Sri Krishna College of Engineering and Technology

An Autonomous Institution, Affiliated to Anna University

Coimbatore – 641 008

DEPARTMENT OF MECHANICAL ENGINEERING

CURRICULUM AND SYLLABI

M.E. ENGINEERING DESIGN

(R2022)

Vision

The department aspires to produce experts in mechanical engineering with moral values and desires to set up centers of excellence in innovative design and testing, composite materials, automation, automotive technology and green fuels.

Mission

To produce world class mechanical engineering graduates by promoting core technical competency blended with advanced computing skills, creative thinking and desire to upgrade continuously, so as to empower them to the expectation of the industries in our country and abroad and also to impart the interpersonal skills and make them realize the values of life.

Programme Outcomes:

PO 1	**Research skill and problem solving**: Able to independently carry out research /investigation and development work to solve practical problems.
PO 2	**Communication**: Able to write and present a substantial technical report/document.
PO 3	**Knowledge**: Demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.
PO 4	**Collaborative and Multidisciplinary work**: Possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.
PO 5	**Usage of modern tools:** Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities with an understanding of the limitations
PO 6	**Ethical Practices and Social Responsibility:** Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.

Programme Specific Outcomes (PSO's):-

At the end of the Programme, Graduate shall have

PSO 1	Possess the analytical skills required for designing the mechanical systems.
PSO 2	Able to use the modern design software's to solve the engineering problems and become a successful professional.

Program Educational Objectives:

PEO 1	Inculcate the advanced knowledge and skills for carrying out assignments and projects in their career to analyze and solve the engineering design problems in industries
PEO 2	Bestow advanced domain knowledge in the field of engineering design to enable them to pursue research and teaching in their career.
PEO 3	Educate them the leadership, ethics, entrepreneurial skills and continuous learning needed for their successful career in our country and abroad

CURRICULUM & SYLLABUS – R2022 - M.E ENGINEERING DESIGN

SEMESTER 1							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credits**	**Ext/Int**	**Category**
1	22PD101	Research Methodology (Common for ED and CC)	3/0/0	3	3	60/40	PC
2	22PD102	Advanced Strength of Materials	3/0/0	3	3	60/40	PC
3	22PD103	Computer Aided Design	3/0/0	3	3	60/40	PC
4	22PD5XX	Professional Elective – I	3/0/0	3	3	60/40	PE
5	22PD5XX	Professional Elective – II	3/0/0	3	3	60/40	PE
6	22PD104	Modelling and Mechanism Simulation Laboratory	0/0/4	4	2	40/60	PC
7	22PD105	Industrial Case Study – 1	0/0/3	3	1.5	40/60	EEC
8	22AC00X	Audit Course – 1	2/0/0	2	0	0/100	AC
			Total	**24**	**18.5**	**800**	

SEMESTER 2							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credits**	**Ext/Int**	**Category**
1	22PD201	Advanced Finite Element Analysis (Common for ED and CC)	3/0/0	3	3	60/40	PC
2	22PD202	Vibration Analysis and Control	3/0/0	3	3	60/40	PC
3	22PD5XX	Professional Elective – III	3/0/0	3	3	60/40	PE
4	22PD5XX	Professional Elective – IV	3/0/0	3	3	60/40	PE
5	22PD203	Computer Aided Engineering Laboratory (Common for ED and CC)	0/0/4	4	2	40/60	PC
6	22PD204	Industrial Case Study – 2	0/0/3	3	1.5	40/60	EEC
7	22PD205	Mini project	0/0/4	4	2	40/60	PW
8	22AC00X	Audit Course - 2	2/0/0	2	0	0/100	AC
			Total	**25**	**17.5**	**800**	

SEMESTER 3							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credits**	**Ext/Int**	**Category**
1	22PD5XX	Professional Elective – V	3/0/0	3	3	60/40	PE
2	22PX00X	Open Elective	3/0/0	3	3	60/40	OE
3	22PD301	Dissertation Phase I	0/0/20	20	10	40/60	PW
			Total	**26**	**16**	**300**	

SEMESTER 4							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credits**	**Ext/Int**	**Category**
1	22PD401	Dissertation Phase II	0/0/32	32	16	40/60	PW
			Total	**32**	**16**	**100**	

Total Credits: 68

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credits	Ext/Int	Category
Professional Electives – Group 1							
1	22PD501	Advanced Automotive Systems (Common for ED and CC)	3/0/0	3	3	60/40	PE
2	22PD502	Advanced Mechanism Design	3/0/0	3	3	60/40	PE
3	22PD503	Advanced Tool Design	3/0/0	3	3	60/40	PE
4	22PD504	Design of Heat Exchangers	3/0/0	3	3	60/40	PE
5	22PD505	Design of Hydraulic and Pneumatic Systems	3/0/0	3	3	60/40	PE
6	22PD506	Design of Material Handling Equipments	3/0/0	3	3	60/40	PE
7	22PD507	Mechanical Behaviour of Engineering Materials	3/0/0	3	3	60/40	PE
8	22PD508	Mechanics of Composites and Smart Materials	3/0/0	3	3	60/40	PE
9	22PD509	Theory of Elasticity and Plasticity	3/0/0	3	3	60/40	PE
10	22PD510	Tribology in Design	3/0/0	3	3	60/40	PE
Professional Electives – Group 2							
11	22PD511	Computer Aided Engineering (Syllabus Content Except FEA)	3/0/0	3	3	60/40	PE
12	22PD512	Concepts of Engineering Design	3/0/0	3	3	60/40	PE
13	22PD513	Experimental Stress Analysis	3/0/0	3	3	60/40	PE
14	22PD514	Failure Analysis in Design	3/0/0	3	3	60/40	PE
15	22PD515	Geometric Dimensioning and Tolerancing (Common for ED and CC)	3/0/0	3	3	60/40	PE
16	22PD516	Industrial Robotics and Artificial Intelligence (Common for ED and CC)	3/0/0	3	3	60/40	PE
17	22PD517	Optimization Techniques in Design (Common for ED and CC)	3/0/0	3	3	60/40	PE
18	22PD518	Quality Concepts in Engineering Design (Common for ED and CC)	3/0/0	3	3	60/40	PE
19	22PD519	Material Characterization Techniques (Common to ED and CC)	3/0/0	3	3	60/40	PE
20	22PM101	Reliability and Computational Methods (Common for ED and CC)	3/0/0	3	3	60/40	PE

Open electives offered to other programmes:

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credits	Ext/Int	Category
1	22PD001	Fundamentals of Industrial Safety	3/0/0	3	3	60/40	OE
2	22PD002	Operations Research	3/0/0	3	3	60/40	OE

Open electives offered by other programmes:

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credits	Ext/Int	Category
1	22PC001	Cost management of Engineering Projects	3/0/0	3	3	60/40	OE
2	22PC002	Fundamentals of Composite Materials	3/0/0	3	3	60/40	OE
3	22PE001	Waste to Energy	3/0/0	3	3	60/40	OE
4	22PF001	Business Analytics	3/0/0	3	3	60/40	OE

Audit Courses

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credits	Category
1	22AC001	English for Research Paper Writing	2/0/0	2	0	AC
2	22AC002	Disaster Management	2/0/0	2	0	AC
3	22AC003	Sanskrit for Technical Knowledge	2/0/0	2	0	AC
4	22AC004	Value Education	2/0/0	2	0	AC
5	22AC005	Constitution of India	2/0/0	2	0	AC
6	22AC006	Pedagogy Studies	2/0/0	2	0	AC
7	22AC007	Stress Management by Yoga	2/0/0	2	0	AC
8	22AC008	Personality Development Through Life Enlightenment Skills	2/0/0	2	0	AC
			Total	**16**	**0**	

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

S. No	Stream	Credits/Semester				Credits	%
		I	II	III	IV		
1	Basic Sciences(BS)	-	-	-	-	**-**	-
2	Professional Core(PC)	11	8	-	-	**19**	27.94
3	Professional Electives(PE)	6	6	3	-	**15**	22.06
4	Open Electives (OE)	-	-	3	-	**3**	4.41
5	Project Work(PW)	-	2	10	16	**28**	41.18
6	Industrial Case Study (EEC)	1.5	1.5	-	-	**3**	4.41
Total		**18.5**	**17.5**	**16**	**16**	**68**	

SEMESTER 1

22PD101	RESEARCH METHODOLOGY	3/0/0/3
Course Objectives:		
1	To impart knowledge of collecting data for carrying out research work effectively.	
2	To enable the students to use optimization technique for problem solving.	
3	To impart decision making skills using statistical tool.	
4	To gain exposure to write research reports.	
5	To impart knowledge about the procedure for filing patents and protecting intellectual property rights.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C101.1	Understand the fundamental search concepts and data collection methods for conducting research work.	[U]
C101.2	Experiment the test hypothesis and analyze the outcome.	[A]
C101.3	Report the research work and write research proposals for various funding agencies.	[Ap]
C101.4	Analyze the procedure for filing patent rights, licensing and transfer of technology.	[A]

Course Contents:

FUNDAMENTALS AND DATA COLLECTION: Research methodology - definition, objectives, mathematical tools for analysis, Research design. Types of research, exploratory research, conclusive research, modelling research, algorithmic research, Research process- steps. Data collection methods- Primary data – observation method, personal interview, telephonic interview, mail survey, questionnaire design. **HYPOTHESES TESTING AND ANALYSIS:** Hypotheses testing – Testing of hypotheses concerning means, concerning variance – one tailed Chi-square test. Introduction to Discriminant analysis, Factor analysis, cluster analysis, multidimensional scaling, conjoint analysis.

REPORT WRITING AND PRESENTATION: Report writing- Types of report, guidelines to review report, report format, typing instructions, oral presentation, power point presentation, Data analysis using excel sheet, Proposal submission for funding agencies. Plagiarism, tools to avoid plagiarism, research ethics.
Case study: (Use software) report format, Prepare review paper, Reference formation end note, Grammar verification, Sample plagiarism report using Urkund/ Turnitin.

PATENT RIGHTS: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. **NATURE OF INTELLECTUAL PROPERTY**: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

	Total Hours:	**45**
Text Books:		
1	Ranjith Kumar, “Research Methodology”, SAGE publication, 2018.	
2	Robert Coe, Michael Waring, Larry V Hadges, James Aruthur, “Research Method and Methodology in Education”, SAGE Publication, 2017.	
3	Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.	

Reference Books:	
1	Dahlia K. Remler, Gregg G. Van Ryzin, “Research Methods in Practice (Strategies for Description and Causation)”,SAGE Publication, 2015.
2	Uwe Flick, “Introducing Research Methodology-A Beginer”, SAGE, 2015.
3	T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008.
Web References:	
1	https://nptel.ac.in/courses/109103024/40
2	https://nptel.ac.in/syllabus/107108011/
3	http://textofvideo.nptel.ac.in/121106007/lec26.pdf
Online Resources:	
1	https://www.wipo.int/edocs/pubdocs/en/intproperty/958/wipo_pub_958_3.pdf
2	https://www.isical.ac.in/~palash/research-methodology/RM-lec9.pdf

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom’s Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C101.1	Understand	Assignment	20
C101.2	Analyze	Quiz	20
C101.3	Apply	Case study	20
C101.4	Analyze	Case study	20

Assessment based on Summative and End Semester Examination

Bloom’s Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	50	20	20
Understand	40	30	30
Apply	10	30	30
Analyse	-	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

22PD102	ADVANCED STRENGTH OF MATERIALS	3/0/0/3
Course Objectives:		
1	To understand the calculation of stresses and strains in components under normal, shear, torsional and rotational loading conditions.	
2	To solve problems involving unsymmetrical bending.	
3	To understand the contact stress and stresses in curved beams.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C102.1	Understand the concepts of stress-strain at a point and the stress-strain relationships for homogenous and isotropic materials.	[U]
C102.2	List the various kinds of stress and strain for 3D problems under different loads.	[R]
C102.3	Apply stress functions and calculate stresses in various beam sections, thin-walled tubes and rotary disc.	[Ap]
C102.4	Determine the deflections and rotations produced by different types of loads: axial, torsional and flexural.	[A]
Course Contents:		
ELASTICITY- Stress-Strain relations and equilibrium equations of elasticity in Cartesian, Polar and spherical coordinates. Differential equations of equilibrium- Compatibility- boundary conditions- representation of 3-dimensional stress of a tensor- Generalized Hook's law –St. Venants principle -Plane stress- Airy's Stress function. **SHEAR CENTRE AND UNSYMMETRICAL BENDING**-Location of Shear centre for various sections- Shear flows. Unsymmetrical Bending: Stresses and deflections in beams subjected to unsymmetrical loading - Kern of a section. **CURVED FLEXURAL MEMBERS**-Circumferential and radial stresses-deflections of curved beam with restrained ends -Wrinkler Bach formula-limitations- closed ring subjected to concentrated load and uniform load – chain links and crane hooks. **TORSION OF NON-CIRCULAR SECTION** -Torsion of rectangular cross sections- St.Venant's theory – Elastic membrane Analogy – Prandtl's stress function – Torsional stresses in hollow thin walled tubes. **STRESSES DUE TO ROTATION& CONTACT STRESSES** - Radial and tangential stresses in solid discand ring of uniform thickness and varying thickness- allowable speeds. Theory of contact stresses - Methods of computing contact stresses - Deflection of bodies in point and line contact Applications.		
	Total Hours:	**45**
Text Books:		
1	Beer F. P. and Johnston R, "Mechanics of Materials", McGraw-Hill Book Co, 2017.	
2	Timoshenko and Goodier, "Theory of Elasticity", McGraw Hill Publications, 2010.	
3	Arthur P Boresi, Richard J Schmidt, "Advanced mechanics of materials", John wiley, 2009.	
Reference Books:		
1	Srinath. L.S., "Advanced Mechanics of solids", Tata McGraw Hill, 2017.	
2	Sadhusingh, "Advanced Strength of Materials", Khanna Publishers, 2012.	

