, wear considerations. Design of Brakes: Design of single shoe brake.	5
14 (10.04.23 - 16.04.23)	4	Sliding Contact Bearings: Design of hydro dynamically lubricated bearings (self-contained), Introduction to hydro static bearings, Design against fluctuating loads: variables stresses, reversed, repeated, fluctuating stresses. Fatigue failure: static and fatigue stress concentration factors, Endurance limit- estimation of endurance limit, Design for finite and infinite life, Soderberg and Goodman design criteria	4 3
15 (17.04.23 - 23.04.23)	**Unit Test – II**		

Course Code	Course Name	Credits
MEL601	**Machine Design**	**01**

Outcomes: Learner will be able to…

1. Design shaft under various conditions
2. Design Knuckle Joint / cotter joint
3. Design Screw Jack
4. Design Flexible flange couplings/ Leaf spring
5. Convert design dimensions into working/manufacturing drawing
6. Use design data book/standard codes to standardise the designed dimensions.

Term Work:

a) Term work - Shall consist of (minimum 3) design exercises from the list which may include computer aided drawing on A3 size sheets.

1) Knuckle Joint / cotter joint
2) Couplings
3) Screw Jack
4) Leaf springs

Software Analysis of any one component from the above list

b) Assignments:

Design exercises in the form of design calculations with sketches and/ or drawings on following machine elements.

1) Bolted and welded joints
2) Bearings.
3) Shaft design (solid and hollow shaft)
4) Flywheel and Belts.

CO-PO Mapping

CO# / PO#	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	3	3	-	-	-	-	-	-	-	-	-
2	3	3	3	-	-	-	-	-	-	-	-	-
3	3	3	3	-	-	-	-	-	-	-	-	-
4	3	3	3	-	-	-	-	-	-	-	-	-
5	3	3	3	-	2	-	-	-	-	-	-	-
6	3	3	3	-	-	-	-	-	-	-	-	-

Week	Duration (Hrs.)	Topic
3 (23.01.23 - 29.01.23)	2	Design of Cotter Joint
4 (30.01.23 - 5.02.23)	2	Design of Bolted Joint
5 (6.02.23 - 12.02.23)	2	Design of Welded Joints
6 (13.02.23 - 19.02.23)	2	Design of Screw Jack
7 (20.02.23 - 26.02.23)	2	Design of Couplings
8 (27.02.23 - 5.03.23)		**Unit Test I**
9 (6.03.23 – 12-03.23)	2	Design of Shafts
10 (13.03.23 - 19.03.23)	2	CAD Modelling of Couplings
11 (20.03.23 – 26.03.23)	2	Design of Belts
12 (27.03.23 - 2.04.23)		Euphoria
13 (3.04.23 - 9.04.23)	2	Design of Flywheels
14 (10.04.23 - 16.04.23)	2	Design of Bearings
15 (17.04.23 - 23.04.23)		**Unit Test - II**

CO attainment value for students above targets values:

CO	Tool	Target Value %		Attainment
		Marks	Students	
MEL601.1 MEL601.2 MEL601.3 MEL601.4 MEL601.5 MEL601.6	Assignment	60%	60 70 80	1 2 3
	Ora / Practical	50%	60 70 80	1 2 3
	CES	60%	60 70 80	1 2 3

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CO Measurement Weightages for Tools:

	Direct Method					Indirect Method
	80%					Course Exit Survey 20%
	Test	Lab	Assignment	ESE (O)	ESE (T)	
MEL601.1		40%		60%		
MEL601.2		40%		60%		
MEL601.3		40%		60%		
MEL601.4		40%		60%		
MEL601.5		40%		60%		
MEL601.6		40%		60%		

Attainment:

All COs

Direct Method

$CO_{MEL601.xDM}$ = 0.4 *Lab + 0.6* ESE(O)

Indirect Method

$CO_{MEL601.xIM}$ = CES

Final CO $CO_{MEL601.x}$ = 0.8 * $CO_{MEL601.XDM}$ + 0.2* $CO_{MEL601.XIM}$

Verified by:

Programme Coordinator

Subject Expert