



INDUS INSTITUTE OF TECHNOLOGY & ENGINEERING

B. Tech. (Mechanical)


DEPARTMENT OF MECHANICAL ENGINEERING

**Proposed Teaching Scheme and Syllabus for
1st to 8th semester
(2021Batch)**

Proceedings of the Board of Studies for the Academic Session 2021-22

Name of Institute **Indus Institute of Technology and Engineering**
Name of Department **Mechanical Engineering**

PRESENT Members

Sr.	Name	Designation	Signature
1	Dr. Umang Patdiwala HoD, Mechanical Engineering Department	Chairperson	
2	Prof. (Dr.) Ragesh Kapadia Professor, Mechanical Engg. Dept. LD College of Engineering, Ahmedabad	Academic Expert & Member	
3	Dr. Manoj Kumar Gupta, Scientist (SF), Institute of Plasma Research, Gandhinagar	Research Domain Expert & Member	
4	Dr. M J Munгла, Associate Professor, Mechanical Engineering Department	Member	
5	Prof. Jaypalsinh Rana, Assistant Professor	Member	
6	Dr. Dhiren Patel Assistant Professor	Member	
7	Dr. Nimisha Patel Associate Professor, Comp. Engg, Dept.	EP Nominee Member	
8	Asst. Prof. Mudit Saxena Assistant Professor, ME Dept.	Departmental T& P Coordinator & Member	
9	Asst. Prof. Bhavin Khatri Assistant Professor, ME Dept.	Representative of ICSSI & Member	
11	Mr. Vishva Sureliya (Batch 2016-2020)	Alumni representative	

ABSENT (Leave of Absence Granted)

Name	Designation
Mr. Jigish Shah Vice President (Design & Development), Ferromatik Milacron (I) Ltd., Ahmedabad	Industry Expert & Member

Board of Studies (BOS) was held for the department Mechanical Engineering for the academic session 2021-22 on 19th June 2021.

The Chairperson welcomed all the members present in BOS meeting and the following points were discussed with the experts from academia, research institute and industry.

Discussion on objectives of the program

As per the guidelines given by competent authority,

- Frame body of BoS member comprising Academic Expert
- As per the suggestion of VC & Dean F & T, courses on employability, VAC, SDCs, MOOC, etc have to be discussed and include in syllabus systematically.

Discussion on the syllabus with the rationale behind it.

Suggestions from Academic Expert

- Courses offered in open elective like Design Thinking, IPR & Robotics need to be made available for Mechanical Engineering Department students.
- IPR topic need to be included in Research Methodology at Post Graduate level.
- B. Tech in minors and honors need to introduced.

Discussion and recommendation.

- Discussed above points and recommendations are consider for upgradation of existing syllabus/courses.

Suggestions from Industry expert.

- Not available.

Suggestion from Research institute.

- Suggested that how to incorporate IDP if students want to carried out their projects at Industry or Research Institute.
- In case of unsatisfactory progress of PG students, what would be remedies?

Discussion and recommendation.

- Extension of six months.

Suggestion from recruiters.

- Need to focus more on fundamentals of all courses.

Discussion and recommendation.

- Certain key fundamental subjects have been listed and focused to strengthen its base.

Suggestion from consultant and practitioner

Discussion and recommendation

Suggestion from students on roll

- More focus should be on subjects which help in training and placement requirements.

Discussion and recommendation.

- Students will be guided with subjects where more weightage should be given from job placement base.

Suggestion from Alumni

- Need to incorporate MATLAB and Robotics at UG levels.
- Need to add course on Entrepreneurship related course.
- Need to add statistical analysis tools in Research Methodology.

Discussion and recommendation.

- In current BoS we have taken initiative to introduce such subjects at different level.

List of employability related courses incorporated in different semesters along with relevant credits.

Sem.	Subject Type	Subject Name	L	T	P	Credits	Hours
1	ES	Elements of Mechanical Engineering	3	0	2	4	5
2	ES	Workshop Practice	0	0	4	2	4
2	OE-1	Open Elective-1 (Basics Mechanical Engineering)	2	0	2	3	4
2	OE-2	Open Elective-2 (Design Thinking)	2	0	2	3	4
3	PCC	Machining Practice	3	0	2	4	5
4	OE-4	Open Elective-4 (Roadmap for Patent Creation)	3	0	0	3	3
6	ES	Entrepreneurship Development	2	0	0	2	2
8	PROJ	Project	0	0	13	26	26

List of value added courses incorporated in different semesters along with relevant credits.

Sem.	Subject Type	Subject Name	L	T	P	Credits	Hours
1,2	HS	Technical English / Soft skills, Communications (Professional)	1	0	2	2	3
4,6	VAC	Yoga, NCC, Self-Development etc Indian Knowledge Systems, Indian Science Technology	2	0	0	2	2
3	HS	Human Values and Professional Ethics	2	0	0	2	2
6	HS	Industrial Management	2	0	0	2	2
4	HS	Management for Engineers	2	0	0	2	2

List of courses having focus on innovation, project based learning, critical thinking, technical paper writing, entrepreneurship, soft skill enhancement and personality development along with relevant credits (list courses under each category).

Sem.	Subject Type	Subject Name	L	T	P	Credits	Hours
1	ES	Workshop Practice	0	0	4	2	4
2	OE	Open Elective-2 (Design Thinking)	2	0	2	3	4
4	OE	Open Elective-4 (Roadmap for Patent	3	0	0	3	3

		Creation)					
5	OE	Open Elective-6 (Introduction to Robotics)	2	0	2	3	4
3-6	INT	Internship	0	0	0	2	0
7	PE	IoT for Manufacturing	2	0	2	3	4
7	PROJ	Fundamental of Research	0	0	4	2	4
8	PROJ	Project	0	0	26	13	26

Discussion on the strategies for achieving the objectives

- Upgradation of syllabus with current industry requirements.
- Addition of practical in various courses to increase hands on practice/skills.
- To obtain PBL, course on fundamentals of research introduced in sem VII.

Discussion and recommendation on Pedagogy and implementation of experiential learning concept.

- Pedagogies on presentation-based learning and learning by doing have been discussed with all members as such practices are prevailing in department for few courses.

Discussion and recommendation on continuous evaluation.

- Existing pedagogies on continuous evaluations have been presented among all the external experts. They appreciated the existing practice.

Discussion and recommendation related to training, internship of the students, project undertaken by the students.

- For UG courses experts found the current process satisfactory, which is in line with AICTE guidelines.
- For PG level, expert suggested to take IDP well in advance for smoothly conduction of research work and timely completion of project with fulfillment of objectives.

Discussion and recommendation on placement & employment opportunities.

- For the placement perspective, expert suggest to focus more on fundamental aspects of core courses.

Discussion and recommendation on potential employers.

- As per the current requirements of multidisciplinary skills, more interdepartmental and intradepartmental courses should be included.

Discussion on best practices to be adopted by Indus University with reference to State/Private/National Universities of repute and Institute of national importance.

- Allocations of mentors for their continuous counselling apart from academic activities.
- Identify the slow and advance learners for their improvement and advancement respective in corresponding courses.

Discussion and recommendation on need based courses for industries (please include

feasibility analysis).

- Discussed on certain courses like Entrepreneurship Development, IPR, IoT for Smart Manufacturing, Robotics etc.

Discussion and recommendation on Skill development courses under Pradhan Mantri Kaushal Vikas Yojana (PMKVY) (please include feasibility analysis).

- Discussed on certain courses like welding technology, workshop practice, NC-CNC machine training etc.

Discussion and recommendation on Diploma and certificate courses (please include feasibility analysis).

- Suggestions have been forwarded related to Honors and Minor Certificate program.

The meeting ended with a vote of thanks by the Chairperson .

.....
Prepared by Chairperson

.....
Recommended by
Director of the Institute

Feedback proforma for experts

Dr. Ragesh Kapadia
Professor, Mechanical Engineering Department,
LD college of engineering, Ahmedabad

(a) What is your opinion about the strategies used for achieving the objective of each programme?

I think the overall structure shown during BOS meeting reflects the sincere hard work of the committee and it is in accordance with AICTE.

(b) Whether the scheme and syllabi comparable with other leading universities nationally and internationally?

Yes, Design Thinking and courses on IPR are good inclusions.

(c) In your opinion, do the schemes and syllabi for each programme meet the requirement of the industry?

Yes, Specifically the internship at the end of even semesters.

(d) Are the courses in the scheme and their contents in the syllabi coherent?

Yes

(e) What is your opinion about the continuous evaluation pattern?

Good, (About 60% under continuous evaluation) It is a very good practice and reflecting the NBA (outcome-based education)

(f) What is your opinion about the training of the students?

Yes, Good opportunity is provided to students in form of internship.

(g) What is your opinion about the placement and employment opportunities?

Personality credits will help in grooming students along with their academics.

(h) Your valuable suggestions towards the improvement of the BOS.

Minors or Honors can be included. Credit for MOOC courses.

(i) Your valuable suggestion towards the improvement of the administrative arrangements.

NO

Feedback proforma for experts

Dr. Manoj Kumar Gupta
Scientist (SF),
Institute of Plasma Research, Gandhinagar

(a) What is your opinion about the strategies used for achieving the objective of each programme?

Strategies are Ok

(b) Whether the scheme and syllabi comparable with other leading universities nationally and internationally?

Yes

(c) In your opinion, do the schemes and syllabi for each programme meet the requirement of the industry?

Yes

(d) Are the courses in the scheme and their contents in the syllabi coherent?

Yes

(e) What is your opinion about the continuous evaluation pattern?

Yes, It is recommended

(f) What is your opinion about the training of the students?

Proper training should be given with feedbacks from industries

(g) What is your opinion about the placement and employment opportunities?

Fundamentals and trainings will help

(h) Your valuable suggestions towards the improvement of the BOS.

Suggested during meeting

(i) Your valuable suggestions towards the improvement of the Administrative arrangements.

It is ok.

Feedback proforma for experts

Mr. Vishwa Surelia
Student Alumni (Batch 2016-2020)

(a) What is your opinion about the strategies used for achieving the objective of each programme?

Scheme, syllabus and content to be taught were put together in most effective way.

(b) Whether the scheme and syllabi comparable with other leading universities nationally and internationally?

I had applied for overseas studies few years back, the credit that needs to be matched during initial evaluation was satisfactory in my case, while my friends from different Indian university were lacking for few credits. Hence, comparing the credit input to the core subjects and departmental subjects are put in the optimum way. Therefore, I believe, syllabus and scheme of Indus University is so far great.

(c) In your opinion, do the schemes and syllabi for each programme meet the requirement of the industry?

Being into the (Auto + Mech.) manufacturing industry for so long, the diversified program that Indus University offers has captured large amount of content that is going to help/support students for the upcoming challenges.

(d) Are the courses in the scheme and their contents in the syllabi coherent?

After studying B.Tech. and M.Tech. Syllabus and understanding, I feel syllabus and its descriptions are design very carefully, considering various factors.

(e) What is your opinion about the continuous evaluation pattern?

Simple yet efficiently benefiting the students.

(f) What is your opinion about the training of the students?

Theoretical knowledge, one must work on applying those into real life practice. Being alumni, I remember the practical knowledge we used to get in labs post/after understanding those theoretically in classrooms. Hence, I believe it is the most effective and interesting way to learn things and best practice to train the students.

Indus University, Ahmedabad

Mechanical Engineering Department

B. Tech Mechanical Engineering Teaching Scheme 2021-2025 (Batch SEM I to VIII)

B. Tech Semester-I

Subject Details				Teaching Scheme					Evaluation Scheme				
									Theory		Practical		Total
Sr. No.	Subject Type	Subject Code	Subject Name	L	T	P	Credits	Hours	CIE	ESE	CIE	ESE	Marks
1	HS		Technical Communication	1	0	2	2	3	60	40	60	40	200
2	BS		Calculus	3	1	0	4	4	60	40	0	0	100
3	BS		Engineering Physics	3	0	2	4	5	60	40	60	40	200
4	ES	ME0111	Elements of Mechanical Engineering	3	0	2	4	5	60	40	60	40	200
5	ES	ME0112	Workshop Practice	0	0	4	2	4	0	0	60	40	100
6	OE-1	ME0113	Open Elective-1 (Basics Mechanical Engineering)	2	0	2	3	4	60	40	60	40	200
7	VAC		Value Added Course (Indian Knowledge System)	3	0	0	3	3	100	0	0	0	100
Total				15	1	12	22	28	400	200	300	200	1100

Indus University, Ahmedabad

Mechanical Engineering Department

B. Tech Mechanical Engineering Teaching Scheme 2021-2025 (Batch SEM I to VIII)

B. Tech Semester-II

Subject Details				Teaching Scheme					Evaluation Scheme				
									Theory		Practical		Total
Sr. No.	Subject Type	Subject Code	Subject Name	L	T	P	Credits	Hours	CIE	ESE	CIE	ESE	Marks
1	HS		Business Communication & Presentation Skills	1	0	2	2	3	60	40	60	40	200
2	BS		Differential Equations and Linear Algebra	3	1	0	4	4	60	40	0	0	100
3	ES	ME0211	Engineering Graphics (For all branches-suggested)	1	0	4	3	5	60	40	60	40	200
4	ES		Environmental Science	2	0	0	2	2	60	40	0	0	100
5	BS		Engineering Chemistry	3	0	2	4	5	60	40	60	40	200
6	OE-2	ME0003	Open Elective-2 (Design Thinking)	2	0	2	3	4	60	40	60	40	200
7	OE-3	ME0212	Open Elective-3 (Introduction to Smart Material)	2	0	2	3	4	60	40	60	40	200
8	VAC	IST0001	Value Added Course (Indian Science and Technology)	1	0	0	1	1	100	0	0	0	100
Total				15	1	12	22	28	520	280	300	200	1300

Indus University, Ahmedabad

Mechanical Engineering Department

B. Tech Mechanical Engineering Teaching Scheme 2021-2025 (Batch SEM I to VIII)

B. Tech Semester-III

Subject Details				Teaching Scheme					Evaluation Scheme				
									Theory		Practical		Total
Sr. No.	Subject Type	Subject Code	Subject Name	L	T	P	Credits	Hours	CIE	ESE	CIE	ESE	Marks
1	HS	SS0301	Human Values and Professional Ethics	2	0	0	2	2	100	00	0	0	100
2	BS		Numerical Methods	3	1	0	4	4	60	40	0	0	100
3	ES	ME0311	Basic Manufacturing Practice	3	0	2	4	5	60	40	60	40	200
4	ES	ME0312	Design Innovation for IP Thinking	2	0	2	3	4	60	40	60	40	200
5	PCC	ME0313	Kinematics of Machines	2	1	0	3	3	60	40	0	0	100
6	PCC	ME0314	Fluid Mechanics	2	0	2	3	4	60	40	60	40	200
7	PCC	ME0315	Strength of Materials	3	0	2	4	5	60	40	60	40	200
8	PCC	ME0316	Material Science and Metallurgy	2	0	2	3	4	60	40	60	40	200
9	INT.	ME0317	Internship-1	0	0	0	2	0	0	0	100	0	100
Total				19	2	10	28	31	400	280	400	200	1400

Indus University, Ahmedabad

Mechanical Engineering Department

B. Tech Mechanical Engineering Teaching Scheme 2021-2025 (Batch SEM I to VIII)

B. Tech Semester-IV

Subject Details				Teaching Scheme					Evaluation Scheme				
									Theory		Practical		Total
Sr. No.	Subject Type	Subject Code	Subject Name	L	T	P	Credits	Hours	CIE	ESE	CIE	ESE	Marks
1	ES	ME0411	Machining Practice	3	0	2	4	5	60	40	60	40	200
2	HS	ME0412	Management for Engineers	2	0	0	2	2	60	40	0	0	100
3	PCC	ME0413	Machine Design and Industrial Drafting	2	0	2	3	4	60	40	60	40	200
4	PCC	ME0414	Engineering Thermodynamics	3	0	0	3	3	60	40	0	0	100
5	PCC	ME0415	Fluid Power Engineering	2	0	2	3	4	60	40	60	40	200
6	PE-1	ME0416	Alternate Energy Sources	3	0	0	3	3	60	40	0	0	100
		ME0417	Product Design & Development										
		ME0418	Non-Conventional Machining										
7	OE-4	ME0419	Open Elective-4 (Roadmap for Patent Creation)	3	0	0	3	3	60	40	0	0	100
	OE-5	ME0420	Open Elective-5* (Energy Management)										
Total				18	0	6	21	24	420	280	180	120	1000

- * Optional Open Elective (i.e. Choose either OE-4 or OE-5 : any one subject only) for Mech. students

Indus University, Ahmedabad

Mechanical Engineering Department

B. Tech Mechanical Engineering Teaching Scheme 2021-2025 (Batch SEM I to VIII)

B. Tech Semester-V

Subject Details				Teaching Scheme					Evaluation Scheme				
									Theory		Practical		Total
Sr. No.	Subject Type	Subject Code	Subject Name	L	T	P	Credits	Hours	CIE	ESE	CIE	ESE	Marks
1	ES	ME0511	Entrepreneurship Development	2	0	0	2	2	60	40	0	0	100
2	PCC	ME0512	Metrology and Instrumentation	2	0	2	3	4	60	40	60	40	200
3	PCC	ME0513	Production Technology	2	0	2	3	4	60	40	60	40	200
4	PCC	ME0514	Internal Combustion Engines	3	0	2	4	5	60	40	60	40	200
5	PCC	ME0515	Design of Machine Elements	3	0	2	4	5	60	40	60	40	200
6	PE-2	ME0516	Total Quality Management	3	0	0	3	3	60	40	0	0	100
		ME0517	Power Plant Engineering										
		ME0518	Design for X (DFX)										
7	OE-6	ME0519	Open Elective-6 (Introduction to Robotics)	2	0	2	3	4	60	40	60	40	200
	OE-7	ME0520	Open Elective-7* (Non-Conventional Energy Sources)										
8	INT.	ME0521	Internship-II	0	0	0	2	0	0	0	100	0	100
Total				17	0	10	24	27	420	280	400	200	1300