Web References:	
1	https://nptel.ac.in/courses/112101095/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C102.1	Understand	Quiz	20
C102.2	Remember	Group Assignment	20
C102.3	Apply	Tutorial	20
C102.4	Analyze	Group Assignment	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	30	30	30
Understand	30	30	30
Apply	40	20	20
Analyse	-	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

22PD103	COMPUTER AIDED DESIGN	3/0/0/3
Course Objectives:		
1	To understand the basic principles of CAD.	
2	To study how various graphical images can be created on the computer and its representation standards.	
3	To gain exposure to commercial FEA package.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C103.1	Understanding the principles of CAD systems and its relation to CAM and CAE systems	[U]
C103.2	Analyse 2D, 3D transformations and projection transformations	[A]
C103.3	Interpret the mathematical representation of 2D and 3D entities	[Ap]
C103.4	Examine basic fundamentals of FEM.	[A]

Course Contents:

CAD Hardware and Software: Types of systems and system considerations, input and output devices, hardware integration and networking, hardware trends, Software modules. Computer Communications: Principle of networking, classification networks, transmission media and interfaces, network operating systems. Computer Graphics: transformation of geometric models, mappings of geometric models and inverse transformations and mapping.

Projections of geometric models: Geometric Modeling, Curve representation: Parametric representation of analytic curves, synthetic curves, curve manipulations and Surface representation. Fundamentals of Solid modeling: boundary representation (B-rep), Constructive Solid Geometry (CSF), sweep representation, Analytic Solid Modeling (ASM), solid modeling based Applications: mass properties calculations, mechanical tolerancing, etc.

Finite Element Modeling and Analysis: Introduction, mesh generation and requirements, semiautomatic and fully automatic methods, design and engineering Applications, System Simulation, when simulation is Appropriate tool / not Appropriate, concept and components of a system, types of models, types of simulation Approaches.

	Total Hours:	**45**
Text Books:		
1	Zeid Ibrahim, CAD/CAM theory and practices, McGraw Hill international edition. 2013.	
2	Radhakrishnan P, Subramanyan S, Raju V “CAD/CAM/CIM”, New Age International, Fourth edition, 2018.	
Reference Books:		
1	P.N. Rao, “CAD/CAM: Principles and Applications”, McGraw Hill Education; 3rd edition, 2017.	
2	Sunil Kumar Srivastava, “Computer Aided Design: A Basic and Mathematical Approach”, I K International Publishing House Pvt. Ltd; 1st Edition, 2012.	
Web References:		
1	https://www.youtube.com/watch?v=EgKc9L7cbKc	
Online Resources:		
1	http://nptel.ac.in/courses/112102101/	

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C103.1	Understand	Quiz	20
C103.2	Analyse	Assignment	20
C103.3	Apply	Seminar	20
C103.4	Analyse	Seminar	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	10	20	20
Understand	40	30	30
Apply	40	30	30
Analyse	10	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

22PD104	MODELLING AND MECHANISM SIMULATION LABORATORY	0/0/4/2

Course Objectives:

1	To impart fundamental knowledge and basic skills to the students in drafting and modelling techniques.
2	Ability to create 2D and 3D models as per the given drawing using modeling packages.
3	To simulate the mechanisms of mechanical components using appropriate software.

Course Outcomes:
Upon completion of the course, students shall have ability to

C104.1	Understand the tools of CAD software.	[U]
C104.2	Apply and practice the software tools for drafting and modelling.	[Ap]
C104.3	Create 2D and 3D models of engineering components.	[C]
C104.4	Create and simulate mechanism of basic components used in day to day life.	[C]

Course Contents:

S.No	List of Experiments	BT	CO Mapping
	Assembly modelling of		
1.	Parts of the Center lathe.	[U]	CO1, CO2
2.	Gudgeon pin and the crank shaft of IC engine with limits and tolerance.	[U]	CO1, CO2
3.	Parts of the shaper tool head	[Ap]	CO1, CO2
4.	Piston of an I.C. engine.	[Ap]	CO1, CO2
5.	Valve operating mechanism of internal combustion engine.	[Ap]	CO1, CO2
	Mechanism simulation of		
6.	Hand Pump.	[C]	CO3, CO4
7.	Wiper.	[C]	CO3, CO4
8.	Conventional differentials used in automobiles	[C]	CO3, CO4
9.	Simple Gear Trains	[C]	CO3, CO4
	Total Hours		**45**

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
75	25	100	60	40	100

Assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment (60%) [100 Marks]		End Semester Practical Examination (40%) [100 Marks]
	FA (75 Marks)	SA (25 Marks)	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	20
Analyse	20	20	20
Evaluate	10	10	10
Create	20	20	20

22PD105	INDUSTRIAL CASE STUDY – 1	0/0/3/1.5

Course Contents:

1. It is mandatory that each student will be required to visit industries based on their field of interest and do the case study in the industry.
2. The student has to submit a report of the case study done in the industry consisting of a title page, introduction, body chapters and a conclusion with references running not less than 20 pages. This report will be evaluated by the faculty coordinator/guide.
3. For each student, a faculty guide will be allotted and he / she will guide and monitor the progress of the student and maintain attendance also.
4. At the end of the semester, one internal examiner and one external examiner, appointed by the COE will examine the report and presentation has to be given by the students to the panel.

Summative assessment based on Continuous and End Semester Examination

Activity	Continuous Assessment [60 marks]	End Semester Examination [40 marks]
Industry Visit	50	100
Case Study - Report Evaluation & Presentation	50	

SEMESTER 2

22PD201	ADVANCED FINITE ELEMENT ANALYSIS	3/0/0/3
Course Objectives:		
1	To understand the significance of weak form and weighted integral statements of differential equations.	
2	To have an insight of the FEA applications to heat transfer, vibrations and fluid flow problem.	
3	To apply suitable methodology to solve the problems.	
4	To gain exposure to commercial FEA packages.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C201.1	Apply finite element method to solve problems in solid mechanics, fluid mechanics and heat transfer.	[Ap]
C201.2	Formulate and solve problems using two dimensional elements including triangular and quadrilateral elements.	[A]
C201.3	Analyze fluid flow, shell and plate bending problems.	[A]
C201.4	Implement and solve the finite element formulations using FEA packages.	[E]
Course Contents:		
Introduction: Relevance of FEA in design-Modelling and Discretization-Variational principles and methods-Weighted integral statements-Weak formulations-Ritz method-Method of weighted residuals-Applications of FEA- Introduction to FEA Software packages -Overview of 1D and 2D elements- Shape functions – Stiffness matrix. **Isoparametric (8 nodal quadrilateral) Formulation**: Introduction-shape function, Jacobian matrix, Strain displacement matrix, Stress-strain relationship matrix and Force vector. Numerical integration-Gauss quadrature -Static condensation-load considerations-Examples of 2D applications. **Dynamic Analysis:** Dynamic equation -Consistent and lumped mass matrices-1D bar element-Formulation of element stiffness, mass and force matrices-Example problems. Natural frequencies-1D bar element-Formulation of element stiffness, mass and force matrices. Fluid flow, Shell and Plate Analysis: Fluid flow basic equation- 1D Fluid flow finite element formulation-1D Fluid flow problems. Thin plate theory, Formulation of Plate bending element stiffness matrix, Formulation of stiffness matrix for four node degenerated quadrilateral shell elements. Grid sensitivity test.		
	Total Hours:	**45**
Text Books:		
1	Rao S.S, “Finite Element Method in Engineering”, Elsevier, 2012.	
2	Seshu P., “Textbook of Finite Element Analysis”, PHI Learning Private Ltd, 2013.	
Reference Books:		
1	Reddy J.N, “Introduction to the finite element method”, McGraw Hill, International Edition, 2018.	
2	Asghar Bhatti M, “Advanced topics in Finite Element Analysis of Structures”, Chaudhry Press, Delhi, 2014.	
3	Chandrupatla T.R., Belegundu A.D., "Introduction to finite elements in engineering", PHI Learning Private Ltd, 2009.	
4	Daryl L Logan, “A First Course in Finite Element Method”, CL Engineering, Fifth Edition, 2010.	

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C201.1	Apply	Group Assignment	20
C201.2	Analyze	Tutorial	20
C201.3	Analyze	Case study	20
C201.4	Evaluate	Case study	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	20	20	20
Understand	30	30	30
Apply	30	30	30
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

22PD202	VIBRATION ANALYSIS AND CONTROL	3/0/0/3
Course Objectives:		
1	To construct the equations of motion from free-body diagrams.	
2	To solve for the motion and the natural frequency of a freely vibrating single degree of freedom undamped / damped system.	
3	To construct the governing differential equation and find solutions for a vibrating mass subjected to an arbitrary force.	
4	To solve for the motion and the natural frequency for forced vibration of a single degree / Multi degree of freedom damped / undamped system.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C202.1	Illustrate the basic terms and components of vibrating system.	[Ap]
C202.2	Model and analyze the single DOF system subjected to free vibrations and steady-state forced vibrations using Newton's second law or energy principles.	[A]
C202.3	Model and analyze multi-DOF systems.	[A]
C202.4	Determine a complete solution to mechanical vibration problems using mathematical or numerical techniques.	[E]

Course Contents:

FUNDAMENTALS OF VIBRATION: Introduction -Sources of Vibration-Mathematical Models-Review Of Single Degree Freedom Systems -Vibration isolation Vibrometers and accelerometers -Response To Arbitrary and non- harmonic Excitations –Impulse loads- Critical Speed Of Shaft-Two rotor system and three rotor system. **TWO DEGREE FREEDOM SYSTEM**: Introduction-Free Vibration Of Undamped And Damped- Forced Vibration With Harmonic Excitation System –Coordinate Couplings And Principal Coordinates.

MULTI-DEGREE FREEDOM SYSTEM AND CONTINUOUS SYSTEM: Multi Degree Freedom System –Influence Coefficients and stiffness coefficients- Flexibility Matrix and Stiffness Matrix –Eigen Values and Eigen Vectors-Matrix Iteration Method –Approximate Methods: Dunkerley, Rayleigh's, and Holzer Method -Geared Systems- Continuous System: Vibration of String, Shafts and Beams. **VIBRATION CONTROL**: Specification of Vibration Limits –Vibration severity standards- Vibration as condition Monitoring tool-Vibration Isolation methods- -Dynamic Vibration Absorber, Torsional and Pendulum Type Absorber- Damped Vibration absorbers –Vibration Control by Design Modification- - Active Vibration Control.

EXPERIMENTAL METHODS IN VIBRATION ANALYSIS: Vibration Monitoring – Data Acquisition Vibration Analysis Overview - Experimental Methods in Vibration Analysis - Vibration Measuring Instruments - Selection of Sensors- Accelerometer Mountings. -Vibration Exciters-Mechanical, Hydraulic, Electromagnetic and Electrodynamics –Frequency Measuring Instruments- Testing for resonance and mode shapes.

Total Hours:	**45**

Text Books:

1	Singiresu S. Rao, " Mechanical Vibrations" , Prentice Hall, Inc., 2017
2	V. Rao Dukkipati, J. Srinivas.," Textbook of Mechanical Vibrations," PHI learning Pvt.Ltd, 2012

Reference Books:

1	HaymBenaroya, Mark L. Nagurka and SeonMi Han , " Mechanical Vibrations" ,CRC Press I, LLC, 2018
2	S. Graham Kelly, "Mechanical Vibrations", Cengage Learning, 2012.

Web References:

1	https://swayam.gov.in/course/4531-introduction-to-mechanical-vibration

Online Resources:	
1	https://lecturenotes.in/subject/148/mechanical-vibration-mv

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C202.1	Apply	Assignment	20
C202.2	Analysis	Tutorial / Case study	20
C202.3	Analysis	Tutorial / Case study	20
C202.4	Evaluate	Group Assignment	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	10	10	10
Understand	30	20	20
Apply	20	20	20
Analyse	30	40	40
Evaluate	10	10	10
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

22PD203	COMPUTER AIDED ENGINEERING LABORATORY	0/0/4/2
Course Objectives:		
1	To impart knowledge to perform stress analysis for any given component under various mechanical loading conditions.	
2	To enable the students to simulate and analyse engineering components under various thermal loading conditions.	
3	To enable the students to verify the simple 2D flow using numerical coding.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C203.1	Solve the simple structural problems using appropriate analysis software.	[A]
C203.2	Evaluate the thermal properties of the given component using analysis software.	[E]
C203.3	Validate the fluid flow problems using CFD	[E]
C203.4	Develop C/ MAT Lab program to simulate mechanical systems.	[C]

Course Contents:

S.No	List of Experiments	BT	CO Mapping
1.	Stress analysis of L bracket	[A]	CO1
2.	Stress analysis of Plate with Hole	[A]	CO1
3.	Stress analysis of axisymmetric component.	[A]	CO1
4.	Stress analysis of Beams and trusses	[A]	CO1
5.	Thermal stress Analysis in 2D components	[E]	CO2
6.	Conductive and convective heat transfer analysis	[E]	CO2
7.	Flow analysis for velocity and pressure distribution in simple 2D flow over flat plate	[E]	CO3
8.	Analysis and Validation of Laminar Pipe Flow using ANSYS Fluent	[E]	CO3
9.	Simulation of Air conditioning system with condenser temperature and evaporator temperatures as Input to get COP using C /MAT Lab	[C]	CO4
10	Simulation of Hydraulic /Pneumatic cylinder using C/MAT Lab	[C]	CO4
11	Simulation of Cam and Follower mechanism using C / MAT Lab	[C]	CO4
	Total Hours		**45**

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
75	25	100	60	40	100

Assessment based on Continuous and End Semester Examination			
Bloom's Level	**Continuous Assessment (60%) [100 Marks]**		**End Semester Practical Examination (40%) [100 Marks]**
	FA (75 Marks)	**SA (25 Marks)**	
Remember	10	10	10
Understand	10	10	10
Apply	10	10	10
Analyse	30	30	20
Evaluate	30	30	30
Create	10	10	20

22PD204	INDUSTRIAL CASE STUDY – 2	0/0/3/1.5

Course Contents:

1. It is mandatory that each student will be required to visit industries based on their field of interest and do the case study in the industry.
2. The student has to submit a report of the case study done in the industry consisting of a title page, introduction, body chapters and a conclusion with references running not less than 20 pages. This report will be evaluated by the faculty coordinator/guide.
3. For each student, a faculty guide will be allotted and he / she will guide and monitor the progress of the student and maintain attendance also.
4. At the end of the semester, one internal examiner and one external examiner, appointed by the COE will examine the report and presentation has to be given by the students to the panel.

Summative assessment based on Continuous and End Semester Examination

Activity	Continuous Assessment [60 marks]	End Semester Examination [40 marks]
Industry Visit	50	100
Case Study - Report Evaluation & Presentation	50	

22PD205	MINI PROJECT	0/0/4/2

Course Contents:

1. Each student is expected to do an individual project.
2. Every student shall have a guide who is the member of the faculty of the institution. Identification of faculty guide has to be completed within a week from the day of beginning of second semester.
3. The student has to identify and select the problem to be addressed as his/her project work; do a detailed literature survey and finalize a comprehensive aim and scope of his/her work to be done.
4. A project report to this effect has to be submitted by each student.
5. Three reviews have to be conducted to access the progress of the project work by a team of faculty (minimum 3 and a maximum of 5) along with their faculty guide as a member of the faculty team.
6. At the end of semester exam, one internal examiner and one external examiner, appointed by the COE will examine the project done by the students.