* Optional Open Elective (i.e. Choose either OE-6 or OE-7: any one subject only for Mech. Students)

Indus University, Ahmedabad

Mechanical Engineering Department

B. Tech Mechanical Engineering Teaching Scheme 2021-2025 (Batch SEM I to VIII)

B. Tech Semester-VI

Subject Details				Teaching Scheme					Evaluation Scheme				
									Theory		Practical		Total
Sr. No.	Subject Type	Subject Code	Subject Name	L	T	P	Credits	Hours	CIE	ESE	CIE	ESE	Marks
1	PCC	ME0621	Heat and Mass Transfer	2	1	2	4	5	60	40	60	40	200
2	PCC	ME0622	Dynamics of Machines	2	1	2	4	5	60	40	60	40	200
3	PCC	ME0623	Machine Design - I	2	0	2	3	4	60	40	60	40	200
4	PCC	ME0624	Robotics	2	0	0	2	2	60	40	0	0	100
5	PE-3	ME0625	Mechanical Vibrations	2	0	2	3	4	60	40	60	40	200
		ME0626	Automobile Systems										
		ME0627	Industrial Engineering										
6	PE-4	ME0628	Computer Aided Design and Analysis	2	0	2	3	4	60	40	60	40	200
		ME0629	Gas Dynamics										
		ME0630	Industrial Safety, Laws and Maintenance										
7	OE-8	ME0631	Open Elective-8* (Rapid Prototyping)	3	0	0	3*	3	60	40	0	0	100
8	HS	ME0632	Operations Research	3	1	0	4	4	60	40	0	0	100
Total				18	3	10	23+3*	28	480	320	300	200	1300

* Optional Open Elective (OE) (i.e. from total nine-OE select any six OE only in four years of B. Tech. programme)

Indus University, Ahmedabad
Mechanical Engineering Department
B. Tech Mechanical Engineering Teaching Scheme 2021-2025 (Batch SEM I to VIII)

B. Tech Semester-VII

Subject Details				Teaching Scheme					Evaluation Scheme				
									Theory		Practical		Total
Sr. No.	Subject Type	Subject Code	Subject Name	L	T	P	Credits	Hours	CIE	ESE	CIE	ESE	Marks
1	PCC	ME0721	Machine Design - II	2	0	2	3	4	60	40	60	40	200
2	PCC	ME0722	Computer Integrated Manufacturing	2	0	2	3	4	60	40	60	40	200
3	PE-5	ME0723	Finite Element Methods	2	0	2	3	4	60	40	60	40	200
		ME0724	Steam & Gas Turbines										
		ME0725	IoT for Smart Manufacturing										
4	PE-6	ME0726	Artificial Intelligence	2	0	2	3	4	60	40	60	40	200
		ME0727	Refrigeration & Air Conditioning										
		ME0728	Theory of Metal Forming Technology										
5	OE-9	ME0729	Open Elective-9 (Introduction to Research)	3	0	0	3	3	60	40	0	0	100
6	PROJ.	ME0730	Fundamentals of Research	0	0	4	2	4	0	0	60	40	100
7	INT.	ME0731	Internship-III	0	0	0	2	0	0	0	100	0	100
Total				11	0	12	19	23	300	200	400	200	1100

Indus University, Ahmedabad
Mechanical Engineering Department
B. Tech Mechanical Engineering Teaching Scheme 2021-2025 (Batch SEM I to VIII)
B. Tech Semester-VIII

Subject Details				Teaching Scheme					Evaluation Scheme				
									Theory		Practical		Total
Sr. No.	Subject Type	Subject Code	Subject Name	L	T	P	Credits	Hours	CIE	ESE	CIE	ESE	Marks
1	PROJECT	ME0821	Project	0	0	24	12	24	0	0	60	40	100

SEMESTER-I

Subject: Element Mechanical Engineering (ES)								
Program: B. Tech. (Mechanical)				Subject Code: ME 0111		Semester: I		
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
3	0	2	4	16/40	16/40	24/60	24/60	200

Course Objectives:

1. To understand thermodynamic laws.
2. To identify best fuel and lubrication selection as per different working condition.
3. To apply gas laws and develop refrigeration principle in usable devices.
4. To generate steam as per required application and select boilers as per required working condition.
5. To apply Internal combustion engine working principle in practical application.
6. To select drive and transmission element as per working condition.

Course Outcomes:

After study this course student will be able:

1. To know and learn thermodynamic properties and laws in practical engineering application.
2. To identify and select best fuels and lubricant from available.
3. To judge behaviors of gases and changing in its properties under different working condition.
4. To know working of home appliances like refrigeration, water cooler, and Air-conditioner.
5. To decide amount of heating need for generation of steam as per required application. To calculate amount of energy having in generated steam.
6. To identify and select boilers as per required working condition.
7. To select Internal Combustion engine (petrol and Diesel engine) as per function and power requirement.

COURSE CONTENT

UNIT-1

[08]

1 Basic Concepts of Thermodynamics

Basic units and dimensional analysis, Intensive and Extensive Properties, Energy, heat, temperature, specific heat capacity, Interchange of heat, change of state, Internal energy, enthalpy, entropy, efficiency, Open and Closed systems, statements of Zeroth Law, First law & Second law of Thermodynamics

2 Fuels and Lubricants

Different types of fuels, their properties and applications. Different types of lubricants and applications.

3 Engineering Materials

Types and applications of Ferrous & Nonferrous metals, Timber, Abrasive material, silica, ceramics, glass, graphite, diamond, plastic and polymer

UNIT-2

[09]

4 Properties of Gases

Ideal and Real Gases, Gas laws, Boyle's law, combined gas law, gas constant, Internal energy, Relation between C_p and C_v , Enthalpy, constant volume process, Constant pressure process, Isothermal process, polytropic process, Adiabatic process.

5 Refrigeration

Introduction, Refrigerant, Vapour compression system, basic applications

6 Properties of Steam

Introduction, steam formation, types of steam, enthalpy, specific volume of steam and dryness fraction of steam, Internal energy, steam tables, measurement of dryness fraction throttling calorimeter, separating calorimeter.

UNIT-3

[14]

7 Heat Engines

Heat Engine cycle and Heat Engine, working substances, Classification of heat engines, Description and thermal efficiency of Carnot; Rankine; Otto cycle and Diesel cycles.

8 Steam Boilers

Introduction, classification, Simple vertical and horizontal boiler, Boiler details, Boiler performance. Functioning of different mountings and accessories.

9 Couplings

Construction and applications of Couplings (Box; Flange; Pin type flexible; Universal and Oldham)

UNIT-4

[14]

10 Internal Combustion Engines

Classifications, Difference between I.C. and E.C. , Otto four-stroke engine, Diesel- four-stroke engine, Difference between Otto cycle and Diesel engine, Two-stroke engines, Difference between two- stroke and four-stroke engines, indicated power (IP), Brake power (BP), Efficiencies.

11 Transmission of Motion and Power

Shaft and axle, Belt drive, Chain drive, Friction drive, Gear drive

12 Clutches and Brakes

Clutches (Disc and Centrifugal), and Brakes (Block; Shoe; Band and Disc)

Text Books:

1. Elements of Mechanical Engineering by P S Desai and S B Soni- Atul Prakashant
2. Elements of Mechanical Engineering by K.P. Roy and Prof. S.K. Hajra Chaudhary, Media Promoters and publishers Pvt. Ltd. Bombay
3. Elements of Mechanical Engineering by Sadhu Singh S. Chand Publication.

References:

1. Introduction to Engineering Materials by B.K. AgrawalTata Mcgraw HillPublication, New Delhi
2. Basic & Applied Thermodynamics by P K Nag - Tata McGraw Hill Pvt. Ltd., Mumbai
3. Basic Mechanical Engineering by Pravin Kumar, Pearson
4. Fundamental of Mechanical Engineering by G.S. Sawhney, PHI PublicationNew Delhi

Web Resources:

1. <http://ronney.usc.edu/AME101/AME101-LectureNotes.pdf>
2. https://www.technicalsymposium.com/alllecturenotes_mech.html#.XPYtgtR95nl
3. http://www.engineering108.com/pages/Mechanical_Engineering/EME/element_of_Mechanical_engineering_ebooks-free-download.html

MOOC:

1. <https://nptel.ac.in/downloads/112108148/>
2. <https://nptel.ac.in/courses/112107216/6>
3. <https://nptel.ac.in/downloads/112105129/>
4. <https://nptel.ac.in/courses/116102012/26>

LIST OF LAB PRACTICAL

Sr. No.	List of Practical
1	To study of different types of fuels and lubrication.
2	To study of Vapour Compression Refrigeration System.
3	To understand construction and working of various types of boilers.
4	To understand construction and working of mountings and accessories of boiler.
5	To study of Otto, Diesel & Carnot cycle & find out its Air standard efficiencies.
6	To study of working of two stroke and four stroke Petrol & Diesel Engine.
7	To determine the Swept volume & Clearance volume of Two stroke & Four stroke Petrol & Diesel Engine.
8	To study various types of gears and pulleys.
9	To study of various types of brakes, coupling and clutches
10	To determine velocity ratio of belt drive and gear drive systems.

Subject: Workshop Practice (ES)								
Program: B. Tech. (All Branches)				Subject Code: ME 0112		Semester: I		
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
0	0	4	2	NA	16/40	NA	24/60	100

Course Objective:

1. Recognize the importance of Workshop in today's technology and its impacts on market competition.
2. Understand basic of various methodologies to manufacture components/structure.
3. Understand different tools and equipments used in mechanical workshop.
4. Analyze the engineering and economical aspects of workshop practices.

Course Outcome:

After learning the course, the students should be able to:

1. Prepare basic joints used in carpentry.
2. Prepare edges for better joint for fitting.
3. Prepare better joint for welding.
4. Prepare various shapes and objects by using Carpentry, Fitting, and Welding.

COURSE CONTENT

- | | | |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| 1 | Introduction to Mechanical Workshop
Introduction, Safety rules in Mechanical workshop, Safety slogans, Tools and Equipment used for safety in Mechanical workshop. | [02] |
| 2 | Workshop Layout
Introduction, Types of layouts, Rules and regulations for Workshop layouts and Preparation of actual layout. | [04] |
| 3 | Fitting Shop
Introduction, Classification and characteristics of Engineering Materials, Tools and Equipment for Fitting shop, Different operations, preparation of job in Fitting shop. | [16] |
| 4 | Carpentry Shop
Introduction, Wooden Materials, Tools and Equipment for Carpentry shop, Different operations, preparation of job in Carpentry shop. | [14] |

5 Tin Smithy Shop

[09]

Introduction, Sheet Materials, Different operations, Tools and Equipment for Tin Smithy shop, preparation of job in Tin Smithy shop.

List of Experiments

1. To study about safety rules in Mechanical Workshop.
2. To study about Workshop layout and preparation of actual layout of Mechanical Workshop.
3. To study about Fitting shop and preparation of job.
4. To study about Carpentry shop and preparation of job.
5. To study about Tin Smithy shop and preparation of job.
6. To study about basics of welding and to prepare weld joints.

Subject: Basic Mechanical Engineering (OE-I)								
Program: B. Tech (All Branches except Mech.)				Subject Code: ME 0113		Semester: I		
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
2	0	2	3	16/40	16/40	24/60	24/60	200

Course Objectives:

1. To understand thermodynamic laws
2. To identify best fuel and lubrication selection as per different working condition
3. To apply gas laws and develop refrigeration principle in usable devices
4. To generate steam as per required application and select boilers as per required working condition
5. To apply Internal combustion engine working principle in practical application
6. To select drive and transmission element as per working condition

Course Outcomes:

After study this course student will be able

1. To know and learn thermodynamic properties and laws in practical engineering application
2. To identify and select best fuels and lubricant from available
3. To judge behaviors of gases and changing in its properties under different working condition
4. To know working of home appliances like refrigeration, water cooler, and Air-conditioner
5. To decide amount of heating need for generation of steam as per required application. To calculate amount of energy having in generated steam
6. To identify and select boilers as per required working condition
7. To select Internal Combustion engine (petrol and Diesel engine) as per function and power requirement

COURSE CONTENT

UNIT-1

[05]

1 Basic Concepts of Thermodynamics

Basic units and dimensional analysis, Intensive and Extensive Properties, Energy,

heat, temperature, specific heat capacity, Interchange of heat, change of state, Internal energy, enthalpy, entropy, efficiency, Open and Closed systems, statements of Zeroth Law, First law & Second law of Thermodynamics

2 Fuels and Lubricants

Different types of fuels, their properties and applications. Different types of lubricants and applications.

UNIT-2

[07]

3 Properties of Gases

Ideal and Real Gases, Gas laws, Boyle's law, combined gas law, gas constant, Internal energy, Relation between C_p and C_v , Enthalpy, constant volume process, Constant pressure process, Isothermal process, polytropic process, Adiabatic process.

4 Refrigeration

Introduction, Refrigerant, Vapour compression system, Applications

UNIT-3

[09]

5 Properties of Steam

Introduction, steam formation, types of steam, enthalpy, specific volume of steam and dryness fraction of steam, Internal energy, steam tables, Measurement of dryness fraction throttling calorimeter, separating calorimeter.

6 Steam Boilers

Introduction, classification, Simple vertical and horizontal boiler, Boiler details, Boiler performance. Functioning of different mountings and accessories.

UNIT-4

[09]

7 Internal Combustion Engines

Classifications, Difference between I.C. and E.C., Otto four-stroke engine, Diesel- four-stroke engine, Difference between Otto cycle and Diesel engine, Two-stroke engines, Difference between two- stroke and four-stroke engines, indicated power (IP), Brake power (BP), Efficiencies.

8 Transmission of Motion and Power

Introduction, Couplings methods of drive, power transmission elements, shaft and axle, Belt-drive, pulleys, power transmitted by a belt, Chain drive, Friction drive, Gear drive.

Text Books:

1. Elements of Mechanical Engineering by P S Desai and S B Soni- Atul Prakashant
2. Elements of Mechanical Engineering by K.P. Roy and Prof. S.K. Hajra Chaudhary, Media Promoters and publishers Pvt. Ltd. Bombay
3. Elements of Mechanical Engineering by Sadhu Singh S. Chand Publication

References:

1. Basic & Applied Thermodynamics by P K Nag - Tata McGraw Hill Pvt. Ltd., Mumbai
2. Basic Mechanical Engineering by Pravin Kumar, Pearson

3. Fundamental of Mechanical Engineering by G.S. Sawhney, PHI Publication New Delhi

Web Resources:

1. <http://ronney.usc.edu/AME101/AME101-LectureNotes.pdf>
2. https://www.technicalsymposium.com/alllecturenotes_mech.html#.XPYtgtR95nl
3. http://www.engineering108.com/pages/Mechanical_Engineering/EME/element_of_Mechanical_engineering_ebooks-free-download.html

MOOC:

1. <https://nptel.ac.in/downloads/112108148/>
2. <https://nptel.ac.in/courses/112107216/6>
3. <https://nptel.ac.in/downloads/112105129/>
4. <https://nptel.ac.in/courses/116102012/26>

LIST OF PRACTICALS

Sr. No.	Title of Practical
1	To study of different types of fuels and lubrication.
2	To study of Vapour Compression Refrigeration System.
3	To understand construction and working of various types of boilers.
4	To understand construction and working of mountings and accessories of boiler.
5	To study of Otto, Diesel & Carnot cycle & find out its Air standard efficiencies.
6	To study of working of two stroke and four stroke Petrol & Diesel Engine.
7	To determine the Swept volume & Clearance volume of Two stroke & Four stroke Petrol & Diesel Engine.
8	To study various types of gears and pulleys.
9	To study of various types of brakes, coupling and clutches
10	To determine velocity ratio of belt drive and gear drive systems.

SEMESTER-II

Subject: Engineering Graphics (ES)								
Program: B. Tech. (All Branches)				Subject Code: ME 0211			Semester: II	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
1	0	4	3	16/40	16/40	24/60	24/60	200

Course Objectives:

1. The course is aimed at developing basic graphic skills.
2. Develop skills in preparation of basic drawings.
3. Skills in reading and interpretation of engineering drawings

Course Outcomes:

1. After learning the course, the students should be able to
2. Understand the conventions and the methods of engineering drawing.
3. Interpret engineering drawings using fundamental technical mathematics.
4. Construct basic and intermediate geometry.
5. Improve their visualization skills so that they can apply these skills in developing newproducts.

COURSE CONTENT

UNIT-1

[04]

1 Introduction to Engineering Graphics

Principles of Engineering Graphics and their Significance – Drawing Instruments and their Use – Conventions in Drawing – Lettering – BIS Conventions- Dimensioning systems – polygons-types of lines

2 Engineering Curves

Classification and application of Engineering Curves, Construction of different methods of Ellipse, parabola and Hyperbola, construction of Conics, Cycloid Curves – Cycloid, Hypocycloid, Epicycloids, Involute and Spirals.

3 Projections of Points and Lines

Introduction to principal planes of projections, Projections of the points located in Same quadrant and different quadrants, Projections of line with its inclination to one reference plane and with two reference planes. True length and

Inclination with the reference planes.

UNIT-2

[04]

4 Projections of Planes

Projections of planes (polygons, circle, and ellipse) with its inclination to one reference plane and with two reference planes, Concept of auxiliary plane method for projections of the plane.

5 Projections of Solids

Classification of solids. Projections of solids (Cylinder, Cone, Pyramid, Prism) along with frustum of cone and pyramid with their inclinations to one reference plane and with two reference planes.

UNIT-3

6 Orthographic and Sectional Orthographic Projections

Fundamental of projection along with classification, Projections from the pictorial view of the object on the principal planes for view from front, top and sides using first angle projection method and third angle projection method, introduction of section of objects, full sectional view.

UNIT-4

[04]

7 Isometric Projections

Isometric Scale, Conversion of orthographic views into isometric projection, isometric view or drawing.