Summative assessment based on Continuous and End Semester Examination

Activity	Continuous Assessment [60 marks]	End Semester Examination [40 marks]
Project Review I	30	100
Project Review II	30	
Project Review III	40	

SEMESTER 3

22PD301	DISSERTATION PHASE I	0/0/20/10

Course Contents:

1. Each student is expected to do an individual project.
2. Every student shall have a guide who is the member of the faculty of the institution. Identification of faculty guide has to be completed within a week from the day of beginning of third semester.
3. The student has to identify and select the problem to be addressed as his/her project work by conducting a complete literature survey and finalize a comprehensive aim and scope of his/her work to be done.
4. 25% of the total project work (up to design phase) has to be completed by the end of third semester.
5. A project report (of the phase-I) to this effect has to be submitted by each student. Also, the complete design project report has to be submitted by each student.
6. Two mid semester reviews and one end semester review of the progress of the project work have to be conducted by a team of faculty (minimum 3 and a maximum of 5) along with their faculty guide as a member of the faculty team.
7. During the end semester exam, one internal examiner and one external examiner, appointed by the COE will examine the project phase I done by the students.

Summative assessment based on Continuous and End Semester Examination

Activity	Month	Continuous Assessment [60 marks]	End Semester Examination [40 marks]
Problem Statement	August	50	100
Project Evaluation (Up to design phase)	September	50	

SEMESTER 4

22PD401	DISSERTATION PHASE II	0/0/32/16

Course Contents:

1. The entire semester shall be utilized by the students to do their project work by receiving the directions from the guide. The time may be used for library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present periodical seminars about the progress made in the project.
2. The progress of the project is to be evaluated on a continuous basis by conducting a minimum of three reviews. The review committee may be constituted by the Head of the Department.
3. Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion. This final report shall be in typewritten form as specified in the guidelines issued by the COE.
4. The project work is evaluated jointly by external and internal examiners constituted by the COE based on oral presentation and the project report. The candidate is expected to publish the project work in peer reviewed journal. Presenting a portion of the project in International Conference/Journal is mandatory.

Summative assessment based on Continuous and End Semester Examination

Activity	Month	Continuous Assessment [60 marks]	End Semester Examination [40 marks]
Project Evaluation	January	30	100
Project Evaluation	February	30	
Project Evaluation + Presenting in International Conference/Journal	March	40	

PROFESSIONAL ELECTIVES – GROUP 1

22PD501	ADVANCED AUTOMOTIVE SYSTEMS	3/0/0/3
Course Objectives:		
1	To impart the knowledge on automotive subsystems design.	
2	To enable the students to design and fabricate the automotive systems.	
3	To impart the basics of analysing the vehicle performance.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C501.1	Define and illustrate the concepts of automotive engine system.	[U]
C501.2	Identify objects of vehicle drive and control systems.	[Ap]
C501.3	Examine the braking system.	[A]
C501.4	Determine the vehicle performance.	[E]
Course Contents:		
DESIGN OF ENGINE PARTS: Auto design, aspect of auto design, basic requirement for design, design procedure- Design of piston for I.C Engine, design of piston rings, piston pin - Fuel system- carburetor performance - review questions. **DESIGN OF CLUTCH PLATES, GEAR BOX AND PROPELLER SHAFT:** Function of clutch- requirement of clutch- types of clutch- clutch system derivation - problems for single plate clutch, multi plate clutch, centrifugal clutch- design of fluid flywheel - state the factors to be considered for designing a gear drive, design of planetary gear box, problems - design of propeller shaft – derivation – problems. **DESIGN OF SUSPENSION SPRINGS AND STEERING MECHANISM:** Types of suspension springs, design of coil spring, problems - types of steering mechanism, types of steering gears turning circle radius problems. **DESIGN OF BRAKING SYSTEM:** Classification of brake, braking of vehicle, Band and block brake, internal expanding brake, braking of vehicle, problems – design of disc and hydraulic brake. **PERFORMANCE OF VEHICLE:** Power of propulsion, air resistance, rolling resistance, grade resistance, traction and tractive effort, acceleration, gradiability, draw bar pull, calculation of equivalent weight. Design, evaluation and fabricate of any one sub system of a 4 Wheel automobile.		
	Total Hours:	**45**
Text Books:		
1	A.Kolchin and V.Demidov., “Design of Automotive Engines” 2nd Edition, MIR Publisher, Moscow, 2013 (Reprint)	
2	Shigley J.E and Mischke C. R., “Mechanical Engineering Design”, Tenth Edition, Tata McGraw-Hill , 2015.	
Reference Books:		
1	Bhandari, V.B., “Design of Machine Elements”, Fourth Edition, Tata McGraw-Hill Publishing Company Ltd., 2007	
2	Spotts M.F., Shoup T.E “Design and Machine Elements” Eight Edition, Pearson Education, 2004	
Web References:		
1	http://nptel.ac.in/courses/112103019/Automobile Engineering	
Online Resources:		
1	http://pioneer.netserv.chula.ac.th/~kjirapon/self-practice.html	

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C501.1	Understand	Presentation	20
C501.2	Apply	Tutorial	20
C501.3	Analyze	Assignment	20
C501.4	Evaluate	Project/ Case Study	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	10	10	10
Understand	30	30	30
Apply	30	30	40
Analyse	20	20	10
Evaluate	10	10	10
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

22PD502	ADVANCED MECHANISM DESIGN	3/0/0/3
Course Objectives:		
1	To develop a thorough understanding of the various mechanisms and its design.	
2	To design and simulate various mechanisms used in real life applications.	
3	To study about the synthesis and dynamics of mechanisms.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C502.1	Understand the concept of advanced mechanisms which are used in real life applications.	[U]
C502.2	Perform two and three-position synthesis and apply Chebychev spacing to describe cognate linkages.	[E]
C502.3	Analyze forces on static and dynamic mechanisms	[A]
C502.4	Apply the engineering tools in computing the mobility of various mechanisms	[Ap]
Course Contents:		
Introduction: Review of fundamentals of kinematics-classifications of mechanisms-components of mechanisms – mobility analysis – formation of one D.O.F. multi loop kinematic chains, Network formula – Gross motion concepts-Basic kinematic structures of serial and parallel robot manipulators compliant mechanisms-Equivalent mechanisms. **Kinematic analysis:** Position Analysis – Vector loop equations for four bar, slider crank, inverted slider crank, geared five bar and six bar linkages. Analytical methods for velocity and acceleration Analysis– four bar linkage jerk analysis. Plane complex mechanisms-auxiliary point method. Spatial RSSR mechanism - Denavit - Harten berg Parameters – Forward and inverse kinematics of robot manipulators. **Path curvature theory, coupler curve:** Fixed and moving centrodes, inflection points and inflection circle. Euler Savary equation, graphical constructions – cubic of stationary curvature. Four bar coupler curve-cusp crunode coupler driven six-bar mechanisms-straight line mechanisms **Synthesis of four bar mechanisms:** Type synthesis – Number synthesis – Associated Linkage Concept. Dimensional synthesis – function generation, path generation, motion generation. Graphical methods-Pole technique, inversion technique-point position reduction-two, three and four position synthesis of four- bar mechanisms. Analytical methods- Freudenstein's Equation-Bloch's Synthesis. **Synthesis of coupler curve based mechanisms & cam mechanisms:** Cognate Lingages-parallel motion Linkages. Design of six bar mechanisms-single dwell-double dwell-double stroke. Geared five bar mechanism-multi-dwell. Cam Mechanisms-determination of optimum size of cams. Mechanism defects. Study and use of Mechanism using Simulation Soft-ware packages. Students should design and fabricate a mechanism model as term project. Robot dynamic analysis: Introduction, Equation for robotic manipulators, Lagrangian formulation method.		
	Total Hours:	**45**
Text Books:		
1	Ramamurti, V., "Mechanics of Machines", Narosa, 2012.	
2	Robert L.Norton., "Design of Machinery", Tata McGraw Hill, 2014.	
3	Uicker, J.J., Pennock, G. R. and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 2012.	
Reference Books:		
1	Amitabha Ghosh and Asok Kumar Mallik, "Theory of Mechanism and Machines", EWLP, Delhi, 2014.	

2	Kenneth J, Waldron, Gary L. Kinzel, “Kinematics, Dynamics and Design of Machinery”, John Wiley-sons, 2012.
3	Sandor G.N., and Erdman A.G., “Advanced Mechanism Design Analysis and Synthesis”, Prentice Hall, 2014.

Web References:

1	https://www.cs.cmu.edu/~rapidproto/mechanisms/references.html

Continuous Assessment				End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom’s Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C502.1	Understand	Assignment	20
C502.2	Evaluate	Assignment	20
C502.3	Analyze	Case study	20
C502.4	Apply	Case study	20

Assessment based on Summative and End Semester Examination

Bloom’s Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	10	20	20
Understand	30	20	20
Apply	40	30	30
Analyse	20	20	20
Evaluate	-	10	10
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

22PD503	ADVANCED TOOL DESIGN	3/0/0/3
Course Objectives:		
1	To study the essential properties and recent progress in cutting tool materials.	
2	To select suitable single point cutting tools and multipoint cutting tools for machining process.	
3	To develop skill on design of Jigs and Fixtures for conventional and CNC machines.	
4	To create expertise in press tool design.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C503.1	Identify the properties of tool material, tool nomenclature and classify the cutting tools.	[U]
C503.2	Interpret the parameters of the cutting tools for machining process.	[Ap]
C503.3	Analyse the various locating and clamping methods.	[A]
C503.4	Design the jigs, fixtures, press tools and tools for CNC machine tools.	[C]

Course Contents:

INTRODUCTION TO TOOL DESIGN Introduction –Tool Engineering – Tool Classifications– Tool Design Objectives – Tool Design in manufacturing- Challenges and requirements- Standards in tool design-Tool drawings -Surface finish – Fits and Tolerances - Tooling Materials- Ferrous and Non-ferrous Tooling Materials- Carbides, Ceramics and Diamond –Non-metallic tool materials-Designing with relation to heat treatment. **DESIGN OF CUTTING TOOLS** Mechanics of Metal cutting –Oblique and orthogonal cutting- Chip formation and shear angle - Single-point cutting tools – Milling cutters – Hole making cutting tools- Broaching Tools - Design of Form relieved and profile relieved cutters-Design of gear and thread milling cutters

DESIGN OF JIGS AND FIXTURES Introduction – Fixed Gages – Gage Tolerances – selection of material for Gages – Indicating Gages – Automatic gages – Principles of location – Locating methods and devices – Principles of clamping – Drill jigs – Chip formation in drilling – General considerations in the design of drill jigs – Drill bushings – Methods of construction –Thrust and Turning Moments in drilling - Drill jigs and modern manufacturing- Types of Fixtures – Vice Fixtures – Milling Fixtures – Boring Fixtures – Broaching Fixtures – Lathe Fixtures – Grinding Fixtures – Modular Fixtures – Cutting Force Calculations.

DESIGN OF PRESS TOOL DIES Types of Dies –Method of Die operation–Clearance and cutting force calculations- Blanking and Piercing die design – Pilots – Strippers and pressure pads- Presswork materials – Strip layout – Short-run tooling for Piercing – Bending dies – Forming dies – Drawing dies-Design and drafting. **TOOL DESIGN FOR CNC MACHINE TOOLS** Introduction –Tooling requirements for Numerical control systems – Fixture design for CNC machine tools- Sub plate and tombstone fixtures-Universal fixtures– Cutting tools– Tool holding methods– Automatic tool changers and tool positioners – Tool presetting– General explanation of the Brown and Sharp machine.

Total Hours:	**45**

Text Books:

1	E.G.Hoffman," Jig and Fixture Design", Thomson Asia Pvt Ltd, Singapore, 2013.

2	Cyrll Donaldson, George H.LeCain, V.C. Goold, “Tool Design”, Tata McGraw Hill Publishing Company Ltd., 2010.
Reference Books:	
1	Mehta, N.K., “Machine Tool Design”, Tata McGraw Hill, 2012.
2	M. Weck, “Handbook of Machine Tools, Vol. 1-4”, John Wiley, USA. 2010.
Web References:	
1	https://www.paragon-rt.com/Services/Jigs-Fixtures-and-Gauges

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	**Bloom’s Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C503.1	Understand	Class Presentation	20
C503.2	Apply	Group Assignment	20
C503.3	Analyze	Mini project	20
C503.4	Create	Mini project	20

Assessment based on Summative and End Semester Examination

Bloom’s Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1: [60 Marks]	**CIA2: [60 Marks]**	
Remember	20	10	10
Understand	30	20	20
Apply	40	40	40
Analyse	10	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1: 100 Marks			**CA 2: 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

22PD504	DESIGN OF HEAT EXCHANGERS	3/0/0/3
Course Objectives:		
1	To understand the fundamentals of heat exchanger.	
2	To understand the heat transfer phenomenon through different mediums.	
3	To know the various design aspects to be considered in design of heat exchangers.	
4	To enable the students to understand the design aspects and performance of condenser and cooling tower.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C504.1.	Understand the methods of heat exchanger analysis.	[U]
C504.2.	Analyse the flow, stress and failures in tubes, header sheets and pressure vessels	[A]
C504.3.	Design and analyse single and multipass heat exchangers.	[C]
C504.4.	Design compact and plate heat exchangers.	[C]
C504.5.	Design and analyse the condensers and cooling towers.	[C]

Course Contents:

FUNDAMENTALS OF HEAT EXCHANGER : Introduction Temperature distribution and its implications types – shell type heat exchanger, tube heat exchangers – regenerators and recuperators – analysis of heat exchangers – Logarithmic mean temperature difference (LMTD) and effectiveness method – Simple problems. Use of Heat pipes as heat exchangers. **FLOW AND STRESS ANALYSIS:** Types of flow, laminar, transitional and turbulent – Effect of turbulence – friction factor – pressure loss, simple problems – stress in tubes – header sheets and pressure vessels, simple problems – thermal stresses, shear stresses, types of failures.

DESIGN ASPECTS : Heat transfer and pressure loss – flow configuration – effect of baffles – effect of deviations from ideality – design of double pipe – design of finned tube, shell and tube heat exchangers, simulation of heat exchangers – Formulation of initial and boundary conditions. **COMPACT AND PLATE HEAT EXCHANGERS:** Types – merits and demerits – common design aspects of heat exchanger – design of compact heat exchangers – design of plate heat exchangers – performance influencing parameters in compact heat exchangers and limitations. Selection of heat exchanger.

CONDENSERS & COOLING TOWERS: Introduction to Condenser – Types of condenser – Design aspects of condenser – Design of surface condenser – Design of evAporative condensers – cooling tower, functions, types– design of natural draft, design of induced draft cooling towers – performance characteristics – problems. Maintenance of condensers and cooling towers.

	Total Hours:	**45**

Text Books:	
1	P Arthur. Frass, “Heat Exchanger Design”, John Wiley & Sons, 2011.
2	“Numerical Modelling and Experiment Testing of Heat Exchangers”, Springer, May 2018.
3	Nirmal Parmar (Ed.), Kevin shah LAP , “Design and Analysis of shell and tube type heat exchanger”, Lambert Academic publishing, 2017.
Reference Books:	
1	Cryogenic Heat Transfer, Second Edition by Randall F. Barron, Gregory F. Nellis, CRC Press, May 23, 2016.
2	Hewitt.G.F, Shires.G.L, Bott.T.R, Process Heat Transfer, CRC Press, 2006.

3	Taborek.T, Hewitt.G.F and Afgan.N, Heat Exchangers, Theory and Practice, McGraw-Hill Book Co., 2001.
Web References:	
1	http://www.thermopedia.com/content/832/
2	http://www.alternative-energy-tutorials.com/energy-articles/heat-exchanger-design.html
3	https://www.brighthubengineering.com/hvac/59900-fundamentals-of-heat-exchanger-theory-and-design/
Online Resources:	
1	http://www.hcheattransfer.com/tools.html
2	https://nptel.ac.in/courses/103103027

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C504.1	Understand	Quiz	20
C504.2	Analyse	Group Assignment	20
C504.3	Create	Project	20
C504.4	Create	Project	20
C504.5	Create		

Assessment based on Summative and End Semester Examination

Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1: [60 Marks]	**CIA2: [60 Marks]**	
Remember	10	10	10
Understand	30	20	20
Apply	30	40	40
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1: 100 Marks			**CA 2: 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

22PD505	DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS	3/0/0/3
Course Objectives:		
1	To impart the science, use and applications of hydraulics and pneumatics as fluid power in industry.	
2	To provide the knowledge on the design of pneumatics and hydraulics systems.	
3	To impart the fundamental concepts of installing and troubleshooting the fluid power system.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C505.1	Understand the working principles of hydraulics system, hydraulic actuators and valves	[U]
C505.2	Operate and maintain hydraulic and pneumatic systems	[Ap]
C505.3	Analyze the scenario and provide suitable solution to the problems in hydraulic and pneumatic systems	[A]
C505.4	Design hydraulic and pneumatic circuits for the given Applications	[C]
Course Contents:		
OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS: Hydraulic Power Generators – Selection and specification of pumps, pump characteristics. Fluid Power Actuators, Linear hydraulic actuators, types of hydraulic cylinders, single acting, double acting special cylinders like tandem, rod less, telescopic, cushioning mechanism. Construction of double acting cylinder, rotary actuators, fluid motors, gear, vane and piston motors. **CONTROL AND REGULATION ELEMENTS:** Pressure - direction and flow control valves - relief valves, non-return and safety valves - actuation systems. **HYDRAULIC CIRCUITS:** Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits – industrial circuits - press circuits - hydraulic milling machine - grinding, planning, copying, - forklift, earth mover circuits - design and selection of components - safety and emergency mandrels **PNEUMATIC SYSTEMS AND CIRCUITS:** Pneumatic fundamentals - control elements, position and pressure sensing - logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods – k-v mApping methods - step counter method - compound circuit design - combination circuit design. **INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS:** Pneumatic equipments - selection of components - design calculations – Application - fault finding - hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.		
	Total Hours:	**45**
Text Books:		
1	Andrew Parr, “Hydraulic and Pneumatics” (HB), Jaico Publishinh house, 2015.	
2	Antony Espossito, “Fluid Power with Applications”, Prentice Hall, 2013.	
3	Manjumdar S.R, “Oil Hydraulics”, Tata McGraw-Hill, December 2012.	
Reference Books:		
1	Srinivasan. R, "Hydraulic and Pneumatic Control", IInd Edition, Tata McGraw - Hill Education, 2012.	
2	Dudleyt, A. Pease and John J. Pippenger, “Basic fluid power”, Prentice Hall, 2010.	
3	K.Shanmuga Sundaram, “Hydraulic and Pneumatic Controls: Understanding made Easy" S.Chand & Co Book publishers, New Delhi,	

	2009.
4	Bolton. W., “Pneumatic and Hydraulic Systems “, Butterworth-Heinemann, 2006.
Web References:	
1	http://nptel.ac.in/courses/112105047/
2	http://hydraulicspneumatics.com/

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	**Bloom’s Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C505.1	Understand	Quiz	20
C505.2	Apply	Group Assignment	20
C505.3	Analyze	Mini Project	20
C505.4	Create	Mini Project	20

Assessment based on Summative and End Semester Examination

Bloom’s Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1: [60 Marks]	**CIA2: [60 Marks]**	
Remember	20	20	20
Understand	40	30	30
Apply	20	30	30
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1: 100 Marks			**CA 2: 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

22PD506	DESIGN OF MATERIAL HANDLING EQUIPMENTS	3/0/0/3
Course Objectives:		
1	To provide the fundamental knowledge on material handling equipment.	
2	To study the design of hoist, gears, conveyors and elevators.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C506.1	Understand the basic concepts and applications of material handling equipment.	[U]
C506.2	Analyse and design the hoisting elements.	[A]
C506.3	Apply the procedures to design conveyors and elevators.	[Ap]
C506.4	Evaluate the design process used in fork lift trucks.	[E]
Course Contents:		
MATERIALS HANDLING EQUIPMENT: Types - Computer Aided Material Handling Equipment- Computer Controlled Conveyor System, Automated Guided Vehicles - selection and Applications. **DESIGN OF HOISTS:** Design of hoisting elements: Welded and roller chains - Hemp and wire ropes - Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks – crane grabs - lifting magnets - Grabbing attachments - Design of arresting gear - Brakes: shoe, band and cone types. **DRIVES OF HOISTING GEAR:** Hand and power drives - Traveling gear - Rail traveling mechanism - cantilever and monorail cranes - slewing, jib and luffing gear - cogwheel drive - selecting the motor ratings. **CONVEYORS:** Types - description - design and Applications of Belt conveyors, Apron conveyors and escalators Pneumatic conveyors, Screw conveyors and vibratory conveyors. **ELEVATORS**: Bucket elevators: design - loading and bucket arrangements - Cage elevators - shaft way, guides, counter weights, hoisting machine, safety devices - Design of fork lift trucks.		
	Total Hours:	**45**
Text Books:		
1	Raymond A. Kulwiec, “Materials handling equipment”, Willey Online, 2018.	
2	Siddhartha Ray, “Introduction to material handling”, New age International, 2nd edition, 2018.	
Reference Books:		
1	Alexandrov, M., “Materials Handling Equipments”, MIR Publishers, 2016.	
2	P.S.G. Tech., “Design Data Book”, Kalaikathir Achchagam, Coimbatore, 2018.	
3	Boltzharol, A., “Materials Handling Handbook”, the Ronald Press Company, 2016	
Web References:		
1	http://www.mhi.org/fundamentals/material-handling	
2	https://people.engr.ncsu.edu/kay/Material_Handling_Equipment	
Online Resources:		
1	http://nptel.ac.in/courses/ 112107143/36	
2	https://pe.gatech.edu/courses/material-handling-101-fundamentals-analysis-and-selection	

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C506.1	Understand	Quiz	20
C506.2	Analyze	Group Assignment	20
C506.3	Apply	Project / Case study	20
C506.4	Evaluate	Project / Case study	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	20	0	10
Understand	50	60	40
Apply	-	10	20
Analyse	30	10	20
Evaluate	-	20	10
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

22PD507	MECHANICAL BEHAVIOUR OF ENGINEERING MATERIALS	3/0/0/3
Course Objectives:		
1	To understand the behavior of the materials under the action of various loading conditions.	
2	To understand the various strengthening mechanisms.	
3	To determine the mechanical properties of the materials.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C507.1	Recall the fundamentals of mechanical and metallurgical behaviour of materials.	[R]
C507.2	Understand the various strengthening mechanism.	[U]
C507.3	Identify the bahavior of materials under the action of loads.	[Ap]
C507.4	Analyze the biaxial state of stress.	[A]
Course Contents:		
Mechanical and metallurgical fundamentals: stress and strain relationship for elastic behavior- state of stress in two dimensions – mohr's circle of stress – two dimension – simple problems- - elastic stress strain relations – strain energy – true stress strain – yielding criteria for ductile materials - deformation by slip – slip by dislocation movement – critical resolved shear stress for slip – dislocation sources – frank read source - strengthening mechanisms - work hardening- bauschinger effect- boundary strengthening- solid solution strengthening- hardening from fine particles- precipitation (age) hardening, dispersion hardening. **Forming and Testing of materials:** Forging process – forging defects – rolling process – defects in rolled parts – extrusion process – production of seamless pipe and tubing - Tension test – Engineering stress stain curve – mechanical properties in tension test – hardness test – Brinell hardness – Meyer hardness – Vickers hardness- Rockwell hardness – Microhardness test – torsion test – mechanical properties in torsion – impact test – izod and charpy. **Fatigue, creep and fracture**: fatigue test – stress cycles - stages of fatigue failure – theories of fatigue failure - S-N curve – effect of metallurgical variables on fatigue – corrosion fatigue - Creep- creep test- creep curve- structural changes during creep- factors affecting creep strength- creep mechanism- deformation mechanism mAps - Fracture- types of fracture- Griffith criterion.		
	Total Hours:	**45**
Text Books:		
1	George E Dieter, "Mechanical Metallurgy", McGraw Hill Book Co., 2016.	
2	Norman E Dowling," Mechanical behavior of materials: Engineering methods for deformation, fracture and fatigue", prentice Hall, 4th edition, 2012.	
Reference Books:		
1	William F Hosford, "Mechanical behavior of materials", Cambridge university press, 2009.	
Web References:		
1	http://stu.westga.edu/~bthibau1/MEDT%207477-Cooper/Calibre%20Library/Dieter%20George%20Ellwood/Mechanical%20metallurgy%20(13)/Mechanical%20metallurgy%20-%20Dieter_%20George%20Ellwood.pdf	
Online Resources:		
1	https://nptel.ac.in/syllabus/113107048/	

Continuous Assessment	End	Total

Formative Assessment	Summative Assessment	Total	Total Continuous Assessment	Semester Examination	
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C507.1	Remember	Quiz	20
C507.2	Understanding	Assignment	20
C507.3	Apply	conduct experiment	20
C507.4	Analyze	Tutorial	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	30	20	10
Understand	40	40	30
Apply	10	40	40
Analyse	20	-	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

22PD508	MECHANICS OF COMPOSITES AND SMART MATERIALS	3/0/0/3
Course Objectives:		
1	To understand the basic concepts and classifications of composite materials.	
2	To analyse micro & macro mechanical behaviour of composites.	
3	To understand the fundamentals of smart materials.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C508.1	Define the basic concepts and manufacturing methods of composite materials.	[U]
C508.2	Analyse the micro and macro mechanical properties of composites.	[A]
C508.3	Evaluate the fatigue and fracture properties of composites.	[E]
C508.4	Illustrate the characteristics and applications of smart materials	[Ap]

Course Contents:

INTRODUCTION: Modern materials in design, types, metals, polymers, ceramics, composites, classification of composites, advantages, Applications and limitations, Matrix and reinforcement-their roles, principal types of fibre and matrix materials. **MANUFACTURE OF COMPOSITE COMPONENTS:** Layup and curing, open and closed mould processes, bag moulding, filament winding, pultrusion, pulforming, thermoforming, injection moulding, blow moulding, an overview of metal matrix composite processing and ceramic matrix composite processing.

MICRO AND MACRO MECHANICAL BEHAVIOUR OF A LAMINATE: Volume and mass fractions, Density and Void Content - Evaluation of elastic moduli, strength of unidirectional lamina. Hooke's law for different types of materials, engineering constants for orthotropic materials. Stress, strain relations for plane stress in an orthotropic materials and in a lamina of arbitrary orientation, strength of an orthotropic lamina, basic strength theories. Classical lamination theory - Maximum stress criterion- Tsai-Wu criterion - lamina stress - types of laminates - strength and stiffness of laminates – inter laminar stresses in laminates.

ANALYSIS OF COMPOSITE STRUCTURES: Fatigue, Fracture mechanics-basic principles, fracture initiation, crack growth and crack growth modes, toughening mechanisms, Environmental effects, Composite joints-bonded, bolted and bonded-bolted joints. **SMART MATERIALS:** Rheological, piezoelectric, shape-memory and magnetostrictive materials. Material characteristics of smart materials.