Text Books

1. P. J. Shah, "A Text Book of Engineering Graphics" Publication: S. Chand.
2. A Text Book of Machine Drawing by P. J. Shah S. Chand & Company Ltd., New Delhi

Reference Books:

1. N. D. Bhatt, "Elementary Engineering Drawing", Charotar Publishing House, Anand
2. P. D. Patel, "Engineering Graphics" Publication: Mahajan
3. A text book of Engineering Drawing by R. K. Dhawan, S. Chand & Company Ltd., New Delhi
4. A text book of Engineering Drawing by P. S. Gill, S. K. Kataria & sons, Delhi

Web resources:

1. <http://nptel.ac.in/courses/112103019/>

MOOCS:

1. <https://onlinecourses.nptel.ac.in>

LIST OF PRACTICAL/DRAWING SHEETS

1. Practice sheet (which includes dimensioning methods, different types of line, preparation of title block, Polygon)
2. Engineering curves – I (Ellipse, parabola and Hyperbola)
3. Engineering curves – II (Cycloid, Hypocycloid, Epicycloids, Involutives, Spirals)
4. Projections of Points and Line
5. Projections of Line
6. Projections of Planes
7. Projections of solids
8. Orthographic projection
9. Section Orthographic projection
10. Isometric projection

Subject: Design Thinking (OE-2)								
Program: B. Tech. (All Branches Except Mech.)				Subject Code: ME 0003			Semester: II	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuou sInternal Evaluation (CIE) Theory	Continuou sInternal Evaluation (CIE) Practical	Total Marks
2	0	2	3	16/40	16/40	24/60	24/60	200

Course Objectives:

1. To excite the student on creative design and its significance;
2. To make the student aware of the processes involved in design;
3. To make the student understand the interesting interaction of various segments of humanities, sciences and engineering in the evolution of a design;
4. To get an exposure as to how to engineer a design

Course Outcomes:

1. Able to appreciate the different elements involved in good designs and to apply them in practice when called for.
2. Aware of the product oriented and user oriented aspects that make the design a success.
3. Will be capable to think of innovative designs incorporating different segments of knowledge gained in the course;
4. Students will have a broader perspective of design covering function, cost, environmental sensitivity, safety and other factors other than engineering analysis.

COURSE CONTENT

UNIT-1

[14]

1 Introduction to Design Thinking

Design and its objectives; Design constraints, Design functions, Role of Science, Engineering and Technology in design; Engineering as a business proposition; Functional and Strength Designs. How to initiate creative designs? Initiating the thinking process for designing a product of daily use. Need identification; Problem Statement; Market survey- customer requirements; Design attributes and objectives; Ideation; Brain storming approaches; arriving at solutions; Closing on to the Design needs.

UNIT-2

[14]

2 Design process

Different stages in design and their significance; Defining the design space; Analogies and “thinking outside of the box”; Quality function deployment-meeting what the customer wants; Evaluation and choosing of a design. Design Communication; Realization of the concept into a configuration, drawing and model. Concept of “Complex is Simple”. Design for function and strength. Design detailing- Material selection,

UNIT-3

[12]

3 Prototyping

Rapid prototyping; testing and evaluation of design; Design modifications; Freezing the design; Cost analysis. Engineering the design, From prototype to product. Planning; Scheduling; Supply chains; inventory; handling manufacturing/construction operations; storage; packaging; shipping; marketing; feed-back on design.

UNIT-4

4 Modular design

[08]

Design optimization; Design as a marketing tool; Intellectual Property rights –Trade secret; patent; copy-right; trademarks.

Text Books:

1. Balmer, R. T., Keat, W. D., Wise, G., and Kosky, P., Exploring Engineering, Third Edition: An Introduction to Engineering and Design - [Part 3 - Chapters 17 to 27]
2. Dym, C. L., Little, P. and Orwin, E. J., Engineering Design - A Project based introduction Wiley.
3. Pahl, G., Beitz, W., Feldhusen, J. and Grote, K. H., Engineering Design: A Systematic Approach, 3rd ed. 2007.

Reference Books:

1. Eastman, C. M. (Ed.), Design for X Concurrent engineering imperatives, 1996.
2. Haik, Y. And Shahin, M. T., Engineering Design Process, Cengage Learning.
3. Voland, G., Engineering by Design, Pearson publication

Web Resources:

1. <http://opim.wharton.upenn.edu/~ulrich/designbook.html>
2. http://www2.warwick.ac.uk/fac/sci/wmg/ftmsc/modules/modulelist/peuss/designforx/design_for_x_notes_section_5.pdf

MOOC:

1. <https://nptel.ac.in/courses/109104109/>

List of Practical

1. To understand attributes of Design Thinking & Domain selection.
2. Observation through AEIOU - visit selected domain/place for getting insights and define problems. (Field activity)
3. Study and summarization of AEIOU activity/inputs.
4. Preparation of Mind Map
5. Preparation of Empathy Map
6. Systematic field exercises, empathization and Secondary Research activities - student teams need to define and validate their problem through the Ideation Phase.
7. Preparation of Ideation canvas.
8. Preparation of Product Development Canvas (PDC)
9. Customer/User Revalidation (Reject/Redesign/Retain) and Refinement of product Idea.
10. Preparation of a Rough Primary Prototype.

Subject: Introduction to Smart Materials (OE-3)								
Program: B. Tech. (All Braches; Except Mech.)				Subject Code: ME 0212			Semester: II	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuou sInternal Evaluation (CIE) Theory	Continuou sInternal Evaluation (CIE) Practical	Total Marks
2	0	2	3	16/40	16/40	24/60	24/60	200

Course Objectives

1. To study various types of smart materials used in engineering application
2. To study processing of smart materials
3. To study basics of sensors and its engineering application
4. To study basics of actuators and its engineering application

Course Outcomes

1. By the end of course students will able to
2. Understand various smart material and its importance in engineering application
3. Know various processing technics of smart materials
4. Get knowledge of use of smart material as sensors and actuators.

COURSE CONTENT

UNIT-1

[14]

1 Introduction

Characteristics of metals, polymers and ceramics. Introduction to smart materials. Classification of smart materials, Components of a smart System, Applications of smart material

2 Smart Materials

Piezoelectric materials, Electrostrictive Materials, Magnetostrictive materials, Magnetoelectric materials, Magnetorheological fluids, Electrorheological fluids, Shape Memory materials

UNIT-2

[10]

3 Processing of Smart Materials

Semiconductors and their processing, Metals and metallization techniques, Ceramics and their processing, Polymers and their synthesis, UV radiation curing of polymers

UNIT-3

[10]

4 Sensors

Introduction, Conductometric sensors, Capacitive sensors, Piezoelectric sensors, Magnetostrictive sensors, Piezoresistive sensors, Optical sensors, Resonant sensors, semiconductor-based sensors, Acoustic sensors, polymeric sensors, Carbon nanotube sensors

UNIT-4

[14]

5 Actuators

Introduction, Electrostatic transducers, Electromagnetic transducers, Electrodynamical transducers, Piezoelectric transducers, Electro-strictive transducers, Magneto-strictive transducers, Electro thermal actuators, Comparison of actuation, Applications

Text Books:

1. Smart Material Systems and MEMS: Design and Development Methodologies, V. K. Varadan, K. J. Vinoy, S. Gopalakrishnan, John Wiley and Sons, England, 2006.
2. Smart Structures and Materials, Brian Culshaw, Artech House, London, 1996.
3. Smart Materials and Structures, Mukesh V. Gandhi, Brian S. Thompson, Springer, May-1992

Reference Books:

1. Smart Structures: Analysis and Design, A. V. Srinivasan, Cambridge University Press, Cambridge, New York, 2001.
2. Smart Structures, P. Gaudenzi, Wiley, 2009
3. Piezoelectric Sensorics: Force, Strain, Pressure, Acceleration and Acoustic Emission Sensors, Materials and Amplifiers, G. Gaudenzi, Springer, Berlin, New York, 2002.
4. Analysis and Performance of Fiber Composites, B. D. Agarwal and L. J. Broutman, John Wiley & Sons.
5. Engineering aspects of Shape memory Alloys, T. W. Duerig, K. N. Melton, D. Stockel, C.
6. Mayman, Butterworth – Heinemann, 1990.

Web Resources:

1. <https://nptel.ac.in/courses/112104173/>
2. www.iop.org/EJ/article/0964-1726/5/3/002/sm6301.ps.gz

MOOCs:

1. <https://nptel.ac.in/courses/112104173/>
2. <https://nptel.ac.in/courses/112104251/>

List of Experiments

Experiment. No.	Introduction to smart material Lab
1	Introduction to smart material Lab
2	To study about various kind of smart materials and their engineering applications.
3	To study about metallization techniques.
4	To study about processing of ceramic materials and synthesis of polymers.
5	To study about sensors, actuators and their engineering applications.
6	Experimental demonstration of Linear variable differential transducer.
7	Experimental demonstration of thermocouple.
8	Experimental demonstration of RTD sensor.
9	To study strain measurement using strain gauges and cantilever assembly.
10	Experimental demonstration of Stepper Motor.

SEMESTER-III

Subject: Basic Manufacturing Practice (ES)								
Program: B. Tech. (Mechanical)				Subject Code: ME0311			Semester: III	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuou sInternal Evaluation (CIE) Theory	Continuou sInternal Evaluation (CIE) Practical	Total Marks
2	0	2	3	16/40	16/40	24/60	24/60	200

Course Objectives:

1. To understand various manufacturing processes & its classifications
2. To understand various Casting processes, it's working principles with all tools and accessories and applications
3. To understand various welding processes, it's working principles with all tools and accessories and applications
4. To understand various metal forming processes, it's working principles with all tools and accessories and applications

Course Outcomes:

1. Students will be able to understand about the various manufacturing processes in detail and develop their knowledge in the field of manufacturing which will be use to fulfil the industrial applications.
2. Students will be able to design and develop the industrial applications related to the casting processes, welding processes, metal forming processes and the advantages, limitation and applications of all these processes.
3. Enables students to have a strong foundation in area of manufacturing processes

COURSE CONTENT

UNIT-1

[07]

1 Introduction to Manufacturing Processes:

Importance of manufacturing, economic and technological consideration, Classification of manufacturing processes, and their characteristics.

2 Super Finishing Process:

Introduction and working principle with its industrial application of Grinding, Lapping, Buffing, Honing, Burnishing and Polishing process.

UNIT-2

[10]

3 Metal Joining Processes:

Principle of welding, soldering, Brazing and adhesive bonding. Classification of

welding and allied processes. Gas welding and gas cutting, Principle, Oxyacetylene welding equipment, Flame cutting. Arc welding, Power sources and consumables, Gas welding and cutting, Processes and Equipment's. Resistance welding, Principle and Equipment's, Spot, Projection and seam welding process, Atomic hydrogen, ultrasonic, Plasma and laser beam welding, Electron beam welding, and special welding processes e.g. TIG, MIG, friction and explosive welding, Welding defects. Electrodes and Electrode Coatings.

UNIT-3

[10]

4 Forming and Shaping Processes:

Metal working, Elastic and plastic deformation, Concept of strain hardening, Hot and cold working, Rolling, Principle and operations, roll pass sequence, Forging, forging operations, extrusion, Wire and tube drawing processes. Forging: Method of forging, Forging hammers and presses, Principle of forging tool design, Cold working processes- Bending, Shearing, Drawing, Squeezing, Blanking, Piercing, deep drawing, Coining and embossing, Metal working defects, cold heading, Riveting, Thread rolling bending and forming operation.

UNIT-4

[10]

5 Metal Casting Processes:

Pattern – Definition, Types of patterns, application, allowances and material used for patterns, molding materials, molding sands, molding sands; properties and sand testing; grain fineness; moisture content, clay content and permeability test, core materials and core making, core print; core boxes, chaplets, gating system design. molding practices: Green, dry and loam sand molding, pit and floor molding; shell molding; permanent molding; carbon dioxide molding. Vacuum casting, Permanent mold casting, Slush casting, Pressure casting, die casting, Centrifugal casting, Continuous casting, squeeze casting, casting alloys, Casting defects, Design of casting, Gating system design, and riser design. Melting furnaces, Metallurgical considerations in casting elements of gating system, and risers and their design.

Text Books:

1. Manufacturing Technology (Vol. – I & II) – P.N. Rao – Tata McGraw Hill Pub.
2. A Text Book of Production Technology (Manufacturing Processes) – P.C. Sharma – S.Chand and Company Ltd., New Delhi.
3. Elements of Workshop Technology - Volume I &II - Machine Tools Paperback, Hajra Choudhury & A.K. Hajra Choudhury & Nirjhar Roy S.K, Media Promoters

Reference Books:

1. Manufacturing Science – A. Ghosh & A.K. Mallik – East West Press Pvt. Ltd.,
2. Manufacturing Engineering and Technology – S. Kalpakjian & S.R. Schmid – Addison Wesley Longman, New Delhi

3. A Text Book of Production Technology (Vol. I & II) – O.P. Khanna– Dhanpat Rai
4. A Textbook of Manufacturing Technology: Manufacturing Processes, R.K. Rajput, Lakshmi Publication Pvt. Ltd., 2007.
5. Introduction to Manufacturing Processes and Materials, Robert C. Creese, CRC Press, Taylor and Francis Group, 1999

Web resources:

1. Fundamental of Manufacturing Processes, https://onlinecourses.nptel.ac.in/noc17_me21/preview.
2. Manufacturing Processes, <https://nptel.ac.in/courses/112107145/14>.
3. Manufacturing Processes <https://nptel.ac.in/courses/112107144/>.

LIST OF EXPERIMENTS

1. To study and observe various stages of casting through demonstration of sand casting process.
2. To determine AFS fineness number of given sand sample.
3. To demonstrate the working of sand Muller.
4. To prepare a standard specimen under identical conditions for checking important physical properties of foundry sand.
5. To determine clay percentage of given sand sample by wash and weight method.
6. To determine the moisture content in molding sand.
7. To determine permeability number of green sand, core sand and raw sand.
8. To find out the hardness of baked or dried cores made up of core sands and resin sands.
9. To study effect of types of joint and welding current on tensile properties of SMAW welded plate of mild steel.
10. To study various metal forming techniques and demonstration of deep drawing process on hydraulic press.
11. To study different types of super finishing processes and demonstration of grinding and buffing techniques.
12. To study different types of plastic material and their molding methods.

Subject: Kinematics of Machines (PCC)								
Program: B. Tech. (Mechanical)				Subject Code: ME 0313			Semester: III	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuou sInternal Evaluation (CIE) Practical	Total Marks
2	1	0	3	16/40	-	24/60	-	100

Course Objectives:

1. To understand the basic components and layout of linkages in the assembly of a system/machine
2. To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism
3. Selection of power transmission devices like belt drive, rope drive, gears, gear trains and its applications
4. To facilitate students to understand the types of cam and follower, motion and profile drawing of cam
5. To synthesis mechanism to perform certain prescribed task/motion

Course Outcomes:

1. Understand the principles of kinematic pairs, chains and their classification, DOF, inversions, equivalent chains and planar mechanisms.
2. Analyze the planar mechanisms for position, velocity and acceleration.
3. Synthesize planar four bar and slider crank mechanisms for specified kinematic conditions.
4. Evaluate gear tooth geometry and select appropriate gears for the required applications.
5. Analyze cams and followers for specified motion profiles.
6. Assess various concepts of mechanisms like straight line motion mechanisms, steering gear mechanisms and working principles of power elements (Gears, gear trains, Cams, Belt and Chain drives) and design related problems effectively.

COURSE CONTENT

UNIT-1

[06]

1 Mechanisms & Machines:

Terminology and Definitions, Mechanism & Machines. Rigid and resistance body,

link, Kinematic pair, types of motion, classification of Kinematic pairs, Kinematic Chain, Linkage, Mechanics, degrees of freedom, Mobility – Kutzbach criterion, Gruebler's criterion, Grashof's Law, Kinematic Inversion of four bar chain, Single and Double slider crank Chain, Four bar chain mechanism with lower pairs,

Steering gear mechanisms such as Davis and Ackermann Steering gear.

UNIT-2

[08]

2 Velocity and Acceleration Diagrams of Mechanisms:

Displacement, velocity and acceleration analysis in simple mechanisms, Graphical Method, Rubbing Velocity, velocity and acceleration polygons, Instantaneous Centre of Velocity, Kennedy Theorem, Angular velocity ratio theorem, Coriolis acceleration component.

UNIT-3

[10]

3 Belt Rope and Chain:

Introduction, belt and ropes drives, selection of belt drive, types of belt drives, Materials used for belt and rope drives, law of belting, velocity ratio, tension ratio, Length of belt, V-belts, Wire rope, Slip and Creep of belt drive, tensions for flat belt drive, angle of contact, centrifugal tension, Maximum power transmitted by belt, chain drive & its classification.

4 Gears & Gear Trains:

Introduction, Classification of Gears, Gear Terminology, Law of Gearing, Velocity of Sliding, Forms of teeth, Involute and cycloidal tooth profiles, Arc of the contact, Numbers of pairs of teeth in contact, Interference in involute Gears, Minimum Number of teeth, under cutting, Comparison of Cycloidal and involute tooth forms, Spur, Helical, Spiral, Worm, Worm Gear and Bevel Gears (Basics only). Simple, Compound, Reverted & epicyclic gear trains, Algebraic and tabular methods of finding velocity ratio of epicyclic gear trains.

UNIT-4

[08]

5 Cam and Followers:

Introduction, Definitions of cam and followers, applications, Types of Cams, Types of Followers, Cam Terminology, displacement, velocity and acceleration curves for uniform velocity, Simple Harmonic Motion, Uniform Acceleration Retardation, Cycloidal motion, Cam profiles: cam with reciprocating/oscillating follower having knife-edge, roller and flat-face follower inline and offset. Tangent circular arc and eccentric cam.