	Total Hours:	**45**

Text Books:	
1	Autar K Kaw, "Mechanics of Composite Materials", CRC Press, NY, 2010.
2	Srinivasan A V and Michael McFarland, “Smart Structures: Analysis and Design”, Cambridge University Press, UK, 2012
Reference Books:	
1	Ronald F Gibson, “Principles of Composite Material Mechanics", McGraw Hill Book Co, 2015.
2	Robert M Jones, "Mechanics of Composite Materials", Taylor and Francis, 2005.
Web References:	
1	https://www.pnas.org/content/96/15/8330

Online Resources:	
1	http://nptel.ac.in/courses/101104010/
2	https://onlinelibrary.wiley.com/doi/book/10.1002/9781119441632

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C508.1	Understand	Quiz	20
C508.2	Analyze	Poster Presentation/ Seminar	20
C508.3	Evaluate	Case Study	20
C508.4	Apply	Group Assignment	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	10	10	10
Understand	30	30	30
Apply	30	30	30
Analyse	20	20	20
Evaluate	10	10	10
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

22PD509	THEORY OF ELASTICITY AND PLASTICITY	3/0/0/3
Course Objectives:		
1	To understand the theories of stress, strain and plasticity.	
2	To obtain stress and strain value for a given model using graphical method.	
3	To impart the advances in plasticity and plastic strain analysis.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C509.1	Understand the stress and strain tensor field.	[U]
C509.2	Demonstrate knowledge on the essential facts, concepts, theories and principles underlying elasticity and plasticity theory.	[A]
C509.3	Apply appropriate quantitative science, engineering and mathematical tools to solve problems pertaining to elastic and plastic material behavior.	[Ap]
C509.4	Formulate the concepts for plasticity and plastic deformation analysis.	[E]
Course Contents:		
Analysis of stress and strain: Stress at a point, stress tensor, stress concentration factor, stress transformations, principal stresses, octahedral stress, equations of equilibrium, strain tensor, principal strains, strain-displacement relations, compatibility conditions, measurement of surface strains using strain gauges. Tensile deformation of ductile material. Ductile Vs Brittle behaviour. Mohar circle, **Constitutive equations:** General theory, generalized Hooke's law, equations of elasticity, formulation of the general elasticity problem, boundary conditions, two dimensional problems in rectangular and polar co-ordinates, **Contact stresses:** Introduction, geometry of contact surfaces, notation and meaning of terms, expressions for principal stresses, method of computing contact stresses – Analytical and numerical method. **Plasticity:** Plastic flow and its microscopic and macroscopic descriptions, stress-strain curves of real materials, definition of yield criterion, concept of a yield surface in principal stress space, yield criteria, tresca, von Mises, difference between tresca and von mises criteria. **Plastic Strain Analysis:** Prandtl- Reuss and Levy -Mises equations, deformation in plane stress-yielding of thin sheet in biaxial and uniaxial tension. Plane strain deformation-stress tensor, hydrostatic and deviator components, plastic potential, plastic instability, effect of strain rates and temperature effects on flow stress. Introduction to slip line theory, weighted residual method.		
	Total Hours:	**45**
Text Books:		
1	Jane Helena, "Theory of Elasticity and Plasticity", PHI Learning Private Limited, India, 2017	
2	Norman E Dowing, "Mechanical Behaviour of materials" (International Edition, 4e), Pearson, 2012	
3	G E. Dieter, "Mechanical Metallurgy", McGraw Hill, 2007.	
Reference Books:		
1	MumtazKassir, "Applied Elasticity and Plasticity", CRC Press,2017	
2	Timoshenko,S.P, J. N. Goodier, "Theory of Elasticity", Tata Mac Graw Hill Education Pvt Ltd, 2015.	
Web References:		
1	https://onlinecourses.nptel.ac.in/noc18_ce18/	

Online Resources:	
1	https://www.cet.edu.in/noticefiles/260_Lecturer%20Notes%20on%20AEP-ilovepdf-compressed.pdf
2	https://onderwijsaanbod.kuleuven.be/syllabi/e/H03Y1AE.htm#activetab=doelstellingen_idp1610640

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C509.1	Understand	Class Presentation	20
C509.2	Analyze	Group Assignment	20
C509.3	Apply	Tutorial	20
C509.4	Evaluate	Group Assignment	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	20	20	30
Understand	30	30	30
Apply	30	20	20
Analyse	10	20	10
Evaluate	10	10	10
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

22PD510	TRIBOLOGY IN DESIGN	3/0/0/3
Course Objectives:		
1	To provide greater insight into the science and technology of interacting surfaces in relative motion.	
2	To impart the fundamentals of surfaces, friction, wear, lubrication and their effects.	
3	To enable the students to apply the concepts in designing hydro dynamic, hydro static and rolling element bearings.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C510.1	Understand the different laws of friction and topology of surfaces	[U]
C510.2	Explain the various modes of wear and its mechanisms	[U]
C510.3	Analyze the behaviour of bearings under different lubrication regimes.	[A]
C510.4	Solve the real time engineering problems using the concepts of Tribology	[Ap]
Course Contents:		
Surface Interaction, Friction and Wear: Topography of Surfaces–Surface features-Properties and measurement–Surface interaction - Theories of Friction - Friction properties of metallic and non-metallic materials–friction in extreme conditions–Thermal considerations in sliding contact. Types of wear – Mechanism of various types of wear – Laws of wear–Theoretical wear models-Wear of Metals and Non-metals–Surface treatments–Surface modifications–surface coatings methods-Surface Topography measurements–Laser methods–instrumentation-International standards in friction and wear measurements. **Lubrication and Tribology in Industries**: Lubricants and their physical properties-Viscosity and other properties of oils – Additives-and selection of Lubricants-Lubricants standards – Lubrication Regimes – typical tests. Measurement of viscosity-Viscosity Index- Petroff's Equation- Viscous flow through rectangular slot – Hydrostatic step Bearing and its Energy losses- Reynolds equation-Raimondi and Boyd Method-Temperature rise. Tribology in Metal working industries – effects of friction, wear and lubrication in metal working – classification of plastic deformation processes – rolling – drawing – extrusion – forging – sheet metal working – metal removal. Paper and pulp industries – paper making processes – tribological considerations and Applications. Glass fiber industries – making of glass fiber – tribological considerations. **Tribo Measurments, Nanotribology And Seals**: Measurement techniques – contact and non-contact type. Introduction to Nano tribology – measurement tools – fabrication techniques. Seals – types of seals – friction in seals – characteristics. Diagnostic maintenance of Tribological Components.		
	Total Hours:	**45**
Text Books:		
1	Harish Hirani, "Fundamentals of Engineering Tribology with Applications", Cambridge University Press, New Delhi, 2016.	
2	Sushil Kumar Srivastava, "Tribology in Industries", S Chand Publications, Revised Edition, 2012.	
Reference Books:		
1	Bharat Bhusan, "Introduction to Tribology", Second Edition, Wiley Publishers, March -2013.	
2	Ming Qui "Bearing Tribology: Principles and Applications "Springer Nature,	

	2012.
Web References:	
1	nptel.iitm.ac.in/video
2	https://nptel.ac.in/courses/11210214/

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C510.1	Understand	Quiz/ Presentation	20
C510.2	Understand	Group assignments	20
C510.3	Analyse	Case Study	20
C510.4	Apply	Case Study	20

Assessment based on Summative and End Semester Examination

Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1: [60 Marks]	**CIA2: [60 Marks]**	
Remember	10	10	10
Understand	40	40	40
Apply	30	30	30
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1: 100 Marks			**CA 2: 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

ELECTIVE - GROUP 2

22PD511	COMPUTER AIDED ENGINEERING	3/0/0/3
Course Objectives:		
1	To evaluate and refine the design using computer simulations rather than physical prototype testing thus saving money and time.	
2	To improve product design or assist in the resolution of engineering problems for a wide range of industries.	
3	To analyze the robustness and performance of components and assemblies.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C511.1	Recall the basics of CAD/CAM/PLM.	[R]
C511.2	Apply simulation techniques to the product development process.	[Ap]
C511.3	Generate minimal state multi-body dynamics equations for each vehicle or mechanism and solve the dynamic equations efficiently.	[Ap]
C511.4	Judge the performance of the manufacturing process using simulation.	[E]
Course Contents:		
INTRODUCTION TO PRODUCT LIFE CYCLE Product Lifecycle Management (PLM) Computer-Aided Design (CAD),Computer-Aided Manufacturing (CAM), Digital Manufacturing, Product Data Management (PDM), Physical Prototype Testing, Product Lifecycle Optimization For Suitability, Reliability, And Profitability, Predictive Engineering Analytics. **MULTIBODY DYNAMICS SIMULATION** Concurrent Dynamics, Multibody Dynamics Simulation programs-Concept Feasibility Evaluation, Control System Design and Testing, Hardware-in-the-Loop Simulation and System Failure Analysis, Kinematics Generalized Mass Matrix ,Newton-Euler Equations, Hamilton's Equations, Joint Motion, System Angular Momentum. **DESIGN OPTIMIZATION AND PROCESS SIMULATION** Introduction to design optimization, ShApe/ Size, Topology Optimisation, Parametric Optimization, Design of Experiments (DoE), Design Process Automation, Manufacturing Process Simulation-Casting, Sheet Forming, Hydroforming, Forging (and bulk metal forming), Rolling, Powder Compaction, Sintering, Hipping (hot iso-static pressing), Heat Treatment and Annealing, Injection Molding.		
	Total Hours:	**45**
Text Books:		
1	P N Rao “CAD/CAM: Principles and Applications” Tata McGraw Hill, Second Edition. 2004.	
2	Grieves, Michael. “Product Lifecycle Management”, McGraw-Hill, 2006.	
3	Deb K. “Optimization for Engineering Design: Algorithms and Examples”, Prentice Hall of India, 2004.	
Reference Books:		
1	Karl T. Ulrich and Steven D. Eppinger “Product design and Development”, McGraw Hill, International Edition, 2000	
2	Kevin Otto, Kristin Wood, “Product Design”, Pearson, 2001	
3	Rao.V.Dukkipati, ‘Engineering system Dynamics’, Narosa Publishing House, New Delhi.2004	
4	Saxena, A., and Sahay, B., 2006, "Computer Aided Engineering Design," Anamaya and Springer.	

Web References:	
1	http://www.concurrentdynamics.com/multibody%20dynamics/MBS_Kinematics.pdf
2	https://www.plm.automation.siemens.com/en_us/plm/cae.shtml
3	http://www.concurrent-dynamics.com/
4	http://pro-sim.com/solutions/rd/manufacturing-process-simulation/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C511.1	Remember	Quiz	20
C511.2	Apply	Assignment	20
C511.3	Apply	Tutorial	20
C511.4	Evaluate	Case Study	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	20	30	30
Understand	30	20	20
Apply	30	20	20
Analyse	10	10	20
Evaluate	10	20	10
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

22PD512	CONCEPTS OF ENGINEERING DESIGN	3/0/0/3
Course Objectives:		
1	To impart knowledge on selection of materials and manufacturing processes for designing the appropriate component/products.	
2	To impart the fundamental design methods to develop and analyse the products.	
3	To impart the importance of probability concepts in product design	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C512.1	Define and illustrate the fundamental concepts of design	[U]
C512.2	Identify the materials and design methods to integrate with the manufacturing processes.	[Ap]
C512.3	Apply the code of ethics for green design process	[Ap]
C512.4	Examine hypothesis and apply FMEA for the component design**.**	[A]

Course Contents:

DESIGN FUNDAMENTAL Importance of design- The design process-Considerations of good design –Morphology of Design –Organization for design– Computer Aided Engineering –Designing to codes and standards – Concurrent Engineering – Product and process. Cycles – Technological Forecasting – Market Identification – Competition Benchmarking. **CUSTOMER ORIENTED DESIGN & SOCIETAL CONSIDERATIONS** Identification of customer needs- customer requirements- Quality Function Deployment- Product Design Specifications- Human Factors in Design – Ergonomics and Aesthetics. Societal consideration - Contracts – Product liability – Protecting intellectual property – Legal and ethical domains – Codes of ethics – Ethical conflicts – Environment responsible design-future trends in interaction of Engineering with society.

DESIGN METHODS Creativity and Problem Solving –Creativity methods-Theory of Inventive Problem Solving (TRIZ) – Conceptual decomposition-Generating design concepts-Axiomatic Design – Evaluation methods-Embodiment Design-Product Architecture Configuration Design- Parametric Design. Role of models in design-Mathematical Modeling – Simulation – Geometric Modeling –RApid prototyping- Finite Element Analysis– Optimization – Search Methods. **GREEN DESIGN PROCESS:** Material life cycle, embodied energy, 80-20 rule, carbon footprint, green design in industry, sustainability, biomimetics.

MATERIAL SELECTION PROCESSING AND DESIGN Material Selection Process– Economics–Cost Vs Performance – Weighted property Index – Value Analysis – Role of Processing in Design – Classification of Manufacturing Process – Design for Manufacture – Design for Assembly –Designing for castings, Forging, Metal Forming, Machining and Welding – Residual Stresses – Fatigue, Fracture and Failure. **PROBABILITY CONCEPTS IN DESIGN FOR RELIABILITY** Probability – Distributions – Test of Hypothesis – Design of Experiments – Reliability Theory – Design for Reliability – Reliability centered Maintenance-Robust Design Failure mode Effect Analysis.

Total Hours:	**45**

Text Books:	
1	Dieter, George E., “Engineering Design”, McGraw Hill, International Editions, SingApore, 2017.
2	Karl T. Ulrich and Steven D. Eppinger “Product Design and Development”, McGraw Hill Edition 2016.
Reference Books:	
1	Pahl, G, and Beitz, W, “Engineering Design”, Springer – Verlag, NY. 2013.