6 Kinematic Synthesis of Mechanisms:

Types of synthesis, Function generation, Path generation, Motion generation, Graphical synthesis, Chebyshev's spacing for accuracy points, Freudenstein's equation

Text Books

1. Shigley, J.E and Uicker, J.J: Theory of Machines and Mechanisms, Oxford University Press
2. Rattan S.S.: Theory of Machines Tata McGraw-Hill Publishing Co. Ltd. New Delhi

Reference Books:

1. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2005.
2. Rao. J. S. and Duggipati. R. V. "Mechanisms and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992.
3. C.S. Sharma and Kamlesh Purohit, Theory of Mechanisms and Machines, PHI Learning Pvt. Limited, 2006
4. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2005
5. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
6. Allen S. Hall Jr., "Kinematics and Linkage Design", Prentice Hall, 1961
7. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", Affiliated East- West Pvt. Ltd., New Delhi, 1988.
8. Sadhu Sigh : Theory of Machines, "Kinematics of Machine", Third Edition, Pearson Education, 2012.

Web resources:

1. <https://nptel.ac.in/courses/112104121>
2. <http://kmoddl.library.cornell.edu/>
3. <https://www.journals.elsevier.com/mechanism-and-machine-theory>
4. Mechanalyzer software for mechanism
<http://www.roboanalyzer.com/mechanalyzer.html>

MOOCS:

1. <https://onlinecourses.nptel.ac.in>

Subject: Fluid Mechanics (PCC)								
Program: B. Tech.(Mechanical)				Subject Code: ME 0314			Semester: III	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
2	0	2	3	16/40	16/40	24/60	24/60	200

Course Objectives

1. Provide fundamental knowledge of fluid.
2. Develop basic understanding of Fluid properties.
3. Give the knowledge of behavior of fluid under various conditions.

Course Outcomes

1. Understand the fundamentals of Fluid Mechanics and related applications.
2. Know basics of fluid kinematics and dynamics and their applications.
3. Formulate basic equations for Fluid Engineering problems.
4. Calibrate various fluid flow measuring devices.
5. Understand the necessity and concept of dimensional analysis, boundary layer and compressible fluid flow.

COURSE CONTENT

UNIT-1

[06]

1 Fluid Properties and Fluid Statics

Fluid, ideal and real fluid, properties of fluid: mass density, weight density, specific volume, specific gravity, viscosity, surface tension, capillarity, vapor pressure, compressibility and bulk modulus. Newtonian and Non-Newtonian fluids. Pressure, Pascal's law, Hydro static law, Manometer, and Hydrostatic forces on submerged planes and curved surfaces, Buoyancy and Flotation.

UNIT-2

[10]

2 Fluid Kinematics

Streamline, stream tube. Continuity equation, acceleration of a fluid particle, motion of fluid particle along curved path, Normal and tangential acceleration. Description of fluid motion, Lagrangian and Eulerian approach, Type of fluid flow, Type of flow lines-path line, streak line, acceleration, Rotational flow, Rotation and Vorticity circulation, stream and potential function.

3 Fluid Dynamics

Euler's Equation, Bernoulli's equation and its practical application, Venturimeter, Orifice meter, Nozzle, Pitot tube, Impulse momentum equation, Momentum of Momentum equation, Kinetic energy and Momentum correction factor

UNIT-3

[08]

4 Viscous Flow

Flow of viscous fluids in circular pipe, shear stress and pressure gradient relationship, Velocity distribution, Hagen Poiseuille Equation, flow of viscous fluids between two parallel plates (Couette flow), shear stress and pressure gradient relationship, Velocity distribution

5 Turbulent Flow

Reynolds's experiment, Effect of turbulence, Expression for loss of head due to friction in pipes (Darcy-Weisbach equation), Expression for co-efficient of friction in terms of shear stress.

UNIT-4

[08]

6 Compressible Fluid Flow

Basic Thermodynamic relations, Basic equations for one dimensional compressible flow, stagnation properties, pressure wave propagation and sound velocity, Flow through nozzles

7 Dimensional Analysis and Model Analysis

Methods of dimensional analysis, Rayleigh's method, Buckingham's theorem, Limitations. Dimensionless number and their significance, model laws, Reynolds model law, Fraude's model law, Euler's model law, Weber's model law, Mach's model law, Type of models, scale effect in model, limitation of hydraulic similitude.

Text Books:

1. Fluid Mechanics and Fluid Power Engineering – D.S. Kumar– Kataria & Sons – NewDelhi
2. A text of Fluid Mechanics – R. K. Rajput – S. Chand & Company Ltd., Delhi

Reference Books:

1. Fluid Mechanics & Hydraulics Machines-R. K. Bansal-Laxmi Publications. Delhi
2. Engineering Fluid Mechanics –K.L. Kumar, Eurasia Publication House, Delhi
3. Mechanics of Fluid – B.S. Massey – English Language Book Society (U.K.)
4. Fluid Mechanics- Yunush A. Cengel, John M. Cimbala- MH, Delhi
5. Introduction to Fluid Mechanics and Fluid Machines – S.K. Som and G. Biswas- MH, Delhi
6. Hydraulics and Fluid Mechanics Including Hydraulic Machine- PN Modi&SM Seth
7. Theory and Application of Fluid Mechanics- K. Subramanya-TMH Delhi

8. A text of Fluid Mechanics – R. K. Rajput – S. Chand & Company Ltd., Delhi

Web resources:

1. <http://nptel.ac.in/courses/112105171/>
2. <http://nptel.ac.in/courses/112104118/>
3. www.learnerstv.com
4. <http://www.mne.psu.edu/cimbala/Learning/Fluid/fluid.htm>
5. http://www.efluids.com/efluids/pages/edu_tools.htm

LIST OF EXPERIMENTS

1. Performance to determine Metacentric height using Buoyancy force.
2. Experimental verification of Bernoulli's theorem.
3. To determine type of flow using Reynold's experiment.
4. To evaluate friction factor of pipe flow experimentally.
5. Experimental determination of coefficient of discharge of rectangular and V notch in open channel flow.
6. Experimental calibration of Venturi meter.
7. Experimental calibration of Orifice meter.
8. Experimental calibration of Rotameter.
9. Dimensional Analysis, Model Similitude and various Dimensionless numbers- their study, application and case study
10. Pressure measurement using Pitot tube in wind tunnel.

Subject: Strength of Materials (PCC)								
Program: B. Tech. (Mechanical)				Subject Code: ME 0315			Semester: III	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuou sInternal Evaluation (CIE) Theory	Continuou sInternal Evaluation (CIE) Practical	Total Marks
3	0	2	4	16/40	16/40	24/60	24/60	200

Course Objectives

1. To gain a fundamental understanding of the concepts of stress and strain by analysis of solids and structures.
2. To study engineering properties of materials, force-deformation and stress-strain relationship
3. To learn fundamental principles of equilibrium, compatibility, and force-deformation relationship, and principle of superposition in linear solids and structures
4. To analyze, determinate and indeterminate axial members, tensional members and beams to determine axial forces, torque, shear forces, bending moments, slopes and deflection.
5. To determine stress, strain, and deformation of bars, beams and rods
6. To be able to perform structural analysis by hand computations and design axial and tensional members.

Course Outcomes

After the study of this subject

1. Analyze and design structural members subjected to tension, compression, torsion, bending and combined stresses using the basic concepts of stress, strain and elastic behavior of materials.
2. Utilize appropriate materials in design considering engineering properties, sustainability, cost and weight.
3. Perform engineering work in accordance with ethical and economic constraints related to the design of structures and machine parts

Content

UNIT-I

[08]

Simple Stresses and Strains

Introduction, Stress, Strain, Types of stresses and strains, Elasticity and elastic limit, Hook's law and elastic moduli, Stress- strain relationship,

Elongation of uniformly tapering circular and rectangular member, Elongation due to self-weight, Stresses in composite section, Thermal stresses

Elastic Constants

Longitudinal, Lateral and Volumetric strain, Shear strain, Young's modulus, Bulk modulus, Shear modulus, Poisson's ratio, Relationship between Young's, Bulk and Shear modulus

UNIT-II

[08]

Principal Stresses and Strain

Stress in Tensile member due to pure shearing, two mutually perpendicular direct stress, principal plane, principal stresses, and Mohr circle of stress.

Beams

Introduction of Beams, Various type of Beams, Various type of Supports, Reactions at supports, Shear force and bending moment at any section of a beam, Methods for determination of S.F. and B.M. diagrams of beams (simply supported, overhang and cantilever) subjected to various loads, Relation between Shear Force and Bending Moment, Point of contra-flexure.

[08]

UNIT-III

Bending of Beams

Theory of simple bending, section modulus, symmetric section practical application of bending equation.

Torsion of Circular rods

Theory of simple torsion, solid and hollow shafts, torsional rigidity, importance of angle of twist and various stresses in shafts

UNIT-IV

[08]

Deflection of Beam

Relation between slope deflection and radius of curvature, problem by Macaulay's method, Double integration method, Moment Area Method, Conjugate Beam method.

Columns and Struts

Classification, end condition, equivalent length, Euler's theory formula, limitation, application, derivation, Rankine's hypothesis.

Text Books

1. Strength of Materials, Dr. R.K. Bansal, Laxmi Publication, 6th edition, 2015
2. Strength of Materials, U.C. Jindal, Pearson, 2nd edition, 2018
3. Strength of Materials, R.K. Rajput, Schand Publication 6th edition, 2015.

Reference Books

1. Elements of Strength of Material – Timoshenko & Young- EWP press
2. Mechanics of Material-Gere and Timoshenko CBS Publications
3. Mechanics of Solids – Beer & Johnson, Tata McGraw Hill Publications
4. Strength of material – Ryder–ELBS
5. Introduction to Solid Mechanics – I. H. Shames–PHI
6. Engineering Mechanics of Solids – E.P. Popov – PHI

Web resources

1. <https://www.coursera.org/learn/mechanics-1>
2. <https://www.edx.org/>
3. <https://nptel.ac.in/courses/112107146/>

MOOCS

1. <https://www.coursera.org/learn/mechanics-1>
2. https://onlinecourses.nptel.ac.in/noc17_ce22/preview
3. <https://online.uwc.edu/academics/courses/egr-203>

List of Experiments for Strength of Materials

1. To study mechanical properties
2. To perform tensile test.
3. To study compression test.
4. To Perform Torsion test.
5. To Perform Fatigue test.
6. To Perform Impact test.
7. To Perform Brinell hardness test.
8. To Perform Rockwell hardness test.
9. To Perform Deflection of Beam.
10. To study various type of strain gauge.

Subject: Material Science and Metallurgy (PCC)								
Program: B. Tech. (Mechanical)				Subject Code: ME0316			Semester: III	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuou sInternal Evaluation (CIE) Theory	Continuou sInternal Evaluation (CIE) Practical	Total Marks
2	0	2	3	16/40	16/40	24/60	24/60	200

Course Objectives:

1. To study various materials and properties of materials
2. To study basic concept and importance of phase diagram and Fe-C diagram
3. To study principle of heat treatment and various types of heat treatment
4. To study Nondestructive testing of materials
5. To study about powder metallurgy

Course Outcomes:

By the end of the course students will be able to:

1. Understand various materials used in engineering applications and their properties.
2. Describe importance of phase diagram and Fe-C diagram
3. Recognized principle and techniques of heat treatment
4. Get knowledge of Nondestructive testing of materials used in engineering field.

COURSE CONTENT**UNIT-1****[07]****1 Introduction:**

History of Material Science, Definition of Metallurgy & its application, microscopic & macroscopic examination, different types of engineering materials, selection criteria for engineering materials, Physical, Mechanical, Electrical, Thermal, Magnetic Properties of materials

2 Solidification of Metals:

Nucleus formation & crystal growth, Homogeneous & heterogeneous nucleation, grain, grain boundary, grain growth, solidification process, effect of grain size on properties of Metals.

	UNIT-2	[07]
3 Phase & Phase Equilibrium Diagrams:		
Gibb's phase rule, Solid solution, Hume-Rothery's rule, Equilibrium phase diagram, lever rule, eutectic system, and eutectoid system, Allotropy of iron, Iron-Carbon diagram, steel & cast iron		
	UNIT-3	[08]
4 Heat treatment of steel:		
TTT diagram, CCT diagram, Annealing, normalizing, hardening & tempering, hardenability. Induction and Case hardening: Carburizing, Nitriding, Cyaniding, Carbon-Nitriding		
	UNIT-4	[08]
5 Non-destructive Testing:		
Radiography, liquid penetration test, magnetic particle testing, ultrasonic testing, eddy current test.		
6 Powder Metallurgy:		
Concept, Processes, Characteristics of metal powders, Production of metal powders, Blending & mixing, Compacting, Pre-sintering & sintering, secondary operations.		

Text Books:

1. Material Science and Metallurgy, O.P Khanna, Dhanpat Rai Publications
2. Engineering Materials, R. K Rajput, S. Chand Publications
3. Material Science & Engineering, Raghvan V, Prentice Hall of India

Reference Books:

1. Material Science and Engineering: An Introduction, William D. Callister and David G. Rethwisch, John Wiley, 10th edition, 2018.
2. Introduction to physical metallurgy, Sidney H Avner, Tata McGraw-Hill Publishing Company, 2nd edition, 2006.
3. The Science and Engineering of Materials, Donald R. Askeland, Pradeep P. Fulay and Wendelin J. Wright, Cengage.
4. Physical Metallurgy Principles - Robert E Reed-Hill and Reza Abbaschian
5. Heat Treatment Principles & Techniques, Rajan T. V., Sharma C.P, Prentice Hall of India.
6. Principles of Materials Science and Engineering, W F Smith, McGraw Hill.

Web resources:

1. <https://nptel.ac.in/downloads/112108150/>

2. <https://nptel.ac.in/courses/113105023/>
3. <https://nptel.ac.in/courses/113106032/>
4. Principle of physical metallurgy, <https://nptel.ac.in/courses/113105024/>
5. Material Science and Engineering, <https://nptel.ac.in/courses/113107078/>
6. Introduction to Material Science and Engineering,
7. <https://nptel.ac.in/courses/113102080/>

LIST OF EXPERIMENTS

1. To study types and properties of materials
2. To study ferrous and non-ferrous materials
3. To study of metallurgical microscope and perform micro examination of standard specimen.
4. To prepare the specimen for microscopic observation.
5. To study allotropy of iron and iron carbon diagram
6. To study heat treatment and check effect of quenching media on hardness of steel.
7. To measure hardenability of given material with Jominy hardenability test.
8. To perform liquid penetration test for given sample.
9. To study of magnetic particle test.
10. To study of ultrasonic test.

Subject: Design Innovation for IP Thinking (ES)								
Program: B. Tech. (Mech.)				Subject Code: ME 0312			Semester: III	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
1	0	2	2	16/40	16/40	24/60	24/60	200

Course Objectives:

1. To excite the student on creative design and its significance;
2. To make the student aware of the processes involved in design;
3. To introduce fundamental aspects of Intellectual property rights to students who are going to play a major role in development and management of innovative projects in industries.
4. To disseminate knowledge on patents, copyrights, Trademarks, Geographical Indication and Intellectual property laws.

Course Outcomes:

1. Able to appreciate the different elements involved in good designs and to apply them in practice when called for.
2. Aware of the product oriented and user oriented aspects that make the design a success.
3. Students will be able to do patent search analysis to perform prior art for their innovative idea using extensive databases.
4. Students will be able to prepare patent applications and file the same with the patent and trademark office regional, national and international.

COURSECONTENT**UNIT-1****[14]****Introduction to Design Thinking**

Design and its objectives; Design constraints, Design functions, Role of Science, Engineering and Technology in design; Engineering as a business proposition; Functional and Strength Designs. How to initiate creative designs? Initiating the thinking process for designing a product of daily use. Different stages in design and their significance; Defining the design space; Analogies and “thinking outside of the box”; Quality function deployment-meeting what the customer wants; Evaluation and choosing of a design

UNIT-2

[14]

Prototyping and Design Optimization

Rapid prototyping; testing and evaluation of design; Design modifications; Freezing the design; Cost analysis. Engineering the design, From prototype to product. Planning; Scheduling; Supply chains; inventory; handling manufacturing / construction operations; storage; packaging; shipping; marketing; feed-back on design-Design optimization; Design as a marketing tool.

UNIT-3

[12]

Introduction to Intellectual Property : Innovation and Intellectual property rights, concepts of intellectual property, need for protecting intellectual property, theories on concept of property-IPR-Concept of patent, criteria of patentability, process of obtaining a patent-Trademark-criteria for trademark-procedure for trademark registration-Meaning of Industrial designs-Rights in Industrial design.

UNIT-4

Intellectual property as geographical indication (GI): Meaning of GI-difference between GI and trademarks-concept of authorized user-infringement-offences and penalties. [08]

Intellectual property laws and IP commercialization: Intellectual property laws in India-legal basis of intellectual property protection-Traditional IP-Evolving IP-Brand Management-Brand and pricing strategies –patent mining-Landscape and mapping.

Text Books:

1. Balmer, R.T., Keat, W.D., Wise, G., and Kosky, P., Exploring Engineering, Third Edition: An Introduction to Engineering and Design - [Part 3 - Chapters 17 to 27]
2. Dym, C. L., Little, P. and Orwin, E. J., Engineering Design - A Project based introduction Wiley.
3. D P Mittal (Taxman Publication), Indian Patents Law and Procedure B.L. Wadern, Patents, trademarks, copyrights, design and geographical Judications.

Reference Books:

1. Eastman, C.M. (Ed.), Design for X Concurrent engineering imperatives, 1996.
2. Haik, Y. And Shahin, M.T., Engineering Design Process, Cengage Learning.
3. Voland, G., Engineering by Design, Pearson publication

Web Resources:

1. <http://opim.wharton.upenn.edu/~ulrich/designbook.html>

2. http://www2.warwick.ac.uk/fac/sci/wmg/ftmsc/modules/modulelist/peuss/designforx/design_for_x_notes_section_5.pdf

MOOC:

1. <https://nptel.ac.in/courses/109104109/>

List of Practical

1. To understand attributes of Design Thinking & Domain selection.
2. Observation through AEIOU - visit selected domain/place for getting insights and define problems. (Field activity)
3. Study and summarization of AEIOU activity/inputs.
4. Preparation of Mind Map
5. Preparation of Empathy Map
6. Systematic field exercises, empathization and Secondary Research activities - student teams need to define and validate their problem through the Ideation Phase.
7. Preparation of Ideation canvas.
8. Preparation of Product Development Canvas (PDC)
9. Customer/User Revalidation (Reject/Redesign/Retain) and Refinement of product Idea.
10. Preparation of a Rough Primary Prototype.