2	Ken Hurst., “Engineering Design principles”, Elsevier India .2010.
Web References:	
1	http://http://nptel.ac.in/courses/107108010

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom’s Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C512.1	Understand	Quiz	20
C512.2	Apply	Group Assignment	20
C512.3	Apply	Group Assignment	20
C512.4	Analyse	Case Study/Presentation	20

Assessment based on Summative and End Semester Examination

Bloom’s Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	30	20	20
Understand	30	30	20
Apply	30	30	40
Analyse	10	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

22PD513	EXPERIMENTAL STRESS ANALYSIS	3/0/0/3
Course Objectives:		
1	To study the various experimental techniques involved for measuring displacements, stresses, strains in structural components.	
2	To bring awareness on photo elasticity fundamentals.	
3	To study the basic concepts of non-destructive testings.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C513.1	Describe variety of strain gauges and strain gauge circuits.	[U]
C513.2	Calculate strain using strain gauge rosettes.	[A]
C513.3	Illstrate different methods of photo-elasticity along with properties of different materials for strain measurement.	[Ap]
C513.4	Demonstrate different types of coatings and test the strain data using brittle coating.	[Ap]
C513.5	Acquire knowledge in the fundamentals of NDT.	[U]
Course Contents:		
MEASUREMENTS & EXTENSOMETER: Principles of measurements, Accuracy, Sensitivity and range of measurements. Mechanical, Optical Acoustical and Electrical extensometers and their uses, Advantages and disadvantages. **ELECTRICAL RESISTANCE STRAIN GAUGES:** Principle of operation and requirements, Types and their uses, Materials for strain gauge. Calibration and temperature compensation, cross sensitivity, Rosette analysis, Wheastone bridge and potentiometer circuits for static and dynamic strain measurements, strain indicators. **PHOTOELASTICITY:** Two dimensional photo elasticity, Concept of light – photoelastic effects, stress optic law, Interpretation of fringe pattern, Compensation and separation techniques, Photo elastic materials. Introduction to three dimensional photo elasticity. **BRITTLE COATING AND MOIRE METHODS**: Introduction to Moire techniques, brittle coating methods and holography. **NON – DESTRUCTIVE TESTING:** Fundamentals of NDT, Radiography, ultrasonic, magnetic particle inspection, Fluorescent penetrant technique, Eddy current testing, Acoustic Emission Technique.		
	Total Hours:	**45**
Text Books:		
1	Freddi, Alessandro, Olmi, Giorgio, Cristofolini, Luca, “Experimental Stress Analysis for Materials and Structures”, Springer , 2015	
2	Sadhu Singh, “Experimental Stress Analysis”, Khanna Publishers, New Delhi, 2009	
3	U.S.Jindal ,” Experimental Stress Analysis” Pearson Publications , 2012	
Reference Books:		
1	James W. Dally and William F. Riley, “Experimental Stress Analysis - 4th edition”, College House Enterprises, LLC. , 2005	
2	Doyle James F, Modern experimental stress analysis: C - 04 edition, Wiley, John & Sons, ,2004.	
Web References:		
1	https://swayam.gov.in/course/1309-experimental-stress-analysis-an-overview	
Online Resources:		
1	https://onlinecourses.nptel.ac.in/noc16_me08/preview	

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C513.1 & C513.5	Understand	Group Assignment	20
C513.2	Analysis	Seminar	20
C513.3	Apply	Case study / Mini project	
C513.4	Apply	Case study / Mini project	20
			20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	10	10	10
Understand	30	20	30
Apply	30	30	30
Analyse	30	40	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

22PD514	FAILURE ANALYSIS IN DESIGN	3/0/0/3
Course Objectives:		
1	To understand the various failure modes and theories of failures.	
2	To learn the varieties of fracture mechanisms and fracture modes associated with failure.	
3	To impart fundamental knowledge of corrosion and environmentally-assisted cracking.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C514.1	Define and understand the various modes of failure and material behavior under fracture loading.	[U]
C514.2	Demonstrate the failures due to fracture, creep, fatigue, corrosion and wear failures.	[A]
C514.3	Analyse the failure mechanisms and identify alternate materials and/or service conditions that prolong component life.	[A]
C514.4	Implement the principles of failure analysis in innovative applications.	[Ap]

Course Contents:

Materials and Design Process: Factors affecting the behavior of materials in components, effect of component geometry and shApe factors, design for static strength, stiffness, designing with high strength and low toughness materials, material selection process, introduction to stress, two dimensional and three dimensional state of stress, Mohr's circle two and three dimensions, hydrostatic stress, von-Mises, maximum shear stress (Tresca), octahedral shear stress.

Fracture Mechanics: Ductile fracture, brittle fracture, cleavage-fractograPhy, ductile to brittle transition, factors affecting ductile to brittle transition, fracture mechanics Approach to design-energy criterion, stress intensity Approach, time dependent crack growth and damage - Linear Elastic Fracture Mechanics: Griffith theory, energy release rate, Instability and R-curve, stress analysis of cracks-stress intensity factor, Crack growth instability analysis.

Fatigue: Statistical nature of fatigue, signal-noise curve, low cycle fatigue, strain life equations, structural feature of fatigue, fatigue crack propagation, effect of stress concentration, size, surface properties, metallurgical variables on fatigue, case studies, designing against fatigue, detail design, improvements after failure and service, fatigue of bolts, welded and adhesive joints. Fatigue Tests-Purpose, specimen, fatigue test procedures, evaluation of fatigue test results, crack growth measurement. Creep, stress rupture, elevated temperature fatigue,

Corrosion and Wear Failures: Types of corrosion, Factors influencing corrosion failures, analysis of corrosion failures, stress corrosion cracking - sources, characteristics of stress corrosion cracking, procedure of analyzing stress corrosion cracking, various types of hydrogen damage failures, corrective and preventive action. Types of wear, lubricated and non – lubricated wear, wear on different materials, different methods of wear measurement. Role of friction on wear, analysis of wear failures, wear tests -ferrograPhy.

Failure Analysis Tools: Reliability concept and hazard function, Application of Poisson, exponential and Weibull distribution for reliability, bathtub curve, parallel and series system, failure mode effect analysis - definition-Design, types, process, industrial case studies / Projects.

Total Hours:	**45**

Text Books:	
1	Collins. J. A., Failure of Materials in Machine Design, John Wiley & Sons, 2010.
2	J.E. Shigley and Mische, Mechanical Engineering Design, McGraw Hill, 2004.
3	Withered C. E., Mechanical Failure Avoidance Strategies and Techniques, McGraw-Hill, 2004.
4	Prashant Kumar, Elements of Fracture Mechanics, McGraw-Hill, 2009.
Reference Books:	
1	F.Michael and Ashby, Material Selection in Mechanical Design, Butterworth Heinemann, 2004.
2	ASM Metal Handbook, Failure Analysis and Prevention, ASM Metal Park, Ohio, USA, Vol.10, 2002.
3	F. Rui, Martins, Failure Analysis of bilge keels and its deisgn improvements, Engineering Failure Analysis, Volume 27, pp 232-249, January 2013.
Web References:	
1	http://nptel.ac.in/courses/112106072/

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C514.1	Understand	Quiz	20
C514.2	Analyse	Presentation	20
C514.3	Analyse	Group Assignment & Tutorial	20
C514.4	Apply	Case study	20

Assessment based on Summative and End Semester Examination

Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1: [60 Marks]	**CIA2: [60 Marks]**	
Remember	30	20	20
Understand	50	30	40
Apply	20	30	20
Analyse	-	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1: 100 Marks			**CA 2: 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

22PD515	GEOMETRIC DIMENSIONING AND TOLERANCING	3/0/0/3
Course Objectives:		
1	To impart the knowledge on various tolerance system.	
2	To understand the concepts of datum and use them for geometric analysis.	
3	To learn and apply geometric dimensioning and tolerance standards to communicate design intent.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C515.1	Recall the mutual dependence of design and manufacture in the production of cost effective quality products.	[R]
C515.2	Discover the various symbols used to specify tolerances on component drawings.	[U]
C515.3	Choose the suitable tolerance for mating components.	[Ap]
C515.4	Examine and apply the most suitable inspection method/technique for cost effective quality control.	[A]
Course Contents:		
Tolerance Analysis: Process Capability, process capability metrics, C_p, C_{pk}, cost aspects, feature tolerances, geometric tolerances, Orientation Tolerances, Profile Tolerances, Form Tolerances surface finish review of relationship between attainable tolerance grades and different machining process, cumulative effect of tolerances, sure fit law, normal law and truncated normal law. **Selective Assembly:** Interchangeable and selective assembly, deciding the number of groups, Model-I: group tolerances of mating parts equal; Model-II; total and group tolerances of shaft, control of axial play – introducing secondary machining operations, laminated shims, examples. **Datum Systems:** Degrees of freedom, grouped datum systems – different types, two and three mutually perpendicular grouped datum planes, grouped datum systems with spigot and recess, pin and hole, grouped datum systems with spigot and recess pair and tongue – slot pair, computational of translational and rotational accuracy, geometric analysis and applications. **True Position Tolerancing Theory:** Comparison between co-ordinate and convention method of feature location, tolerancing and true position tolerancing, virtual size concept, floating and fixed fasteners, projected tolerance zone, assembly with gasket, zero true position tolerance, functional gauges, paper layout gauging, compound assembly, examples. **Tolerance Charting Technique:** Operation sequence for typical shaft type of components, preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples, design features to facilitate machining, datum features – functional and manufacturing, component design – machining considerations, redesign for manufacture, examples.		
	Total Hours	**45**
Text Books:		
1	Harry Peck, "Designing for Manufacture", Pitman Publications, London, 2013.	
2	Matousek R, "Engineering Design - A Systematic Approach", Blackie and Son Ltd., London, 2014.	
Reference Books:		
1	Spotts M F, "Dimensioning and Tolerance for Quantity Production", Prentice Hall Inc., New Jersey, 2013.	
2	Oliver R Wade, "Tolerance Control in Design and Manufacturing", Industrial Press Inc., New York, 2015.	
Web References:		
1	http://web.mit.edu/2.810/www/files/readings/GeometricTolerancing.pdf	

Online Resources:	
1	https://www.etilearn.com

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C515.1	Remember	Quiz	20
C515.2	Understand	Presentation	20
C515.3	Apply	Group assignments	20
C515.4	Analyze	Case Study	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	40	40	40
Understand	20	20	20
Apply	30	30	20
Analyse	10	10	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

22PD516	INDUSTRIAL ROBOTICS AND ARTIFICIAL INTELLIGENCE	3/0/0/3
Course Objectives:		
1	To understand the basic concepts associated with the design and functioning of robots.	
2	To understand the drives and sensors used in robots.	
3	To analyze robot kinematics and robot programming.	
4	To understand the fundamentals and applications of artificial intelligence.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C516.1	Summarize the types, principles and applications of industrial robots and sensors.	[U]
C516.2	Implement the kinematic and dynamic motions of robot for specific applications.	[Ap]
C516.3	Design the drive mechanism and power transmission systems used in robot for specific applications.	[C]
C516.4	Apply AI in industrial robotics.	[Ap]
Course Contents:		
REVIEW OF ROBOT KINEMATICS, ROBOT DRIVES AND CONTROL – Robot anatomy – Work volume –Precision movement – End effectors – Sensors. Robot Kinematics – Direct and inverse kinematics – Robot trajectories – Control of robot manipulators – Robot dynamics – Methods for orientation and location of objects. **-**Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers. **ROBOT SENSORS, CELL DESIGN AND APPLICATION -**Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Representation - Image Grabbing –Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing - Image segmentation – Pattern recognition – Training of vision system **-** Robot work cell design and control – Safety in Robotics – Robot cell layouts –Multiple Robots and machine interference –Robot cycle time analysis. Industrial application of robots - Economical aspects for robot design, Safety for robot and associated mass **ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE -**Methods of Robot Programming – Characteristics of task level languages lead through programming methods – Motion interpolation. Artificial intelligence – Basics – Goals of artificial intelligence – AI techniques – problem representation in AI –Problem search techniques – DFS and BFS technique - Problem reduction and solution techniques - Application of AI in Robots. Case study- Basic Robot Programming in shop floor operation and control Robots.		
	Total Hours	**45**
Text Books:		
1	Mikell P Groover, Mitchell Weiss, Roger Nagel, Nicholas Odrey, “Industrial Robotics - SIE: Technology - Programming and Applications”, 2nd Edition, McGraw Hill Education, 2017.	
2	R. K. Rajput, “Robotics and Industrial Automation”, 3rd Edition, S. Chand Limited, 2014.	
3	Larry T. Ross, Stephen W. Fardo, and Michael F. Walach, “Industrial Robotics Fundamentals, Theory and Applications”, G – W publisher, 2017.	
Reference Books:		
1	Yoram Koren, “Robotics for Engineers”, Mc Graw-Hill, 2011.	

2	Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, “Robotics Engineering – An Integrated Approach”, Prentice-Hall of India Pvt. Ltd., 2011.
3	Deb, S.R. “Robotics Technology and Flexible Automation”, Tata Mc Graw-Hill, 2010.
4	Timothy Jordanides et al, “Expert Systems and Robotics “, Springer – Verlag,New York, May 2010.
Web References:	
1	http://nptel.ac.in/courses/112101099/Robotics
2	http://www.zapmeta.co.in/ws?q=robotics%20online%20course&asid=zm_in_010_016&mt=b&nw=s& de=c&ap=1t4
3	http://www.makeblock.com/?gclid=CNfIsaaa0dMCFdgRaAodZ_oBXg
4	http://www.robotmaster.com/en/why-robotmaster

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	**Bloom’s Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C516.1	Understand	Quiz	20
C516.2	Apply	Group Assignment	20
C516.3	Create	Case study	20
C516.4	Apply	Case study	20

Assessment based on Summative and End Semester Examination

Bloom’s Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1: [60 Marks]	**CIA2: [60 Marks]**	
Remember	10	10	10
Understand	30	30	20
Apply	40	20	30
Analyse	20	20	20
Evaluate	-	10	10
Create	-	10	10

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1: 100 Marks			**CA 2: 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

22PD517	OPTIMIZATION TECHNIQUES IN DESIGN	3/0/0/3
Course Objectives:		
1	To create awareness about optimization techniques.	
2	To understand and apply optimization techniques to real life problems.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C517.1	Understand the basics of optimization techniques applied to engineering problems.	[U]
C517.2	Formulate and solve non-linear programming problems.	[A]
C517.3	Solve integer and dynamic programming problems.	[A]
C517.4	Implement non-traditional techniques to make important managerial decisions.	[E]
Course Contents:		

INTRODUCTION TO OPTIMUM DESIGN AND MATHEMATICAL MODEL: Adequate and Optimum design-Principles of optimization-Conventional Vs Optimal design process-Design variables-Formulation of objective function-Design constraints-Variable bounds Classification of engineering optimization problem. Single variable optimization techniques -Optimality Criteria-Bracketing Methods-Exhaustive search method-Bounding phase method-Region Elimination Methods-Interval halving method-Fibonacci search method-Golden section search method.

MULTI-VARIABLES OPTIMIZATION TECHNIQUES: Gradient based Methods-Newton-Raphson method -Bisection method -Secant method -Cubic search method-Optimality criteria -Direct s search Method-Simplex search methods-Hooke-Jeeve's pattern search method-Powell's conjugate direction method-Gradient based method-Cauchy's method Newton's method -Conjugate gradient method. **MULTI VARIABLE CONSTRAINED OPTIMIZATION TECHNIQUES**: Kuhn-Tucker conditions -Penalty Function-Concept of Lagrangian multiplier -Complex search method- Random search method-geometric programming-Dynamic programming.

ENGINEERING APPLICATIONS: Structural applications -Design of simple truss members. Design applications-Optimum design of simple axial, transverse loaded members-Optimum design of shafts-Optimum design of springs. Dynamic applications-Optimum design of single, two degree of freedom systems and gear vibration absorbers. Mechanisms applications-Optimum design of simple linkage mechanisms. **INTELLIGENT OPTIMIZATION TECHNIQUES**: Introduction to Intelligent Optimization-Soft Computing - Working principles of Genetic Algorithm Types of reproduction operators, crossover & mutation -Simulated Annealing Algorithm-Particle Swarm Optimization (PSO)-multi-objective optimization, Simple case studies in MATLAB on Simulated Annealing and Genetic Algorithm.