Subject: Internship								
Program: B. Tech. (Mechanical)				Subject Code: ME0317			Semester: III	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
0	0	0	2	NA	40/100	NA	NA	100

Note: At the end of 2nd Semester – during summer break each student has to complete one month internship in the industry and submit certificate, report and appear for presentation in 3rd semester.

SEMESTER-IV

Subject: Machine Design and Industrial Drafting (ES)								
Program: B. Tech. (Mechanical)				Subject Code: ME0413			Semester: IV	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
2	0	2	3	16/40	16/40	24/60	24/60	200

Course Objectives

1. To acquire knowledge of fastening arrangements such as welding, riveting, cotters, knuckles.
2. To provide the knowledge of design practices for common machine elements, assembly drawings and blue print reading.
3. To know about production drawing enables to do tolerance analysis and specify appropriate tolerances for machine design applications.
4. To understand basic design procedures for different machine elements.
5. To learn basic tools of AutoCAD

Course Outcomes

1. To carry our tolerance analysis and specify appropriate tolerances to machine elements for various applications.
2. To select materials, tolerances, shapes, type of threads etc in power screw design
3. To analyze the joint strengths in welding and rivet joint
4. Able to analyze the stress and strain on mechanical components under static loading and understand, identify and quantify failure modes for mechanical parts.
5. To prepare basic drafting of machine elements in AutoCAD.

COURSE CONTENT

UNIT-1

[06]

Introduction

Design, Drafting, Difference between design and drafting, Machine Design, Basic procedure of Design, Standards in Design and standardization, Selection of Preferred sizes, Concepts of stresses and Strain.

[07]

UNIT-2

Elements of Production Drawing

Geometric tolerance, types of Geometric tolerance, terminology for Geometric tolerance, Representation of Geometric tolerance on drawing, Dimensional tolerance, Terminology of dimensional tolerance, selection of tolerance, representation of dimensional tolerance, Fits, Hole basis and shaft basis system, Representation of Holes, shafts and Fits, Surface roughness, Terminology of surface roughness, Representation of surface roughness on drawing, Conventional representation of machine parts.

UNIT-3

[09]

Design of Welded Joints

Types of welded joints, stresses in welded joints, Design for various loading conditions in torsion, shear, or direct load, eccentrically loaded welded joints, welding symbols.

Design of Riveted Joints

Types of riveted joints, design of double and triple riveted butt joints with equal and unequal cover plates, Design of Circumferential joint, Longitudinal Butt Joint, Eccentric loading.

UNIT-4

[09]

Miscellaneous Joints

Design and Drawing of cotter and knuckle joint.

Power Screws

Types of power screw threads, design of screw with different types of threads used in practice, Design of nuts, Design of C clamp.

Basics of AutoCAD

Different software packages for drafting, Advantage & Application of CAD, Concept of CAD, 2D drafting using AutoCAD, AutoCAD basic commands & applications, 2D drafting of machine part.

Text Books

1. Design of Machine Elements, V. B. Bhandari, Mc.Graw Hill, Third Edition.
2. Machine design, Dr. P C Sharma, Dr. D K Aggarwal, S K Kataria & Sons, Twelfth Edition.
3. Machine Design: Fundamental and application, P C Gope, PHI.
4. Ma
5. chine Drawing, N. D. Bhatta, Charotar Publication, Fiftieth Edition, 2016
6. Machine Drawing, R. B. Gupta, Satya Prakashan, Tenth Edition, 2016.
7. A Text Book of Machine Drawing, P. S. Gill, S. K. Kataria, Delh

Reference Books

1. Machine Design by Robert L Norton, Pearson Education
2. Machine Design by Dr. S.S. Wadhwa, Dhanpatrai & Co.
3. Mechanical engineering design by Joseph shigley, McGraw Hill Publishing Co.
4. Fundamentals of Machine component design by Juvinall&Marshek, Wiley India education
5. Design of Machine Elements, Farazdak Haideri, Nirali Prakashan.

List of Experiments (Drawing Sheets)

1. Elements of Production Drawing.
2. Drawing of Welded Joints & Riveted Joint.
3. Drawing of Cotter joint & Knuckle Joint.
4. Drawing for Power screw.
5. Drafting of engineering components using AutoCAD.

Subject: Engineering Thermodynamics (PCC)								
Program: B. Tech. (Mechanical)				Subject Code: ME0414			Semester: IV	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuou sInternal Evaluation (CIE) Practical	Total Marks
3	0	0	3	16/40	-	24/60	-	100

Course Objectives

1. To understand the theory and applications of classical thermodynamics, thermodynamic properties, equations of state.
2. To know the nature and role of the following thermodynamic properties of matter internal energy, enthalpy, temperature, pressure and specific volume.
3. To understand the concepts of various laws of thermodynamics.

Course Outcome:

1. Understand basic terms used in thermodynamics.
2. Understand the properties of gas mixtures.
3. Comprehend laws of thermodynamics and its applications.
4. Understand the concept and applications of availability
5. Understand various gas and vapor power cycles.

COURSE CONTENT

UNIT-1

[08]

1 Basic Concept of Thermodynamics

Microscopic & macroscopic point of view, thermodynamic system and control volume, thermodynamic properties, processes and cycles, Thermodynamic equilibrium, Quasi-static process

UNIT-2

[12]

2 First Law of Thermodynamics

First law for a closed system undergoing a cycle and change of state, Energy-A property of the system, Different forms of stored energy, Specific Heat at constant Volume and Pressure, Enthalpy, Energy of an Isolated system, Perpetual motion machine of the first kind-PMM1, Control Volume, Steady flow Process, Mass and Energy balance in a simple steady flow Process.

3 Ideal Gas mixtures

Composition of a gas mixtures, P-v-T behavior of ideal gas mixtures, properties of ideal gas mixtures, psychometrics of gas-vapor mixtures

UNIT-3

[12]

4 Second law of Thermodynamics

Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence, PMM of Second kind, reversibility and irreversibility, Carnot cycle, Carnot theorem, Absolute thermodynamic temperature scale.

5 Entropy

Clausius theorem, property of entropy, inequality of Clausius, entropy change in an irreversible process, principle of increase of entropy, entropy change for non- flow and flow processes, third law of thermodynamics

Unit-4

[10]

6 Availability

Available and unavailable energy, availability of a closed system, availability function of a closed system availability of steady flow system, availability function of open system, Energy of a heat input in a cycle, exergy destruction in heat transfer process, irreversibility

7 Air Standard Cycles

Concept of air standard cycles, Assumptions, Carnot Cycle, Otto Cycle, Diesel Cycle, Dual Cycle, Comparison of Otto, Diesel and Dual cycles, Efficiency of air standard cycle, Mean Effective Pressure, Relative efficiency. Brayton cycle, effect of reheat, regeneration, intercooling and turbine and compressor efficiency on Brayton cycle. (No numerical, for reheat & regenerative).

Text Books

1. Engineering Thermodynamics, P.K. Nag, McGraw-Hill Education
2. Engineering Thermodynamics, D. S. Kumar, S. Kataria and Sons.
3. Fundamentals of Engineering Thermodynamics, R. Yadav Central Publishing House, Allahabad

Reference Books

1. Fundamentals of Thermodynamics, Borgnakke & Sonntag, 7th Ed. Wiley India (P) Ltd
2. Thermodynamics – An Engineering Approach, Yunus Cengel & Boles, McGraw-Hill
3. Engineering Thermodynamics, Gordon Rogers and Yon Mayhew, Pearson Ed
4. Engineering Thermodynamics, Krieth, CRC Press.
5. Engineering Thermodynamics, Jones and Dugan, PHI Learning Pvt. Ltd

Web resources:

1. <https://nptel.ac.in/downloads/112108148/>
2. <https://www.ohio.edu/mechanical/thermo/>
3. <http://web.mit.edu/16.unified/www/FALL/thermodynamics/>

MOOC:

1. <https://www.coursera.org/learn/thermodynamics-intro>
2. https://onlinecourses.nptel.ac.in/noc18_ae05/preview

Subject: Fluid Power Engineering (PCC)								
Program: B. Tech. (Mechanical)				Subject Code: ME0415			Semester: IV	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
3	0	2	4	16/40	16/40	24/60	24/60	200

Course Objectives

1. Provide the detailed understanding and application of fluid power and hydraulic machines
2. Understand the different Hydraulic machines which can give output with less effort.
3. To find efficiencies of different hydraulic turbines by performance
4. To understand working of single stage and multi-stage centrifugal pump and find efficiencies.
5. To analyze the performance of turbine and pump in different working condition by plotting characteristic curves.

Course Outcomes

1. To formulate basic equations for impact of free jets
2. To understand construction and working and performance of various Turbines
3. To understand construction and working & performance of various Pumps
4. To solve and analyze a variety of fluid mechanics and fluid machinery related problems.

COURSE CONTENT

UNIT-1

1 Flow Through Pipes [10]

Loss of energy in pipes, pipe in series and parallel, flow through siphon, equivalent pipe power transmission through pipe, water hammer in pipes.

2 Miscellaneous Machines

Construction and working of hydraulic press, Hydraulic accumulator, Hydraulic intensifier, Hydraulic crane, Hydraulic jack, hydraulic lift, Hydraulic ram, Torque converter

UNIT-2

[10]

3 Impact of Free Jets

Impulse momentum principle, force exerted by the jet on stationary and curved plate, hinged plate, moving plate and moving curve vanes.

4 Impulse Turbines

Classification of turbine, impulse turbine, Pelton wheel, Construction, working, work done, head efficiency and Design aspects, governing of impulse turbine, cavitation of turbines.

UNIT-3

[10]

5 Reaction Turbines

Radial flow reaction turbine, Francis turbine: construction, working, work done, efficiency, design aspect, advantages & disadvantages over Pelton wheel. Axial flow reaction turbine Propeller and Kaplan turbine, bulb tubular turbine, draft tube, specific speed, unit quantities, performance characteristics.

UNIT-4

[12]

6 Centrifugal Pumps

Classification of Pumps, Centrifugal pump, Construction, working, work done, heads, efficiencies, multi stage centrifugal pump, pump in series and parallel, specific speed, net positive suction head, cavitation.

7 Reciprocating Compressors

Construction and working, Multi stage conditions for minimum work, Intercooling, Efficiency of air compressors

8 Rotary Compressors

Introduction, Classification, roots blower, Vane type, Screw compressor

Textbooks

1. Fluid Mechanics-Yunush A Cengel, John M. Cimbala-TMH, Delhi
2. Fluid Mechanics and Fluid Power Engineering– D. S. Kumar–Kataria & Sons–
3. Fluid Mechanics & Hydraulics Machines-R. K. Bansal- Laxmi Publications, Delhi

Reference Books

1. A text of Fluid Mechanics– R. K. Rajput – S. Chand & Company Ltd., Delhi
2. Mechanics of Fluid– B.S. Massey– English Language Book Society(U.K.)
3. Introduction to Fluid Mechanics and Fluid Machines–S. K. Somand G. Biswas- TMH, Delhi.
4. Hydraulics and Fluid Mechanics Including Hydraulic Machine-PN Modi, & SM Seth-Standard, Delhi.

5. Hydraulic Machines: Fundamentals of Hydraulic Power Systems– P. Kumar–
BSPBooks
6. Pvt., Ltd., Hyderabad

Web resources:

1. <http://nptel.ac.in>

LIST OF EXPERIMENTS

1. Performance practical on impact of jet.
2. Performance practical on Centrifugal pump characteristics.
3. Performance practical on Centrifugal pump characteristics (Double Stage).
4. Performance practical on Centrifugal pump characteristics (Variable speed).
5. Performance practical on Gear pumps characteristics.
6. Performance practical on Francis Turbine.
7. Performance practical on Pelton wheel turbine.
8. Performance practical on Kaplan Turbine.
9. Study of various hydraulic devices
10. Performance practical on reciprocating compressor

Subject: Machining Practices (ES)								
Program: B. Tech. (Mechanical)				Subject Code: ME 0411			Semester: IV	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuou sInternal Evaluation (CIE) Theory	Continuou sInternal Evaluation (CIE) Practical	Total Marks
3	0	2	4	16/40	16/40	24/60	24/60	200

Course Objectives:

1. To understand principle, working and characteristics of various Machine Tools used atshop floor.
2. To understand use of various machine tool in the industries.
3. To understand various operations done by various cutting tools for each machinetools.
4. To understand the use of various accessories attachments used for particular machinetools.

Course Outcomes:

1. Understand the basic concept of Machine tools.
2. Understand the advantages, limitation and applications of the various machine tools.
3. Understand the usability of various machine tools as per the industry requirements.

COURSE CONTENT

UNIT-1

[08]

1 Basics of Machines Tools

Introduction, function of machine tools, classification of machine tool, machinetool motions, properties of machine tools.

2 Lathe Machine

Introduction, types of lathes & specification of lathe, components of lathe, lathe operations, too l & work holding devices, transmission mechanism, machining parameters, machining time & material removal rate, Production Lathes (Capstan & Turret Lathe), Alignment tests of lathes.

UNIT-2

[07]

3 Drilling and Boring Machine

Introduction, types of drilling machines, specification of drilling machines, drilling operation, drilling tools, work & tool holding devices, machining parameters,

machining time, boring machines. Purpose and field of application, Horizontal boring machines, Precision boring machines.

4 Sawing Machines

Metal sawing classification: reciprocating sawing machines, circular sawing machines, and band sawing machines.

UNIT-3

[07]

5 Shaper & Planner Machine

Introduction, types of shaper, components of shaper, shaper specification, shaper tools, work holding devices, shaper mechanism, machining parameters, machining time. Planner Machine Introduction, types of planner machines, components, specification of machine, work & tool holding devices, planner mechanism, machining parameters, machining time, difference between shaper and planner.

6 Broaching Machines

Types of broaching machine, advantage, disadvantage and limitations of broaching.

UNIT-4

[08]

7 Milling Machines

Introduction, types of milling, Components of milling, milling machine specification, milling operations, milling cutters, work & tool holding devices, milling mechanism, Indexing mechanism, machining parameters, machining time.

8 Grinding Machines and Abrasives

Classification of grinding finishing. Abrasives machines, cylindrical grinders, internal grinders, Surface grinders, tool and cutter grinders, grinding wheel surface, manufacturing of grinding wheels, selection and designation of grinding wheel, truing and dressing of grinding

Text Books:

1. "Elements of W/S technology Vol-1 & Vol-2 ", by S K Hajrachoudhury, A K HajraChoudhury, Nirjhar Roy, Media Promoters & Publishers PVT. LTD.
2. "Manufacturing Processes" by O.P. Khanna
3. "Manufacturing processes" by J.P.Kaushish, PHI PVT. LTD.

Reference Books:

1. "Manufacturing Technology Vol-1 & Vol-2" by P N Rao, Tata McGraw-hill publishing company limited.

Web Resources:

1. Fundamental of Manufacturing Processes, NPTEL.

LIST OF EXPERIMENTS

1. Safety Rules in Mechanical Workshop.
2. Basics of Machine Tools.
3. To study of metal cutting Lathe machine and prepare the job.
4. To study of Drilling machine and prepare the job.
5. To study of Boring machine.
6. To study of Milling machine and prepare the job.
7. To study of Shaper machine and prepare the job.
8. To study of Planner machine and prepare the job.
9. To study of Sawing and Broaching machine.
10. To study of Cylindrical Grinding machine.
11. To study of Surface Grinding machine and prepare the job.

Subject: Management for Engineers								
Program: B. Tech. (Mechanical)				Subject Code: ME0412			Semester: IV	
Teaching Scheme (Hours per week)				Examination Evaluation Scheme (Marks)				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
2	0	0	2	16/40	0	24/60	0	100

Course Objectives

1. Techniques relating to managing engineering activities, engineer's transition into management, engineering managerial functions, motivation of individual and group behavior.
2. Productivity assessment/improvement.
3. Managing the quality function and communications.

Course Outcomes

1. Able to know, comprehend, apply, analyze, synthesize and evaluate the basic principles of the fundamentals of managing technical organizations.
2. Prepare for further study in the area of engineering technology management.
3. Able to identify and apply appropriate management techniques for managing contemporary organizations.
4. Have an understanding of the skills, abilities, and tools needed to obtain a job on a management track in an organization of their choice.

CONTENTS

UNIT-I

[07]

Meaning, importance, skills and roles of manager, different levels of management. Functions of management, planning: nature, importance, steps, Organizing: Meaning, process, principles of organizing, staffing:-manpower planning, recruitment, selection, placement.

UNIT-II

[07]

Leadership and Organizations Management, Strategic Planning, Budgeting, Project Planning - Risk Identification, Assessment and Response Planning

UNIT-III

[07]

Management of Technology, Product Development and Innovation, Technical Entrepreneurship, Global Trade and International Operations, Operations Management

UNIT-IV

[07]

Marketing Management:-the 4 p's of marketing, demand forecasting (concepts only), market segmentation. Financial management:-meaning, scope, functions, objectives, role of financial manager. Lean Systems, Intellectual Property, Legal Issues in Engineering Management, Principles of Ethics for Engineering Managers

Text Books

1. Principles of Management by PC Tripathi & Reddy.
2. Management –I by Stephen P. Robbins& Stoner.
3. Management-II BY Kotler,Stoner

Reference Books

1. L. M. Prasad; Principles of Management; Sultan Chand and Sons
2. Karminder Ghuman and K. Aswathapa; Management – Concept

Subject: Alternate Energy Sources (PE-1)								
Program: B. Tech. (Mechanical)				Subject Code: ME0416			Semester: IV	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
3	0	0	3	16/40	***	24/60	***	100

Course Objectives

1. Acquire knowledge about alternate energy sources.
2. Understand basic characteristics of alternative energy sources and technologies for their utilization.
3. Analyze the principle and operation of direct energy conversion.
4. Apply the alternate energy sources to real world energy problems.
5. Apply the alternate energy sources to real world energy application.

Course Outcomes

1. Define basic properties of different alternate energy sources and technologies for their utilization.
2. Describe main elements of technical systems designed for utilization of alternate energy sources.
3. Interpret advantages and disadvantages of different alternate energy sources.
4. Undertake simple analysis of energy potential of alternate energy sources, Explain the correlation between different operational parameters.
5. Select engineering approach to problem solving when implementing the projects

COURSE CONTENT

UNIT-1

[10]

1 Introduction

Energy forms, World's and India's production and reserves of energy, Global and national present energy scenarios.

2 Biogas and Biomass

Types of biogas plants, biogas generation, factors affecting biogas generation, advantages and disadvantages applications, scope of biogas energy in India,

biomass energy, energy plantation, gasification, types of gasifier and their applications.

UNIT-2

[12]

3 Ocean Energy

Introduction, OTEC principle, open cycle OTEC system, closed cycle, hybrid cycle, Energy from tides, estimation of tidal power, tidal power plants, single basin, double basin, advantages and limitations, Wave energy, wave energy conversion devices, advantages and disadvantages, small scale hydro power.

4 MHD Power Plant

Principle Of MHD Power Generation, Open Cycle Plant, Closed Cycle Plant, Advantages of MHD Plants.

UNIT-3

[12]

5 Wind Energy

Power in wind, power coefficient, wind mills-types, design consideration, performance, a utilization of wind power – examples. Economics of wind turbines, advantages and disadvantages, Applications, wind energy development in India.

6 Geothermal Energy

Introduction, Vapor dominated system, liquid dominated system, hot dry rock resources, magma resources, advantages and disadvantages, applications, geothermal energy in India: prospects.

UNIT-4

[14]

7 Solar Energy

Solar geometry, solar radiation at the earth's surface, sunrise, sunset and day length, Instruments for solar radiation measurements, estimation of average solar radiation, Solar collectors material, types and performance analysis, Collector efficiency, overall loss coefficient, collector efficiency factor, solar air heaters- types, performance, applications, focusing collector and its types, tracking, performance, non-focusing type collectors, CPC, optical losses.

8 Applications of Solar Energy

Solar water heaters, heating and cooling of buildings, solar pumping, solar cooker, solar still, solar drier, solar refrigeration and A/C, solar pond, solar power plant, heliostat, solar furnace, solar chimney power plant.

Text Books

1. Non- Conventional Energy Source by G. D. Rai, Khanna Pub, New Delhi, 2004.
2. Solar Energy by S. P. Sukhatme, Tata McGraw Hill Pub, New York 2008
3. Solar Energy: Fundamentals and Applications by H.P. Garg & Jai Prakash, TataMcGraw Hill, New Delhi, 1997.

Reference Book

1. Non conventional energy resources by B. H. Khan Tata McGraw Hill Pub, 2006.
2. Principles of Solar Energy / Frank Krieth & John F Kreider John Wiley & sons, New York, 1977.
3. Solar Engineering of Thermal Processes by J.A. Duffic and W.A. Beckman, John Wiley & sons, New York, 1974.
4. Alternate energy sources and application by N.K .Giri Khanna Publication, New Delhi, 2012
5. Non conventional energy sources by Raja et.al. Scitech Publications Chennai
6. Solar Energy – A Hand Book by G N Tiwari – Springer Publication

Web Resources:

1. <https://nptel.ac.in/downloads/108108078/>
2. <https://nptel.ac.in/courses/112105050/>
3. <https://nptel.ac.in/courses/Webcourse-contents/IISc-BANG/notused/Non-Conventional%20Energy%20Systems-/Learning%20Material%20-%20NCES.pdf>
4. <https://nptel.ac.in/courses/108108078/>
5. <http://nptel.ac.in/courses/112104117/18>
6. <http://nptel.ac.in/courses/112104117/17>

MOOCS:

1. Non-Conventional Energy Resources-<https://nptel.ac.in/courses/121106014/>
2. Solar Energy Technology-<https://nptel.ac.in/courses/112105051/>
3. Energy Resources & Technology-<https://nptel.ac.in/courses/108105058/>

Subject: Product Design & Development (PE-1)								
Program: B. Tech. Mechanical Engineering				Subject Code:ME0417			Semester: IV (PE-1)	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
3	0	0	3	16/40	-	24/60	-	100

Course Objectives

1. To know how product specification are made
2. To understand the need of product development
3. To study various rapid prototyping process
4. To identify the need of customers for developing a new product
5. To understand how an organization works while developing a product

Course Outcomes

1. Understand the procedure of research and development of a product
2. To improve the efficiency of any assembly studying various case studies.
3. To identify the specification of any product
4. To identify the life cycle cost for a product
5. To understand how to improve the customer satisfaction for a particular product
6. To apply new technology for preparing a prototype for a new developed product

Content

UNIT-I

[10]

Introduction to Product Design and Development

Definition of product design & Product Development, Difference between product design and product development, design by evolution and innovation, factors affecting product design, standardization, simplification and specialization in product design, Ergonomics in product design, Modern approaches like - Concurrent engineering and quality function deployment (QFD), types of design and redesign, modern product development process, introduction to prototyping, rapid prototyping methods- SLA, LOM, SLS. Benefits of rapid prototyping.

UNIT-II

[12]

Identifying Customer Needs:

Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process. Product Specification: what are specifications, when are specifications established, establishing target specifications, setting the final specification.

UNIT-III

[12]

Development Processes and Organizations

A generic development process, concept development: the front-end process, adopting the generic product development process, FMEA, the AMF development process, product development organizations, the AMF organization.

UNIT-IV

[14]

Product Life Cycle and Product Data Management

Benefits, and Concept of Product Life Cycle Management (PLM), Components/Elements of PLM, Emergence of PLM, Significance Of PLM, Product Data and Product Workflow, The relation Between Product Data and Product Workflow, Different Phases of Product Life Cycle, FAST diagramming, life cycle costs, Value Engineering and Value analysis

Text Books

1. "Product Design & Development.", Karl T Ulrich, Steven D Eppinger, Tata McGraw-Hill New Delhi 2003.
2. Product Design and Manufacturing, Chitale A K, R.C. Gupta, Prentice - Hall India<city of publisher>, <edition>, <year of publishing>.
3. Product Design for Manufacture and Assembly, G. Boothroyd, P. Dewhurst, W. A. Knight, CRC Press

Reference Books

1. Product Design: Techniques in Reverse Engineering and New Product Development, Kevin Otto and Kristin Wood, Pearson Education Inc.
2. Product Lifecycle Management, Grieves, Michael, McGraw-Hill, 2006..
3. Handbook of Product Design for Manufacturing, Bralla, James G., McGraw Hill Pub. 1986
4. Product development, Kevin Otto and Kristine Wood , Pearson Education 2004
5. New Product Development, Timjones. Butterworth Heinmann, Oxford

Web resources

4. <https://ocw.mit.edu/courses/sloan-school-of-management/15-783j-product-design-and-development-spring-2006/lecture-notes/>
5. https://onlinecourses.nptel.ac.in/noc18_de02/preview

MOOCS

1. <https://nptel.ac.in/courses/112107217/>
2. https://onlinecourses.nptel.ac.in/noc19_me22/preview
3. https://onlinecourses.nptel.ac.in/noc19_me23/preview

Subject: Non-Conventional Machining (PE-1)								
Program: B. Tech. (Mechanical)				Subject Code: ME 0418			Semester: IV	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
3	0	0	3	16/40	***	24/60	***	100

Course Objectives:

1. The course aims in identifying the classification of unconventional machining processes.
2. To understand the principle, mechanism of metal removal of various unconventional machining processes.
3. To study the various process parameters and their effect on the component machined on various unconventional machining processes.
4. To understand the applications of different processes

Course Outcomes

1. Develop utilization of understanding of fundamentals of the traditional cutting tools compare it with other tools
2. Identify and utilize fundamentals of metal cutting as applied to the machining.
3. Be able to identify a problem and apply the fundamental concepts and enable to solve problems arising in metal removal process.
4. Demonstrate the ability to define and formulate the properties of cutting tool materials and characteristics
5. Develop the skills of effective utilization of the cutting fluids and applications for better productivity and optimizing the production cost.
6. Become competent to design and analyze problems of engineering particularly having relevance to manufacturing

COURSE CONTENT

UNIT-1

1 Introduction

Introduction to Non-traditional machining, Need for Non-traditional machining process, Comparison between traditional and non-traditional machining, general classification Nontraditional machining processes, classification

based on nature of energy employed in machining, selection of non-traditional machining processes, Specific advantages, limitations and applications of non-traditional machining processes.

2 Chemical Machining

Elements of the process: Etchants. Types of chemical machining process chemical blanking process, chemical milling process. Process characteristics of CHM: material removal rate, accuracy, surface finish, advantages, limitations and applications of chemical machining process.

UNIT-2

[11]

3 Electrochemical and Chemical Metal Removal Techniques

Fundamentals of Electrochemical Machining (ECM), Electrochemical Grinding, Electrochemical Debarring Surface Finish and Accuracy, Economic Considerations, Advantages, Limitations and Applications.

UNIT-3

[12]

4 Mechanical Energy Techniques

Ultrasonic machining, Abrasive Jet Machining and Water Jet Machining – Basic Principle, Equipment, Processes Variables, Mechanism of Metal Removal, Material Removal Rate, Economic Considerations, Advantages, Limitations and Applications.

UNIT-4

[13]

5 Thermal Metal Removal Processes

Principle of Electrical Discharge Machining, Power Circuit for EDM, Material Removal Rate in EDM, Process Parameters, Selection of Tool Electrode and Dielectric Fluids, Characteristics of Spark Eroded Surface, Surface Finish and Accuracy, Advantages, Limitations and Applications, Electron Beam Machining, Plasma Arc Machining and Laser Beam Machining – Economic Considerations, Advantages, Limitations and Applications.

Text Books:

1. Non-Conventional Machining, Mishra P.K., The Institution of Engineers (India), Text Book Series, New Delhi, 1997
2. Unconventional Machining Process, Garry F. Benedict, Marcel Dekker Publication, New York, 1987.
3. Advanced Machining Processes”, V K Jain, Allied Publishers,

Reference Books:

1. A Text book of Production Engineering, Sharma, P. C., New Delhi, 1995
2. Non Traditional Machining Techniques, Bennedict, G. F., Marcel Decker, New York, 1990
3. Pandey and Sha, Modern Manufacturing Process, Prentice Hall, New Jersey.
4. Non Traditional Machining Processes by Jagdeesha T, I.K.International Publishing House Pvt. Ltd.

Web resources:

1. <https://www.mech4study.com/2017/03/ultrasonic-machining-principle-working-equipment-application-advantages-and-disadvantages.html>
2. <http://mechteacher.com/abrasive-jet-machining/>
3. <http://www.navodayaengg.in/wp-content/uploads/2015/12/lecture48.pdf>

Subject: Roadmap for Patent Creation (OE-4)								
Program: B. Tech. (Mechanical)				Subject Code: ME0419			Semester: IV	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
3	0	0	3	16/40	***	24/60	***	100

Course Objectives:

1. To understand basics of patent
2. To know importance of IPR and patent
3. To know patent filing procedure
4. To understand importance of patent search in research and project work

Course Outcomes:

1. After learning the course the students should be able to:
2. Able to identify what is Patent and importance?
3. Able to file patent at their own and know entire procedure
4. Able to search patent thoroughly using web resources
5. Will create awareness about IPR and patent etc.

COURSE CONTENT

UNIT-1

[12]

1 Basics of Patent

Definition and basic concepts; Property and IP; IPR IP and future area, Patent Introduction

2 Patent rational

Introduction, How to a read patent?, Patent Searching and analysis, Novelty aspect, Non obviousness, Industrial application

UNIT-2

[12]

3 Understanding of Research Gap

Use of patent data for research gap analysis, Parts of Patent documents, Terminology and codes used in patent documents, How to read patent – and its details, Identification of potential patent - various tools

4 Patent Identification

Identification of potential patent - various tools, IP identification tool, IP auditand frame work, Public Patent database

UNIT-3

[12]

5 Patent Filing

Research planning and patent -filing activity, Types of patent, Patent filing procedure in India, Patent timeline : India and PCT, Inventions not Patentable in India, Indicator for Patentability

6 Patent Types

Types of patent and patent timelines, Use of patent data base for research/projecttopic identification, Patent invention category

UNIT-4

[12]

7 Laboratory Notebook

Maintenance of laboratory notebook and patenting activity, Importance of laboratory notebook, Identification of inventor, applicant and their rights, When to publish and when to Patent, Procedure for patent filing (forms and fees), Interaction with IP attorney – initial drafting, FER reply and hearing

8 Research Project Plan

Research/Project Planning, Post patent filing requirements, Patent commercialization

Text Books:

1. IP for development: The emerging paradigm; by Gargate, G., Jha S.K. Elsevier, Delhi, India, 2014
2. Intellectual Property A Very Short Introduction Siva Vaidhyanathan
3. Foundations of Intellectual Property Robert P. Merges, Jane C. Ginsburg

References:

1. Guide to Intellectual Property What it is, how to protect it, how to exploit it
2. Key to IP Identifying Your Patents, Trademarks, Copyrights, and Trade Secrets ChrisWeiss Esq.

Web Resources:

1. Roadmap For Patent Creation Prof. Gouri Gargate Indian Institute Of Technology-Kharagpur
2. https://nptel.ac.in/noc/individual_course.php?id=noc19-ge09

MOOC:

1. <https://nptel.ac.in/courses/127105008/26>

Subject: Energy Management (OE-5)								
Program: B. Tech. (Mechanical)				Subject Code: ME0420			Semester: IV	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
3	0	0	3	16/40	***	24/60	***	100

Course Objectives

1. To make students aware of present energy scenario.
2. To make students understand the energy management approach.
3. To prepare energy audit report for different energy conservation instances.
4. To inculcate sustainable technology development competence into students.

Course Outcomes

1. Students will be aware of energy scenario in various energy sectors.
2. Students will understand the energy management approach.
3. Students will learn to prepare energy audit report for different energy conservation instances.
4. Sustainable technology development competence will be inculcated in the students.

COURSE CONTENT

UNIT-1

[04]

1 Energy Scenario

Classification of Energy, Indian energy scenario, Sectorial energy consumption (domestic, industrial and other sectors), energy needs of growing economy, energy intensity, long term energy scenario, energy pricing, energy security, energy conservation and its importance, energy strategy for the future.

[06]

UNIT-2

2 Energy Management & Audit:

Definition, energy audit, need, types of energy audit. Energy management (audit) approach- understanding energy costs, Bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering

UNIT-3

[04]

3 Energy Management and Energy Planning

Definitions and significance, Energy strategy, energy policy and energy planning, objectives of energy management, Trade – off between energy and environment, energy and economy, Transportation of energy, Seven principles of energy management.

UNIT-4

[10]

4 Energy Monitoring and Targeting

Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques – energy consumption, production, cumulative sum of differences (CUSUM). Energy Management Information Systems (EMIS).

5 Energy and environment, air pollution, climate change

United Nations Framework Convention on Climate Change (UNFCCC), sustainable development, Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), CDM Procedures case of CDM – Bachat Lamp Yojna and industry; Prototype Carbon Fund (PCF).

Text Books

1. Energy Technology Non-conventional, Renewable & Conventional, S. Rao, Dr. B.B.Parulekar, Khanna Publishers, Third Edition, Delhi – 2007.
2. Energy management Audit and conservation, Barun Kumar De, 2nd Edition, VrindaPublications P Ltd.,2014.
3. Energy Engineering and management, Amlan Chakrabarti, PHI Publication, 2011.

Reference Books

1. Energy Conservation Guidebook, Dale R Patrick, Stephen W Fardo, CRC Press, 2ndEdition.
2. Handbook of Energy Audits, Albert Thumann, The Fairmont Press, 6th Edition.
3. Bureau Energy Efficiency Reference book: No.1, 2, 3 4
4. Energy Management Handbook, W.C. Turner, John Wiley and Sons, A Wiley Inter science Carbon Capture and Sequestration: Integrating Technology, Monitoring, and Regulation edited by E J Wilson and D Gerard, Blackwell Publishing.

Web Resources:

1. http://shodhganga.inflibnet.ac.in/bitstream/10603/46067/11/11_chapter%201.pdf
2. <http://lab.fs.uni-lj.si/kes/erasmus/Energy%20Management%20Handbook.pdf>
3. <https://nptel.ac.in/courses/108106022/#>

MOOCs:

1. Energy management systems: <https://nptel.ac.in/courses/108106022/>
2. Energy systems Engineering: <https://swayam.gov.in/courses/5286-energy-systems-engineering>
3. Energy and Development <https://www.edx.org/course/energy-and-development-1>

SEMESTER-V

Subject: Metrology and Instrumentation (PCC)								
Program: B. Tech. (Mechanical)				Subject Code: ME0512			Semester: V	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
2	0	2	3	16/40	16/40	24/60	24/60	200

Course Objectives:

1. To understand basic concept of measurement, metrology and instrumentation.
2. To understand the working of linear and angular measuring instruments.
3. To understand the various temperature and pressure measurement techniques.
4. To provide basic idea about various methods for measurement of screw thread, gear measurements and surface finish parameters.
5. To give an exposure to measurement of straightness, flatness, squareness and parallelism.

Course Outcomes:

1. After successful completion of course students would be able
2. To describe basic concept of measurement, metrology and Instrumentation.
3. To use various linear and angular measuring instruments for engineering
4. applications.
5. To select appropriate instruments for temperature and pressure measurement for various applications.
6. To evaluate quality of surface finish parameter and can measure screw thread and gear tooth.

COURSE CONTENT**UNIT-1****[07]****1 Introduction to Metrology and Instrumentation:**

Meaning, necessity and objectives of Metrology and Instrumentation; Standards of measurement; Elements of measuring system; Methods of Measurement; Sources of Errors; Selection and care of instruments, Generalized Measurement system; Performance Characteristics –static & dynamic characteristics of instruments.