	Total Hours	**45**
Text Books:		
1	Kalyanmoy Deb, "Optimization for engineering design", Prentice Hall India (Pvt) Ltd., 2012.	
2	Taha H.A, "Operation Research: An Introduction", Pearson Education, 10th Edition, 2017.	
3	Pandy N.P and Simon S.P, "Soft Computing techniques", Oxford Higher Education, 2015.	
Reference Books:		
1	Sharma JK, "Operations Research- Theory and Applications", Trinity Press, 6th Edition, 2017.	

2	David E Goldberg, “Genetic Algorithms in Search, Optimization and Machine Learning”, Addison, Wesley Pub Co., Reprint 2000.
Web References:	
1	http// www.nptel.ac.in/downloads/105108127.

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	**Bloom’s Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C517.1	Understand	Quiz	20
C517.2	Analyse	Group Assignment	20
C517.3	Analyse	Tutorial	20
C517.4	Evaluate	Assignment	20

Assessment based on Summative and End Semester Examination

Bloom’s Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1: [60 Marks]	**CIA2: [60 Marks]**	
Remember	10	10	10
Understand	20	20	20
Apply	20	10	20
Analyse	40	40	30
Evaluate	10	20	20
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1: 100 Marks			**CA 2: 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

22PD518	QUALITY CONCEPTS IN ENGINEERING DESIGN	3/0/0/3
Course Objectives:		
1	To impart knowledge on various concepts in engineering design and highlight the principles of implementing quality in a product or service.	
2	To impart knowledge on materials selection and manufacturing processes integrated with Engineering Design.	
3	To impart knowledge on varies strategies of designing experiments.	
4	To expose the students to statistical and six sigma concepts in order to improve the reliability of a product.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C518.1	Understand the various concepts related to quality and design.	[U]
C518.2	Estimate the design parameters and functions using DOE.	[A]
C518.3	Analyze engineering products by using quality tools.	[A]
C518.4	Apply reliability principles in the design of an engineering product.	[Ap]
Course Contents:		
DESIGN FUNDAMENTALS, METHODS AND MATERIAL SELECTION Morphology of Design – The Design Process – Computer Aided Engineering – Concurrent Engineering – Competition Bench Marking – Creativity – Theory of Problem solving (TRIZ) – Value Analysis - Design for Manufacture, Design for Assembly – Design for casting, Forging, Metal Forming, Machining and Welding **FAILURE MODE EFFECT ANALYSIS AND DESIGN FOR SIX SIGMA** Basic methods: Refining geometry and layout, general process of product embodiment - Embodiment checklist- Advanced methods: systems modeling, mechanical embodiment principles-FMEA method- linking fault states to systems modeling - Basis of SIX SIGMA –Project selection for SIX SIGMA- SIX SIGMA problem solving - Lean SIX SIGMA and services. **DESIGN OF EXPERIMENTS** Importance of Experiments, Experimental Strategies, Basic principles of Design, Terminology, ANOVA, Steps in Experimentation, Sample size, Single Factor experiments – Completely Randomized design, Randomized Block design, Statistical Analysis, Multifactor experiments – Two and three factor full Factorial experiments, 2K factorial Experiments, Confounding and Blocking designs, Fractional factorial design, Taguchi's approach - Steps in experimentation, Design using Orthogonal Arrays, Data Analysis, Robust Design- Control and Noise factors, S/N ratios. **DESIGN FOR QUALITY** Objectives and functions-Targets-Stakeholders- Measures and Matrices **–** developing the experimental plan- experimental design – testing noise factors-Running the experiments –Conducting the analysis-Selecting and conforming factor-Set points-reflecting and repeating. **STATISTICAL CONSIDERATION AND RELIABILITY** Frequency distributions and Histograms- Run charts –stem and leaf plots- Pareto diagrams -Cause and Effect diagrams -Box plots- Probability distribution -Statistical Process control– Scatter diagrams –Multivariable charts –Matrix plots and 3-D plots. - Reliability-Survival and Failure-Series and parallel systems-Mean time between failure-Weibull distribution.		
	Total Hours	**45**
Text Books:		
1	Dieter, George E., "Engineering Design - A Materials and Processing Approach", McGraw Hill, International Editions, Singapore, 2012.	
2	Kevin Otto & Kristin Wood, "Product Design Techniques in Reverse Engineering and New Product Development", Pearson Education (LPE), 2015.	
Reference Books:		
1	Karl t. Ulrich, steven d. Eppinger, "Product Design And Development",	

	TataMcGRAW-HILL- 5th Edition, 2016.
2	AmitavaMitra, “Fundamentals of Quality control and improvement”, 4th edition, Wiley, 2016.
3	Montgomery, D.C., “Design and Analysis of experiments”, John Wiley and Sons, 9th edition, 2017.
Web References:	
1	http://www.cqeweb.com/Chapters-HTML/Chap2_html/chapter2.htm
2	http:// http://www.investopedia.com/terms/s/six-sigma.asp
Online Resources:	
1	http://nptel.ac.in/courses/112107143/37
2	https://onlinecourses.nptel.ac.in/noc19_mg17/preview
3	https://nptel.ac.in/courses/102106051/32

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	**Bloom’s Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C518.1	Understand	Quiz	20
C518.2	Analyze	Group Assignment	20
C518.3	Analyze	Assignment	20
C518.4	Apply	Case Study	20

Assessment based on Summative and End Semester Examination

Bloom’s Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1: [60 Marks]	**CIA2: [60 Marks]**	
Remember	10	10	10
Understand	30	30	30
Apply	40	30	30
Analyse	20	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1: 100 Marks			**CA 2: 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

22PD519	MATERIAL CHARACTERIZATION TECHNIQUES	3/0/0/3
Course Objectives:		
1	To impart knowledge on optical and electron microscopy techniques used to characterize the metals and composites.	
2	To have an insight of various chemical and thermal testing methods used for analysing the materials.	
3	To understand the various static and dynamic mechanical testing methods for examining the properties of composites.	
4	To gain exposure on wear and corrosion of metals and composites.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C519.1	Recall the types of optical and electron microscopic techniques used to characterize the metals and composites.	[U]
C519.2	Articulate the chemical and thermal analysis methods for inspecting various materials	[Ap]
C519.3	Apply the various mechanical testing methods to examine the mechanical properties.	[Ap]
C519.4	Analyze the wear and corrosion behaviour of metals and composites.	[A]
Course Contents:		
OPTICAL AND ELECTRON MICROSCOPY: Principles of Optical Microscopy – Estimation of grain size – X- ray Diffraction – Construction and working of Transmission Electron Microscopy, Scanning Electron Microscopy and Atomic Force Microscopy – Chemical and Thermal Analysis - X-Ray Spectrometry, Fourier Transform Infra Red Spectroscopy (FTIR)- Differential Thermal Analysis, Differential Scanning Calorimetry (DSC) and Thermo Gravitymetric Analysis (TGA) – ASTM Standards for metals and composites. **MECHANICAL TESTING – STATIC AND DYNAMIC TESTS:** Hardness – Brinell, Vickers, Rockwell and Micro Hardness Test – Tensile Test – Torsion Test - Ductility Measurement – Impact Test – Charpy & Izod – Fracture Toughness Test, Fatigue – Low & High Cycle Fatigues, S-N curve – Creep Test – Flexural Test - ASTM standards for testing metallic and composite materials. **WEAR AND CORROSION:** Introduction – Abrasive wear, Erosive, Cavitation, Adhesion, Fatigue wear and Fretting Wear- Principle of corrosion – Classification–Testing of corrosion – In-service monitoring, Simulated service, Laboratory testing - wear and corrosion of metals and composites – ASTM standards for wear and corrosion measurements.		
	Total Hours	**45**
Text Books:		
1	G.W.Stachowiak & A.W .Batchelor, “Engineering Tribology”, Butterworth-Heinemann, UK, 2005.	
2	Suryanarayana A. V.K., “Testing of metallic materials”, 2nd edition, BS publications, 2007.	
Reference Books:		
1	S.K.Basu, S.N.Sengupta and B.B.Ahuja, “Fundamentals of Tribology”, Prentice –Hall of India Pvt Ltd, New Delhi, 2005.	
2	Morita.S, Wiesendanger.R, and Meyer.E, “Non-contact Atomic Force Microscopy”, Springer, 2002.	
3	Dieter G.E., “Mechanical Metallurgy”, 3rd edition, ISBN: 0070168938, McGraw Hill, 2017.	

4	ASM Hand book-Materials characterization, Vol – 10, 2004.
Web References:	
1	https://nptel.ac.in/courses/112107146/11
Online Resources:	
1	https://nptel.ac.in/courses/112102014/
2	https://nptel.ac.in/courses/113107078/25

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C519.1	Understand	Assignment	20
C519.2	Apply	Technical Seminar	20
C519.3	Apply	Technical Seminar	20
C519.4	Analyse	Case study	20

Assessment based on Summative and End Semester Examination

Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1: [60 Marks]	**CIA2: [60 Marks]**	
Remember	20	10	10
Understand	30	30	20
Apply	50	40	40
Analyse	-	20	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1: 100 Marks			**CA 2: 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

22PM101	RELIABILITY AND COMPUTATIONAL METHODS	3/0/0/3
Course Objectives:		
1	To acquire fundamental knowledge of the basic reliability concepts which can describe real life phenomena.	
2	To study the basic probability concepts.	
3	To solve problems on differential equations using numerical techniques.	
4	To learn the concept of design of experiments.	
Course Outcomes:		
Upon completion of the course, students shall have ability to		
C101.1	Understand the basic concepts of reliability and curve fitting.	[U]
C101.2	Apply the probability concepts for solving engineering problems.	[Ap]
C101.3	Apply numerical methods to solve algebraic, transcendental and simultaneous equations and to fit the polynomial.	[Ap]
C101.4	Develop inference for engineering problems using terminologies of design of experiments.	[Ap]
Course Contents:		
RELIABILITY MATHEMATICS: Introduction- Random experiments- Basic concepts of Probability- Reliability-System reliability models, maintainability and availability concepts: Introduction- Systems with components in Series- Systems with parallel components- K-out of m- systems- Maintainability function- Availability function. **COMPUTATIONAL METHODS IN ENGINEERING:** Initial value problems for Ordinary Differential Equations: Single step Method: Taylor series method-Euler method for first order-Runge-Kutta method for solving first and second order equations-Multistep methods: Milne's and Adam's predictor and corrector methods. Boundary value problems in partial Differential Equations: One dimensional wave equation and two dimensional Laplace equations and Poisson equation. **DESIGN OF EXPERIMENTS**: Basic Terminologies- Principles of Experimental Design - Techniques of Analysis of Variance, Types of classification, One way classification - Completely Randomized design, Two way classification - Randomized block Design, Three way Classification - Latin square method.		
	Total Hours	**45**
Text Books:		
1	Grewal, B.S., "Numerical methods in Engineering and Science", 44th edition, Khanna Publishers, 2017.	
2	E. Balagurusamy., "Reliability Engineering", Tata McGraw-Hill Publishing company Limited, 2017.	
Reference Books:		
1	Veerajan. T., "Probability, Statistics and Random Process," Tata McGraw-Hill Publishing company Limited, 7th Edition, 2014.	
2	Rajasekaran S., "Numerical methods in Science and Engineering- A Practical Approach", 4nd edition, Wheeler Publishing, 2011.	
3	Neil, P.V., "Advanced Engineering Mathematics", Thomson Asia Pvt Ltd., Singapore, 2003.	
4	David Kincaid and Ward Cheney, "Numerical analysis", brooks/Cole Publishing Company 5rd edition, 2010.	
5	Jain M. K., Iyengar S. R., Kanchi M. B., Jain, "Computational Methods for Partial Differential Equations", New Age Publishers, 2002.	
Web References:		
1	http:// http://nptel.ac.in/courses/111104075/DOE	
2	http:// http://nptel.ac.in/courses/122104019/numerical-analysis	

Online Resources:	
1	https://www.mooc-list.com/course/numerical-methods-engineers-saylororg
2	https://www.canvas.net/browse/usflorida/courses/numerical-methods
3	http://nptel.ac.in/upcoming_courses.php

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C101.1	Understand	Quiz	20
C101.2	Apply	Assignment	20
C101.3	Apply	Presentation	20
C101.4	Apply	Group activity	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	30	30	30
Understand	40	30	30
Apply	20	40	40
Analyse	10	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Open Electives Offered to Other Departments

22PD001	FUNDAMENTALS OF INDUSTRIAL SAFETY	3/0/0/3
Course Objectives:		
1	Define and understand the basic approaches for safety management in an organization.	
2	Perform work design and facility planning.	
3	Impart the fundamental principles of performance monitoring.	
4	Know the methods of safety education and training.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C001.1	Identify the factors governing location decision and site selection	[Ap]
C001.2	Discuss plant layout types for improving the operations.	[U]
C001.3	Classify the worker's rights and responsibilities in an organization.	[Ap]
C001.4	Demonstrate the ability to avoid, prevent and control workplace hazards.	[A]
Course Contents:		
BASICS OF SAFETY ENGINEERING & ACTS: Evolution of modern safety concept – Safety audit – Acts: Factories act – 1948 – Statutory authorities – Tamilnadu factories Rules 1950 under safety and health – Environment act – 1986 – Air act 1981, Water act 1974 – other acts; OHSAS-18000.Safety in industries – General safety concepts, machine guarding, hazards in metal removing process, welding process, cold and hot working process. Introduction to Electrical Acts. **TRAINING METHODOLOGIES & SAFETY MANAGEMENT**: History of Safety movement –Evolution of modern safety concept - General concepts of management – Planning for safety for optimization of productivity - productivity, quality and safety-line and staff functions for safety - budgeting for safety - safety policy. Importance of training - identification of training needs-training methods – programme, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training. **ACCIDENT INVESTIGATION AND REPORTING:** Concept of an accident, reportable and non reportable accidents, unsafe act and condition – Principles of accident prevention, Supervisory role - Role of safety committee - Accident causation models - Cost of accident. Overall accident investigation process - Response to accidents, India reporting requirement, Planning document, Planning matrix, Investigators Kit, Functions of investigator, Four types of evidences, Records of accidents, Accident reports - Class exercise with case study.		
	Total Hours:	**45**
Text Books:		
1	L M Deshmukh , "Industrial safety management", TATA McGraw Hill, 2010.	
2	Heinrich H.W, "Industrial Accident Prevention", McGraw-Hill Company, New York, 2001.	
3	Basudev Panda, "Industrial Safety health environment and security" TATA McGraw Hill, 2013.	
Reference Books:		
1	"The Factories Act 1948", Madras Book Agency, Chennai, 2000.	
2	Relevant India Acts and Rules, Government of India.	
3	Relevant Indian Standards and Specifications, BIS, New Delhi.	