2 Straightness, Flatness, Squareness, Parallelism:

Introduction; Measurement of Straightness, Flatness, Squareness and Parallelism; run out and concentricity; tool makers microscope; Interferometer & its use in checking flatness, surface contour, parallelism etc.; Interferometers & optical flats

UNIT-2

[07]

3 Temperature Measurement:

Introduction; Methods of temperature Measurement; Expansion thermometers; Filled System thermometers; Pyrometers; Calibration of temperature measuring instruments.

4 Pressure Measurement:

Introduction; methods of pressure measurement; Manometers; Elastic pressure transducers; Measurement of Vacuum; Force balance pressure gauges; Electrical pressure transducers; pressure switches; Calibration of pressure measuring instruments.

UNIT-3

[08]

5 Linear Measurements

Introduction & classification of Linear Measuring Instruments; Least count; Engineer's Steel rule; Calipers; Vernier Caliper: working principle, construction, types & precautions to be taken; Vernier Height Gauge; Vernier Depth Gauge, Micrometers: principle, construction, Sources of errors and precautions to be taken, types of micrometers, Miscellaneous linear measuring instruments like Bore gauge, Telescopic gauge, slip gauges, Dial indicators: construction & working; comparators; calibration of various linear measuring instruments; Applications, Advantages & Limitations of commonly used linear measuring instruments.

6 Screw Thread and Gear Measurements:

Introduction & Elements, Specification & forms of Screw Threads; Various Methods for measuring elements of External & Internal Screw Thread; Screw Thread, Gauges; Errors in Threads; Gear tooth terminology; Measurement and testing of spur gear: Various methods of measuring tooth

UNIT-4

[08]

7 Angular and Taper Measurements:

Introduction; Working principle & construction of Angular Measuring instruments like Protractors, Sine bars, Sine centre, Angle gauges, Spirit level, Clinometers, angle dekkor, Applications, Advantages & limitations of commonly used angular measuring instruments; Taper Measuring instruments: Measurement of taper shafts & holes.

8 Measurement of Surface Finish:

Introduction; Surface Texture; Methods of Measuring Surface finish- Comparison

Methods & Direct Instrument Measurement; Sample Length; Numerical Evaluation of Surface Texture; Indication of Surface roughness Symbols used; Adverse effects of poor surface finish.

Text Books:

1. Mechanical Measurements and Instrumentation (Including Metrology and Control Systems)", R.K. Rajput, S.K. Kataria & Sons publication.
2. Mechanical Measurement and Metrology", R K Jain, Khanna Publishers.
4. Industrial Instrumentation & Control", S K Singh, Tata McGrawHill.
5. Mechanical Measurement & Control", D.S. Kumar, Metropolitan Book Pvt Ltd.

Reference Books:

1. Metrology and Measurement", A K Bewoor, V A Kulkarni, McGraw Hill Publication
2. Instrumentation, Measurement and Analysis", B C Nakra, K KChaudhary, TataMcGrawHill Publication
3. Measurement and Instrumentation – Trends and Application", M K Gosh, S Sen, SMukhopadhyay, Ane Books Pvt Ltd.

Web resources:

1. <https://nptel.ac.in/courses/112106179/>
2. <https://nptel.ac.in/courses/112106138/>

LIST OF EXPERIMENTS

1. Introduction to Metrology and Instrumentation.
2. Measuring by vernier calipers.
3. Measuring by outside micrometer.
4. Measuring of internal bores by inside micrometer.
5. Calibration of vernier caliper and micrometer using slip gauge.
6. Measurements using vernier height gauge and vernier depth gauge.
7. Taper angle measurement using sine bar.
8. Measurement of angle using vernier bevel protractor.
9. Surface roughness measurement.
10. Screw thread measurement.

Subject: Production Technology (PCC)								
Program: B. Tech. (Mechanical)				Subject Code: ME0513			Semester: V	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
3	0	2	4	16/40	16/40	24/60	24/60	200

Course Objectives:

1. To provide the fundamental knowledge and principles in material removal processes.
2. To provide the fundamental knowledge and principles in gear manufacturing.
3. To provide the basic knowledge of press tool and jig-fixturedesign.
4. To develop an ability to design and conduct experiments.
5. To develop an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
6. To develop an understanding of professional and ethical responsibility.

Course Outcomes:

1. Able to understand the concept of metal removal and modern manufacturing trends.
2. Able to select cutting tool materials and tool geometries for different metals.
3. Able to design and develop the press tool and jig-fixturedesign.
4. Able to select appropriate machining processes and conditions for different metals.
5. An ability to learn machine tool structures and design.
6. Able to balance between machining efficiency and machining cost based on machining economics.

COURSE CONTENT

UNIT-1

[09]

1 Gear and Threads Manufacturing

Different types of Threads Manufacturing methods and tools involved, Different gear forming and generating methods with their special features, Gears finishing processes.

	UNIT-2	[11]
2	Jigs & Fixtures Definition, its usefulness in mass production, design principles, locating systems and types of locators & clamps, jig bushes, design of jigs and fixtures for various machining operations.	
	UNIT-3	[12]
3	Presses and Press Work Classification of presses, Classification of dies, cutting actions in dies, clearance, cutting forces, center of pressure design of press tools, methods of mounting of punches, scrap reduction, strip layout.	
	UNIT-4	[13]
4	Theory of Metal Cutting Principles of metal machining, cutting tools and tool materials, tool signature, mechanics of chip removal, cutting forces and parameters effecting it, cutting fluids, tool wear, tool life, economics of machining. Multi point cutting tools, temperature measurement at tool-work interface and its effects.	

Text Books:

1. A Text Book of Production Technology, P.C. Sharma – S. Chand and Company Ltd., New Delhi.
2. Production technology, by R.K. Jain, Khanna publishers.
3. Production Technology by O.P. Khanna, Dhanpat Rai publishers.
4. Tool Design by Donaldson, Tata McGraw Hill Pub.

Reference Books:

1. Manufacturing Science, by A. Ghosh & A.K. Malik – East West Press Pvt. Ltd., New Delhi
2. Fundamentals of machining and machine tools, by Boothroyd -CRC publication
3. Metal Cutting principles, by M C Shaw, Oxford University press.
4. Production Technology, by R.K. Jain, Khanna Pub.
5. Production Technology, - H.M.T. By HMT.

Web resources:

1. Metal Cutting and Machine Tools, NPTEL, https://onlinecourses.nptel.ac.in/noc18_me14/preview
2. Jigs and Fixtures, NPTEL, <https://nptel.ac.in/courses/112105126/34>.
3. Press Working, <http://ignou.ac.in/upload/bme059unit-3.pdf>

LIST OF EXPERIMENTS

1. To study and observe various stages of casting through demonstration of sandcasting process.
2. To determine AFS fineness number of given sand sample.
3. To demonstrate the working of sand Muller.
4. To prepare a standard specimen under identical conditions for checking important physical properties of foundry sand.
5. To determine clay percentage of given sand sample by wash and weight method.
6. To determine the moisture content in molding sand.
7. To determine permeability number of green sand, core sand and raw sand.
8. To find out the hardness of baked or dried cores made up of core sands and resin sands.
9. To study effect of types of joint and welding current on tensile properties of SMAW welded plate of mild steel.
10. To study various metal forming techniques and demonstration of deep drawing process on hydraulic press.
11. To study different types of super finishing processes and demonstration of grinding and buffing techniques.
12. To study different types of plastic material and their molding methods.

Subject: Internal Combustion Engine (PCC)								
Program: B. Tech. (Mechanical)				Subject Code: ME0514			Semester: V	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
3	0	2	4	16/40	16/40	24/60	24/60	200

Course Objectives

1. To make students familiar with the basics of combustion and thermodynamic analysis of a spark ignition engine and compression ignition engine.
2. To understand about actual Otto and Diesel cycles.
3. To provide knowledge of combustion process in the combustion chamber.

Course Outcomes

1. Student will learn automobile engine working, valve timing and associated systems such as lubricating system, cooling system, fuel feed system, ignition system etc., their necessity, requirements, construction details, different types and their working
2. Basic concept of combustion in Spark ignition engine and Compression ignition engine, Pressure Vs crank angle diagrams, Knocking, Detonation and pre-ignition
3. Analyze the performance and testing of I.C. Engine
4. Heat balance sheet and performance characteristics will be learnt by students

COURSE CONTENT

UNIT-1

[10]

1 Introduction

Applications, actual working of IC engines, valve and port timing diagrams.

2 Fuel Air Cycles, Actual Cycles and Their Analysis:

Factors considered and assumptions made for fuel–air cycles, dissociation, comparison of air standard and fuel air cycles, Difference between actual cycle and fuel air cycle for SI and CI engines. Effect of variable specific heats on air standard cycles of Otto and diesel cycles.

UNIT-2

[12]

3 Combustion in S.I. Engines

Stages of combustion, ignition lag and the factors affecting the ignition lag, flame propagation and factors affecting flame propagation, abnormal combustion and knocking in SI engines, factors affecting knocking, effects of knocking, control of knocking, combustion chambers for S.I. engines.

4 Combustion in C.I. Engines

Stages of combustion, delay period /ignition lag and the factors affecting it, detonation in C.I. engines, factors affecting detonation, controlling detonation, combustion chambers for C.I. engines.

5 Properties of I.C. Engine Fuels

Desirable properties of I.C. engine fuels, required qualities of S.I and C.I engine fuels, rating of S.I and C.I. engine fuels, HUCR, dopes/additives for S.I. & C.I. engines, use of alternate fuels like CNG, LNG, LPG, vegetable oils, biodiesel, alcohol, biogas and hydrogen for IC engines.

UNIT-3

[12]

6 Engine Testing

Aims of engine testing, measurement of indicated power, brake power, friction power, speed, air consumption, fuel consumption. IC engine efficiencies, specific output, specific fuel consumption, heat balance sheet, performance characteristics of SI and CI engines, testing of IC engines as per Indian standard 10001.

7 Supercharger& Turbocharger

Objects, types of superchargers. Supercharging of SI and CI engines, effects of supercharging, supercharging limits, methods of supercharging, turbo charging.

8 Emission Control

Emission of pollutants from SI & CI engines, control of emissions from SI and CI engines, measurement of pollutants in exhaust gases, emission (Euro & Bharat stage) norms. Working principle of Stirling and Wankle.

UNIT-4

[12]

9 Fuel Supply Systems for S.I Engines

Fuel supply system for SI engines, properties of air-petrol mixture, mixture requirement for different loads and speeds, simple carburetor and its working, calculation of air-fuel ratio, types of carburetors, limitations of a single jet carburetor, modern carburetors, problems in carburetors, altitude compensation, gasoline injection in SI engines, mpfi system for modern automobile engines.

10 Fuel Supply Systems for C.I Engines

Fuel supply systems for C.I. engines: Requirement of ideal injection system, types of injection systems, fuel pumps and injectors, types of nozzles, spray formation, quantity of fuel and size of nozzle orifice.

Text Books

1. A course in Internal combustion engines by V.M.Domkundwar, Dhanpat rai &Co.(p) ltd,New Delhi, 2017.
2. Internal combustion engines by Mathura & Sharma, Dhanpat rai & Sons, New Delhi,2014.
3. Internal combustion engines by V.Ganeshan, Tata McGraw hill pub .co .ltd., New Delhi,

Reference Books

1. Internal combustion engines by RamalingamScitechpub. india Pvt. Ltd., Chennai, 2011.
2. Internal combustion engines by H.N.Gupta, PHI Learning, NewDelhi, 2011.
3. Internal combustion engines by B.L.Singhal Tech-maxpublications,Pune, 2012.
4. Internal combustion engines by Nicole Maden, Published by Clanrye International, 2015

Web Resources

1. <https://nptel.ac.in/courses/103105110/m5l40.pdf>
2. <https://nptel.ac.in/downloads/112104033/>
3. <https://lecturenotes.in/subject/256/ic-engine-ice>

MOOCS

1. NPTEL course lecture IC engine and Gas Turbine:
<https://nptel.ac.in/courses/112103262/>
2. Lecture link for Mechanical subject
<http://videos.gitam.edu/nptel/mechanical.html>
3. NPTEL course lecture IC engine: <https://nptel.ac.in/courses/101101001/28>

LIST OF EXPERIMENTS

1. To study about Fuel supply system for S.I. Engine
2. To Study fuel supply system for C.I Engine.
3. To study about Supercharging and Turbocharger
4. To study about combustion in S.I & C.I Engines.
5. Measurement of emissions from I.C. engine.
6. Performance on Single Cylinder Diesel engine test rig.
7. Performance on two stroke single cylinder Petrol engine test rig.
8. Performance of Multi cylinder Petrol engine test rig using throttle system
9. Performance of Multi cylinder Petrol engine test rig using MPFI system
10. Performance on Multi cylinder Diesel engine test rig

Subject: Design of Machine Elements (PCC)								
Program: B. Tech. (Mechanical)				Subject Code: ME0515			Semester: V	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
3	0	2	4	16/40	16/40	24/60	24/60	200

Course Objectives

1. To develop an ability to design any mechanical component subjected to fluctuating loads.
2. To develop an ability to understand and applications of various theories of elastic failures.
3. To develop an ability to design lever, shaft, keys, couplings, ropes, pulleys, belts, pulley systems etc.
4. To design various material handling equipments.

Course Outcomes

1. To estimate the fatigue strength and life of any mechanical components under fluctuating loads
2. To apply appropriate theories of elastic failures as per application
3. To design mechanical components like shaft, lever, couplings, key, pulley, belts, ropes etc.
4. To carry out static and dynamic analysis of various mechanical components
5. To draft assembly of mechanical systems in AutoCAD

UNIT-1

[04]

Theories of Failure

Maximum Principal Stress theory, maximum Shear Stress theory, strain energy theory, shear strain energy, Maximum Principal strain energy.

UNIT-2

[10]

Design Against Fluctuating Loads

Stress concentration, determination of stress concentration factor, reduction of stress concentration effects, fluctuating stresses, fatigue failure, endurance limit, notch sensitivity, reversed stresses- design for finite and infinite life, cumulative damage in fatigue, Soderberg and Goodman diagrams, modified Goodman diagrams, fatigue design under combined stresses.

UNIT-3

[12]

Design of Shafts

Design of solid and hollow shaft for transmission of torque, bending moment and axial forces, Design of shaft for critical speed, design of shaft for rigidity and stiffness.

Design of Keys and Couplings

Design and drawing of different types of keys & Couplings, Rigid coupling, Flange Coupling, Flexible coupling- Oldham, Universal coupling

Levers

General Procedure for design of levers, design of lever for safety valve, design of bell crank lever, design of rocker arm for exhaust valves

UNIT-4

[10]

Design of Material Handling System

Introduction, M.H. system design principles, factors for selection of M.H. equipment, Design of belt, rope and chains, Pulley Design, Hook design, pulley system design, Design procedure of Sheaves and Drums

Text Books

1. Design of Machine Elements, V. B. Bhandari, Tata McGraw Hill Publishing Co, 4th Edition.
2. Design of Machine Elements, M. F. Spotts, T.E.Shoup, L.E.Hornberger, S. R. Jayaramand
C.V. Venkatesh, Pearson Education, 3rd edition.
3. Mechanical Engineering Design, Joseph Shigley, Tata McGraw Hill Book Co., 3rd edition

Reference Books

1. Standard Handbook of Machine Design, Joseph Shigley, Charles Mischke, Thomas Brown, McGraw-Hill Publishing Co, 3rd edition
2. Machine Design: An Integrated Approach, Norton and Norton, Pearson Publication, 4th edition
3. Machine Design - Volume 1, 2, Farazdak Haideri, NiraliPrakashan, 3rd edition
4. Machine Design, Dr. S.S. Wadhwa, Dhanpat rai & Co, 4th edition
5. Machine Design, P. C. Sharma & Aggarwal, Katariya & Sons, 5th edition

Web resources

1. www.nptel.ac.in
2. www.learnengineering.org
3. <http://www.freestudy.co.uk/>

MOOCS

1. Machine Design Part I (Coursera), <https://www.mooc-list.com/course/machine-design-part-i-coursera>
2. Mechanical Engineering (MIT open courseware), <https://ocw.mit.edu/courses/mechanical-engineering/>
3. Design Courses (edX), <https://www.edx.org/course/subject/design>

List of Practical

1. Drawing of Couplings
2. Drawing of Pulley, pulley systems and hooks
3. Drawing of any one material handling system
4. Drafting of assembly of any one type of material handling system using AutoCAD
5. single plate clutch
6. Drawing of Centrifugal clutches
7. Drawing of Internal Expanding Brake
8. Drawing of Band & Block brake
9. Drafting of assembly of any one type of Brake/Clutch system using AutoCAD

Subject: Entrepreneurship Development (ES)								
Program: B. Tech. -Mechanical Engg.				Subject Code: ME0511			Semester : V	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
2	0	0	2	24/60	-	16/40	-	100

Course Objective:

1. To introduce the concept of Entrepreneur and Entrepreneurship in the mind of participants with reference to process of economic and industrial development of the country.
2. To involve participants in relevant interrelated field based project work or studies of entrepreneurs' promotional policies of the government and other developmental agencies, financial institutions including banks and central government policies to develop target group as entrepreneurs.