Web References:	
1	http/www.nptel.ac.in/courses/112107143

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C001.1	Apply	Quiz	20
C001.2	Understand	Assignment	20
C001.3	Apply	Assignment	20
C001.4	Analyze	Case study	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	40	40	40
Understand	30	30	30
Apply	15	20	15
Analyse	15	10	15
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

22PD002	OPERATIONS RESEARCH	3/0/0/3
Course Objectives:		
1	To enable the students to understand and apply linear programming techniques for industrial operations.	
2	To enable the students to apply network concepts to practical problems.	
3	To impart the importance of inventory management to the students.	
4	To understand the fundamentals of non-traditional optimization techniques.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C002.1	Formulate a real world problem into a mathematical model.	[Ap]
C002.2	Solve the mathematical models of the real world problems using simplex method, transportation and assignment models.	[A]
C002.3	Solve network models and determining the critical path for timely project scheduling and timely completion.	[A]
C002.4	Apply non-traditional optimization methods for real world problems to obtain optimum solutions.	[Ap]
Course Contents:		
Linear Programming problems: Formation of an LP model- graphical solution and Simplex algorithm. Transportation models: Feasible and Optimal solution. Assignment problem- Hungarian method. **Network problems:** Shortest route – minimal spanning tree - maximum flow models. Project networks- PERT and CPM -critical path scheduling. **Inventory Systems:** Inventory management-ABC analysis. Costs involved in inventory control. EOQ and EBQ Models without shortage. **Non-traditional optimization methods:** Genetic algorithm and Simulated annealing- Procedure with Pseudo code.		
	Total Hours:	**45**
Text Books:		
1	Taha H.A, “Operation Research: An Introduction”, Pearson Education 10th Edition, 2017.	
2	Sharma JK, “Operations Research- Theory and applications”, Trinity Press, 6th Edition, 2017.	
Reference Books:		
1	Hira and Gupta, “Operations Research”, Revised edition, S Chand Publications, 3rd Edition, 2017.	
2	Nagarajan K, “Textbook of Operations Research: A Self Learning Approach”, New Age International, First Edition 2017.	
Web References:		
1	http://home.ubalt.edu/ntsbarsh/opre640a/partviii.htm	
2	http://www.pondiuni.edu.in/storage/dde/downloads/mbaii_qt.pdf	
Online Resources:		
1	http://nptel.ac.in/courses/112106131/1/Fundamentals of Operations Research	
2	https://cosmolearning.org/courses/fundamentals-of-operations-research-535/	

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C002.1	Apply	Case study	20
C002.2	Analyse	Case study	20
C002.3	Analyze	Group Assignment	20
C002.4	Apply	GA -Mat Lab practice	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	20	10	10
Understand	40	50	50
Apply	20	20	20
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Open Electives Offered by Other Departments

22PC001	COST MANAGEMENT OF ENGINEERING PROJECTS	3/0/0/3
Course Objectives:		
1	To enable students to understand the principles and practices adopted in industries for successful cost management.	
2	To recognize the need for effective project management skills, specific training to project managers and cost management techniques.	
3	To familiarize the techniques related to management of engineering operations.	
4	To necessitate the engineer's role in cost management of projects.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C001.1	Understand the different cost elements and costing system.	[U]
C001.2	Interpret the selection and initiation of costing techniques in managing a project.	[Ap]
C001.3	Implement project management concepts that effectively integrate financial accounting and cost analysis.	[Ap]
C001.4	Analyze project goals, constraints, deliverables and performance measures in line with costing activities.	[A]
Course Contents:		

Introduction and Overview of the Strategic Cost Management Process: Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Project Management: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Pre-project execution main clearances and documents. Project team: Role of each member. Importance Project site: Data required with significance. Project contracts: Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

Cost Behaviour and Profit Planning Marginal Costing: Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Total Hours:	**45**

Text Books:	
1	B. Ram, “Accounting for Managers”, New Age Publications (Academic) Edition: First, 2015.
2	C. M. Chang, “Engineering Management: Meeting the Global Challenges”, CRC Press, Second Edition, 2016.
Reference Books:	
1	A.K. Gupta, “Engineering Management”, S. Chand Publication, 2014.
2	Basic Knowledge of Accounting/Finance for Project Managers and Engineers, Syed Ali Dilawer, 2nd Edition, 2016.

Web References:	
1	http://bookboon.com/en/accounting-basics-ebooks
Online Resources:	
1	https://www.clarkson.edu/em/handbook/EM11_12StudentHandbook2.pdf

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C001.1	Understand	Quiz	20
C001.2	Apply	Group Assignment	20
C001.3	Apply	Tutorial	20
C001.4	Analyze	Case Study	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	30	30	30
Understand	40	40	40
Apply	20	20	20
Analyse	10	10	10
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

22PC002	FUNDAMENTALS OF COMPOSITE MATERIALS	3/0/0/3
Course Objectives:		
1	To analyze and design structures made of fiber reinforced composite materials.	
2	To develop fundamental relationships for predicting the mechanical and hydrothermal response of multi layered materials and structures.	
3	To develop the student's skills in understanding the different manufacturing methods available for making composite materials.	
4	To enable the students to apply the basic laws of mechanics to the composite materials.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C002.1	Possess the knowledge in processing and fabrication of structural composites	[U]
C002.2	Apply constitutive equations of composite materials and understand mechanical behaviour at micro and macro levels.	[Ap]
C002.3	Determine stress- strain relation in composites materials	[A]
C002.4	Evaluate the relative merits of using composite materials for important engineering and other applications.	[E]
Course Contents:		
INTRODUCTION: Definitions, Composites, Reinforcements and matrices, Types of reinforcements, Types of matrices, Types of composites, Carbon Fibre composites, Properties of composites in comparison with standard materials, Applications of metal, ceramic and polymer matrix composites. **MANUFACTURING METHODS:** Hand and spray lay - up, injection molding, resin injection, filament winding, pultrusion, centrifugal casting and prepregs. Fibre/Matrix Interface, mechanical. Measurement of interface strength. Characterization of systems; carbon fibre/epoxy, glass fibre/polyester, etc. **MECHANICAL PROPERTIES:** Stiffness and Strength: Geometrical aspects – volume and weight fraction. Unidirectional continuous fibre, discontinuous fibers, Short fiber systems, woven reinforcements –Mechanical Testing: Determination of stiffness and strengths of unidirectional composites; tension, compression, flexure and shear**. Laminates:** Plate Stiffness and Compliance, Assumptions, Strains, Stress Resultants, Plate Stiffness and Compliance, Computation of Stresses, Types of Laminates -, Symmetric Laminates, Anti-symmetric Laminate, Balanced Laminate, Quasi-isotropic Laminates, Cross-ply Laminate, Angle-ply Laminate. Orthotropic Laminate, Laminate Moduli, Hygrothermal Stresses.		
	Total Hours:	**45**
Text Books:		
1	N.G.R.Iyengar, "Composite Materials And Structural Analysis", Springer, 2016.	
2	Autar K Kaw, "Mechanics of Composite Materials", CRC Press, NY, 2014.	
Reference Books:		
1	Ronald F Gibson, "Principles of Composite Material Mechanics", McGraw Hill Book Co, 2016.	
2	Robert M Jones, "Mechanics of Composite Materials", Taylor and Francis, 1999.	
Web References:		
1	http://nptel.ac.in/syllabus/114102016/	
2	https://www.slideshare.net/prince321/enterprise-1797829	

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C002.1	Understand	Assignment	20
C002.2	Apply	Quiz	20
C002.3	Analyze	Case study	20
C002.4	Evaluate	Case study	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	10	10	10
Understand	30	30	30
Apply	30	30	30
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Audit Courses

22AC001	ENGLISH FOR RESEARCH PAPER WRITING	2/0/0/0
Modules	**Contents**	**Hours**
1	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	4
2	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	4
3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	4
4	Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature	4
5	Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	4
6	Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	4
Suggested Studies:		
1	Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)	
2	Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press	
3	Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.	
4	Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011	

22AC002	DISASTER MANAGEMENT	2/0/0/0
Modules	**Contents**	**Hours**
1	**Introduction** Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.	4
2	**Repercussions Of Disasters And Hazards**: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.	4
3	**Disaster Prone Areas In India** Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics	4
4	**Disaster Preparedness And Management** Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.	4
5	**Risk Assessment** Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.	4
6	**Disaster Mitigation** Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.	4
Suggested Studies:		
1	R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.	
2	Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.	
3	Goel S. L., Disaster Administration And Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.	

22AC003	SANSKRIT FOR TECHNICAL KNOWLEDGE	2/0/0/0
Modules	**Contents**	**Hours**
1	• Alphabets in Sanskrit, • Past/Present/Future Tense, • Simple Sentences	8
2	• Order • Introduction of roots • Technical information about Sanskrit Literature	8
3	• Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics	8
Suggested Studies:		
1	"Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi.	
2	"Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication	
3	"India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.	

22AC004	VALUE EDUCATION	2/0/0/0
Modules	**Contents**	**Hours**
1	• Values and self-development –Social values and individual attitudes. • Work ethics, Indian vision of humanism. • Moral and non- moral valuation. Standards and principles. • Value judgements	4
2	• Importance of cultivation of values. • Sense of duty. Devotion, Self-reliance. Confidence, Concentration. • Truthfulness, Cleanliness. • Honesty, Humanity. Power of faith, National Unity. • Patriotism.Love for nature ,Discipline	6
3	• Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. • Punctuality, Love and Kindness. • Avoid fault Thinking. • Free from anger, Dignity of labour. • Universal brotherhood and religious tolerance. • True friendship. • Happiness Vs suffering, love for truth. • Aware of self-destructive habits. • Association and Cooperation. • Doing best for saving nature	6
4	• Character and Competence –Holy books vs Blind faith. • Self-management and Good health. • Science of reincarnation. • Equality, Nonviolence, Humility, Role of Women. • All religions and same message. • Mind your Mind, Self-control. • Honesty, Studying effectively	6
Suggested Studies:		
1	Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi	

22AC005	CONSTITUTION OF INDIA	2/0/0/0
Modules	**Contents**	**Hours**
1	**History of Making of the Indian Constitution:** • History Drafting Committee, (Composition & Working)	4
2	**Philosophy of the Indian Constitution:** • Preamble • Salient Features	4
3	**Contours of Constitutional Rights & Duties:** • Fundamental Rights • Right to Equality • Right to Freedom • Right against Exploitation • Right to Freedom of Religion • Cultural and Educational Rights • Right to Constitutional Remedies • Directive Principles of State Policy • Fundamental Duties.	4
4	**Organs of Governance:** • Parliament • Composition • Qualifications and Disqualifications • Powers and Functions • Executive • President • Governor • Council of Ministers • Judiciary, Appointment and Transfer of Judges, Qualifications • Powers and Functions	4
5	**Local Administration:** • District's Administration head: Role and Importance, • Municipalities: Introduction, Mayor and role of Elected Representative, CEO of • Municipal Corporation. • Pachayati raj: Introduction, PRI: ZilaPachayat. • Elected officials and their roles, CEO ZilaPachayat: Position and role. • Block level: Organizational Hierarchy (Different departments), • Village level: Role of Elected and Appointed officials, • Importance of grass root democracy	4
6	**Election Commission:** • Election Commission: Role and Functioning. • Chief Election Commissioner and Election Commissioners. • State Election Commission: Role and Functioning. • Institute and Bodies for the welfare of SC/ST/OBC and women.	4

Suggested reading:	
1	The Constitution of India, 1950 (Bare Act), Government Publication.
2	Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3	D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.
4	M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.

22AC006	PEDAGOGY STUDIES	2/0/0/0
Modules	**Contents**	**Hours**
1	**Introduction and Methodology:** • Aims and rationale, Policy background, Conceptual framework and terminology • Theories of learning, Curriculum, Teacher education. • Conceptual framework, Research questions. • Overview of methodology and Searching.	4
2	• Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. • Curriculum, Teacher education.	4
3	• Evidence on the effectiveness of pedagogical practices • Methodology for the in depth stage: quality assessment of included studies. • How can teacher education (curriculum and practicum) and the school • Curriculum and guidance materials best support effective pedagogy • Theory of change. • Strength and nature of the body of evidence for effective pedagogical practices. • Pedagogic theory and pedagogical approaches. • Teachers' attitudes and beliefs and Pedagogic strategies.	4
4	• Professional development: alignment with classroom practices and follow-up support • Peer support • Support from the head teacher and the community. • Curriculum and assessment • Barriers to learning: limited resources and large class sizes	4
5	**Research gaps and future directions:** • Research design • Contexts • Pedagogy • Teacher education • Curriculum and assessment • Dissemination and research impact.	4
Suggested reading:		
1	Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.	
2	Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.	
3	Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.	
4	Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count. International Journal Educational Development, 33 (3): 272–282.	

5	Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education, Oxford and Boston: Blackwell.
6	Chavan M (2003) Read India: A mass scale, rapid, ‘learning to read’ campaign.
Web References:	
1	www.pratham.org/images/resource%20working%20paper%202.pdf.

22AC007	STRESS MANAGEMENT BY YOGA	2/0/0/0
Modules	**Contents**	**Hours**
1	Definitions of Eight parts of yoga. (Ashtanga)	8
2	**Yam and Niyam.** Do`s and Dont's in life. i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan	8
3	**Asan and Pranayam** i) Various yoga poses and their benefits for mind & body ii) Regularization of breathing techniques and its effects-Types of pranayam	8
Suggested reading:		
1	'Yogic Asanas for Group Tarining-Part-I": Janardan Swami Yogabhyasi Mandal, Nagpur.	
2	"Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata.	

22AC008	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	2/0/0/0
Modules	**Contents**	**Hours**
1	Neetisatakam-Holistic development of personality • Verses- 19,20,21,22 (wisdom) • Verses- 29,31,32 (pride & heroism) • Verses- 26,28,63,65 (virtue) • Verses- 52,53,59 (dont's) • Verses- 71,73,75,78 (do's)	8
2	• Approach to day to day work and duties. • Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48, • Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, • Chapter 18-Verses 45, 46, 48.	8
3	**Statements of basic knowledge.** • Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 • Chapter 12 -Verses 13, 14, 15, 16,17, 18 **Personality of Role model. Shrimad Bhagwad Geeta:** • Chapter2-Verses 17, Chapter 3-Verses 36,37,42, • Chapter 4-Verses 18, 38,39 • Chapter18 – Verses 37,38,63	8
Suggested reading:		
1	"Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.	
2	Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.	