Course Outcome:

1. Understanding of various aspects related to entrepreneurship.
2. To understand the process of Entrepreneurial process and decisions as typical managerial decision

Course Content

Unit-I

- Entrepreneur and Entrepreneurship
- Indian entrepreneurship
- Women Entrepreneurship

Unit-II

- Factors Affecting Entrepreneurship Growth
- Entrepreneurship Motivation
- Entrepreneurship Competencies

Unit-III

- Micro and Small Enterprises
- Opportunity Identification and Selection
- Formulation of Business Plans
- Project Appraisal

Unit-IV

- Financing of Enterprise
- Forms of Business Ownership
- Institutional Finance to Entrepreneurs

Text Books:

- Entrepreneurial Development by Dr. S.S. Khanka S Chand Publication
- Entrepreneurship Development (Obstacles & Solutions) by Dipesh D. Uike Himalaya Publication

Reference Books:

- Entrepreneurship Management: By Aruna Kaulgud
- Essentials of Entrepreneurship & Small Business Management: By Thomas & Norman
- Dynamics of Entrepreneurship & Management: By Vasant Desai.
- Entrepreneurship: Resources & Strategies: by Marc J. Dollinger

Subject: Total Quality Management (PE-2)								
Program: B. Tech. (Mechanical)				Subject Code: ME0516			Semester: V	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
3	0	0	3	16/40	-	24/60	-	100

Course Objectives:

1. Understand the concept of total quality management
2. Learn the selection and application techniques of TQM.
3. Understand the cost of poor quality, effectiveness and efficiency of TQM
4. To understand and learn seven QC tools.
5. To learn about ISO 9000, 9001, 14000

Course Objectives:

1. Students will be able to understand basic concept of Total Quality Management
2. Select & apply appropriate techniques in identifying customer needs as well as quality impact that will be used as inputs in TQM Methodologies.
3. Measure the cost of poor quality and process effectiveness and efficiency to track performance quality and to identify areas for improvement
4. Understand proven methodologies to enhance management processes, such as benchmarking and business process reengineering

COURSE CONTENT

UNIT-1

[09]

Introduction

Introduction – Need for quality – Evolution of quality – Definitions of quality – Dimensions of product and service quality – Basic concepts of TQM – TQM Framework – Contributions of Deming, Juran and Crosby – Barriers to TQM – Customer focus – Customer orientation, Customer satisfaction, Customer Complaints, and Customer retention.

UNIT-2

[11]

TQM Principles

Leadership – Quality Statements, Strategic quality planning, Quality Councils – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal – Continuous process improvement – PDCA cycle, 5S, Kaizen – Supplier partnership – Partnering,
Supplier selection, Supplier Rating.

UNIT-3

[12]

TQM Tools and Techniques

The seven traditional tools of quality – New management tools – Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types. Quality Circles – Cost of Quality – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures.

UNIT-4

[13]

Quality Management System

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards— Sector-Specific Standards—AS 9100, TS16949 and TL 9000— ISO 9001 Requirements—Implementation— Documentation—Internal Audits—
Registration- Environmental Management System: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001— Requirements of ISO 14001—
Benefits of EMS.

Text Books:

1. Dale H. Besterfield, Carol B. Michna, Glen H. Besterfield, Mary B. Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, —Total Quality Management, Pearson Education Asia, Revised Third Edition, Indian Reprint, Seventh Impression, 2018.
2. Quality management, R. Paneerselvam, P Sivasankaran, PHI publication>, Delhi, 2014
3. Suganthi.L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd., 2006.

Reference Books:

1. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, 8th Edition, First Indian Edition, Cengage Learning, 2012.

2. Janakiraman. B and Gopal .R.K., “Total Quality Management – Text and Cases”, Prentice Hall (India) Pvt. Ltd., 2006. ISO9001-2015 standards
3. Total Quality Management: Key Concepts and Case Studies 1st Edition, D.R Kiran, Butterworth-Heinemann; 1 edition (November 15, 2016)
4. Juran's Quality Handbook: The Complete Guide to Performance Excellence, Seventh Edition 7th Edition, Kindle Edition, Joseph A. DeFeo, Joseph M. Juran; McGraw-Hill Education; 7 edition (November 11, 2016)

Web resources:

1. <https://asq.org/quality-resources/total-quality-management>
2. <https://managementhelp.org/quality/total-quality-management.htm>
3. www.netugc.com/total-quality-management-tqm

Subject: Power Plant Engineering (PE-2)								
Program: B. Tech. (Mechanical)				Subject Code: ME0517			Semester: VI	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
3	0	0		16/40	-	24/60	-	100

Course Objectives

1. To provide an overview of Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance
2. To introduce students to different aspects of power plant engineering
3. To familiarize the students to the working of power plants based on different fuels.
4. To expose the students to the principles of safety and environmental issues

Course Outcomes

1. Understand the different power generation methods, its economics and global energy situation
2. Apply the basic thermodynamics and fluid flow principles to different power generation methods
3. Analyze thermodynamic cycles of steam power plant and understand construction, working and significance of its various systems
4. Analyze thermodynamic cycles of gas turbine power plant, nuclear power plant and diesel power plant

COURSE CONTENT

UNIT-1

[08]

Thermal Power Plant:

General layout of modern thermal power plant, Site selection, Presents status of power generation in India.

High Pressure Boilers & Accessories:

Unique features and advantages of high pressure boilers, La-Mont, Benson, Loeffler, Schmidt- Hartmann, Velox, supercritical, Supercharged and fluidized bed combustion boiler. Different types of super-heaters, Re-heaters, economizers, Air pre- heaters, Methods of superheat control, Corrosion in boilers and its prevention.

UNIT-2

[08]

Coal & Ash Handling Systems:

Coal handling storage of coal, Burning systems, Types of stokers their working, Pulverized fuel handling systems, Unit and central systems, Pulverized mills- ball mill, Bowl mill, Ball & race mill, Impact or hammer mill, Pulverized coal burners, Oil burners. Necessity of ash disposal, Mechanical, Hydraulic, pneumatic and steam jet ash handling system, Dust collection and its disposal, Mechanical dust collector, Electrostatic precipitator.

Draught System:

Natural draught- estimation of height of chimney, Maximum discharge, Condition, Forced, Induced and balanced draught, Power requirement by fans.

UNIT-3

[10]

Diesel Power Plant:

Essential components of diesel power plant, Different systems like fuel supply system, Engine cooling system, Engine lubrication system, Exhaust system, Engine starting and stopping system.

Nuclear Power Plant:

Nuclear fusion and fission, Chain reaction, Nuclear fuels, Components of nuclear reactor, Classification of reactors, Pressurized water reactor, Boiling water reactor, Gas cooled reactor, CANDU reactor, Fast breeder reactor, Nuclear waste and its disposal, Nuclear power plants in India.

UNIT-4

[10]

Condensers and Cooling Towers:

Types of condensers, sources of air in condenser, Effects of air leakage, Methods of obtaining maximum vacuum in condenser, Dalton's law of partial pressure, vacuum & condenser efficiency, Mass of cooling water required, Air Pump- Edward air pump. Necessity of cooling ponds and cooling towers, Condenser water cooling systems, Types of cooling towers, cooling ponds.

Economics of Power Generation:

Load curves, Load duration curves, connected load, Maximum load, Peak load, base load and peak load power plants, Load factor, Plant capacity factor, Plant use factor, Demand factor, Diversity factor, cost of power plant, Performance and operating characteristics of power plant, Tariff for electric energy, Power plant engineering software-design, construction, operation and life cycle analysis.

Text Books

1. A Course in Power Plant Engineering, Arora S.C and Domkundwar S, Dhanpat Rai

Publication, 3rd edition, New Delhi, 2016

2. Power Plant Engineering, Nag P.K, Tata McGraw- Hill, 4th edition, New Delhi ,
3. Introduction to Power Plant technology, G.D.Rai, Khanna Publishers, 3rd edition, Delhi, 2016

Reference Books

1. Power Plant Technology, El-Wakil M.M, Tata McGraw-Hill, 1st edition, New Delhi ,
2. Power Plant Engineering, K. K. Ramalingam, Scitech Publications, 2nd edition, New Delhi, 2002
3. Practical Boiler Operation Engineering and Power Plant, Amiya Ranjan Mallick, PHI Learning, 4th edition, Delhi, 2014
4. Power Plant Engineering, C. Elanchezian, and B. Vijaya Ramnath, I K International Publishing House Pvt. Ltd, 2nd edition, Delhi, 2018
5. Power Plant Engineering, G. R. Nagpal, Khanna Publishers, 4th edition, Delhi, 2010
6. Practical Structural Modelling with AECOSim Building Designer, Daniel Heselwood, Nigel Davies, Bentley Institute Press, 2014.

Web resources

1. <https://nptel.ac.in/courses/112107216/>
2. <https://nptel.ac.in/courses/112103243/>
3. <https://nptel.ac.in/courses/115106087/>

MOOCS

1. The Science of Nuclear Energy, <https://www.mooc-list.com/course/science-nuclear-energy-futurelearn>
2. Solar Energy: Photovoltaic (PV) Energy Conversion, <https://www.mooc-list.com/course/solar-energy-photovoltaic-pv-energy-conversion-edx>
3. Energy Principles and Renewable Energy, <https://www.mooc-list.com/course/energy-principles-and-renewable-energy-edx>.

Subject: Design for X (DFX) [PE-2]								
Program: B. Tech (Mechanical)				Subject Code: ME0518		Semester: V		
Teaching Scheme				Examination Evaluation Scheme (Marks)				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total
3	0	0	3	16/40	-	24/60	-	100

Course Objectives:

- 1.To educate students on factors to be considered in designing parts and components with focus on manufacturability, assembly, safety, cost, materials.
- 2.To expose the students to dimensional tolerances, geometric tolerances and true position tolerance techniques in manufacture.
- 3.To impart the knowledge on design considerations for designing components produced using various machining operations like turning, drilling, milling, grinding etc.
4. To educate the students on design rules and recommendations for processes like casting,welding, forgings powder metallurgy and injection molding.

Course Outcomes:

1. Describe the different types of manufacturing systems and compare their suitability for economic production of various components and products.
2. Identify factors and causing mechanisms of the defects likely to occur with different manufacturing processes in producing mechanical products and the relevant design approaches to rectify them.
3. To define proper assembly of various parts at conceptual level
4. Select proper materials and manufacturing processes for designing products/components by applying the relevant principles for ease and economic production.
5. To understand legal expect and ethical practicing for design

COURSE CONTENT

UNIT-1

[08]

Design with Materials

Introduction, Design for Brittle Fracture, Design for Fatigue Failure, Design for

Corrosion Resistance, Design against Wear

UNIT-2

[12]

Design for Manufacturing (DFM)

Role of Manufacturing in Design, Manufacturing Functions, Classification of Manufacturing Processes, Manufacturing Process Selection, DFM Guidelines, Specific Design Rules, Design of Castings, Design of Forgings, Design for Sheet-Metal Forming, Design of Machining, Design of Welding, Residual Stresses in Design, Design for Heat Treatment

UNIT-3

[10]

Design for Assembly (DFA)

Introduction, DFA Guidelines, Role of Standardization in DFMA, Computer Methods for DFMA, DFA Analysis, Interchangeable part manufacture and selective assembly, group tolerance of mating parts equal

Risk, Reliability, and Safety

Introduction, Probabilistic Approach to Design, Design for Reliability, Failure Mode and Effects Analysis (FMEA), Design for Safety

UNIT-4

[08]

Cost Evaluation

Introduction, Activity-Based Costing, Methods of Developing Cost Estimates, Refinements to Cost Analysis Methods, Design to Cost

Legal and Ethical Issues in Engineering Design

Introduction, Product Liability, Legal and Ethical Domains, Protecting Intellectual Property, Solving Ethical Conflicts, Case study

TEXTBOOKS:

1. Peck, H. "Designing for Manufacture", Pitman Publications, London, 1983.
2. Dieter, G.E. "Engineering Design: A Materials and processing Approach", McGraw Hill Co.Ltd, 2000.
3. Bralla, James G., "Handbook of Products Design for Manufacturing: A Practical Guide to Low-cost Production", McGraw Hill, New York, 1986.

REFERENCES:

1. Eggert, R.J. "Engineering Design" Pearson Education, Inc., New Jersey, 2005.
2. Matousek , R. "Engineering Design", Blackie and Son Limited, Glasgow, 1967.
3. Kalandar Saheb, S.D and Prabhakar, O. "Engineering Design for Manufacture", ISPE 1999.
4. Trucks, H.E., "Design for Economical Production", 2nded., Mich., Dearborn, SME 1987.
5. Linberg, Roy A., "Processes and Materials of Manufacture", 4thed., Allyn and Bacon, Boston, U.S.A., 1990.

Subject: Introduction to Robotics (OE-6)								
Program: B. Tech. Mechanical Engineering				Subject Code: ME0519			Semester: V	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
2	0	2	3	16/40	16/40	24/60	24/60	200

Course Objectives:

1. To be familiar with Evolution of robot, robotics and automation.
2. To educate the student with robot anatomy and Kinematics.
3. To Impart knowledge on robotics sensors, vision and actuators
4. To be familiar about Robot Programming methods & Languages of robot.
5. To give awareness about recent and futuristic trends of robotics and its applications.

Course Outcomes:

After study this course students will be able

1. Describe the different types robots, its anatomy and kinematics of motion.
2. Identify the needs and applications of sensors, vision devices and actuators in robots
3. Describe methods of programming a robot and recent advancement in robotics as well futurist trends of the technology.

COURSE CONTENT

UNIT-1

[04]

Introduction to Robotics

Definition and evolution of robots and robotics: History, Influence of mythology and motion pictures, Inventions leading to robotics, Laws of robotics, Progressive advancements in robots: robot in industry, robot in research laboratory, Necessity of automation, Applications of robot.

UNIT-2

[12]

Robot Anatomy & Kinematics

Robot generic structure and components, classification of robot, technical specification of robot, generic robot operations, freedom of motion, Coordinate frames, Mapping, Description of objects in space, Transformation of vectors, Inverting a homogeneous transform, Principal axis rotation. Fixed angle representation, Euler angle representation, and Equivalent angle representation.

UNIT-3

[10]

Robotic Sensors & Vision

Meaning of sensing, Role of sensors in robotics, classification and use of sensors in robotics, Robotic vision, Industrial application of vision-controlled robots, process of imaging, Image acquisition, representation and processing.

Robot Actuation

Control of manipulators, classification of robot actuators, Selection criteria of actuators, hydraulic,

pneumatic and electrical actuators.

UNIT-4

[06]

Robot Programming

Robot programming Environment, Online-offline programming, Programming languages, Programming activities, Programming methods, Programming functions.

Advancement in Robotics

Robot control using Artificial Intelligence: *Nano-robotics, chat-bots driver-less car, Unmanned Air Vehicle (UAV) and swarm drones*, Bio and prosthetic Robots, Exoskeleton, Advanced application of robots and automation in industry, medical, aerospace, military, etc., Future of robotics in futuristic world.

TEXTBOOKS:

1. Mittal R. K. "Robotics and Control", Tata McGraw Hill, New Delhi, 2003.
2. Robot dynamics & control by M W Spong & M. Vidhyasagar, John Wiley & Sons New York.
3. Automation and Robotics by Juan Manuel Ramos Arreguin, InTech 2008.

REFERENCES:

1. John. J. Craig, "Introduction to Robotics: Mechanics and Control", Pearson education
2. E. Rich, K. Knight and S. B. Nair, "Artificial Intelligence", Tata McGraw-Hill publication
3. A. Zilouchian and M. Jamshidi, "Intelligent control systems using soft computing methodologies", CRC Press.

List of Practical

Sr. No.	Title of Practical
1	To study about introduction to robotics
2	To study about robot anatomy
3	To study about kinematic of robot motions
4	To study about different sensors used in robots
5	To study about different actuators used in robots
6	To study about robotic vision
7	To study about Programming methods applied for robot programming
8	To study about recent scenario in robotics field
9	To study about role of Artificial Intelligence in robotic application
10	A case study: An application of robotic technology in recent and futuristic world.

Subject: Non-Conventional Energy Sources (OE -7)								
Program: B. Tech. (Mechanical)				Subject Code: ME0520			Semester: V	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
2	0	2	3	16/40	16/40	24/60	24/60	200

Course objectives

1. To understand various forms of Non-Conventional Energy sources
2. To make students aware of present energy scenario & need for energy conservation
3. To know about utilization of renewable energy sources for domestic & industrial purposes.
4. To analyze environmental aspects of Non-Conventional Energy sources.

Course Outcomes

1. To understand ways of energy production by various unconventional energy sources
2. Recognize the need and ability to engage in lifelong learning for further developments in this field.
3. Students will be able to identify new methodologies/ technologies for effective utilization of Non-Conventional Energy Sources.

COURSE CONTENT

UNIT-1

[08]

1. Solar Energy

Extra-Terrestrial Radiation: Spectral distribution of extra-terrestrial radiation, solar constant, solar radiation at the earth's surface, beam, diffuse and global radiation, instruments for measuring solar radiation and sun shine, solar radiation data.

2. Solar Collectors

Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors, Transmission losses in the Cover, Testing of Solar Collectors.

UNIT-2

[04]

3. Wind Energy

Working Principle, Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria, Wind Measurements

UNIT-3

[04]

4. Biomass Energy

Origin of Biomass, Physical Methods of Bioconversion, Liquefaction of Biomass, Biological Methods for Biomass Conversion, Production of Ethanol, application of bio-gas, application of bio-gas in engines, advantages

UNIT-4

[08]

5. Tidal & Ocean Thermal Energy

Mechanism of Tides and waves as energy suppliers, fundamental characteristics of tidal power, harnessing tidal energy, limitations. Ocean Thermal Energy Conversion-Principle of working, Rankine cycle, OTEC power stations in the world, problems associated with OTEC, mini-hydel power plants, and their economics.

Text Books

1. "Non-Conventional Energy Sources", Rai G.D., Khanna Publishers, New Delhi, 1st edition,
2. "Non-Conventional Energy Sources", N K Bansal, Vikas Publishing House, New Delhi,
3. "Renewable energy sources and conversion technology", M. Kleemann, Tata McGraw Hill,

Reference Books

1. Solar Energy: Principles of Thermal Collection & Storage, S P Sukhatme, Tata McGraw Hill, New Delhi, 2nd edition, 2010.
2. Energy Technology: Non Conventional Renewable and Conventional, S Rao, B Parulekar, Khanna Publishers, New Delhi, 3rd edition, 1994.
3. Wind Energy Conversion Systems, Freris. L.L, Prentice Hall, UK, 1st edition, 1990 .
4. Non-Conventional Energy, Ashok V Desai, New Age International, New Delhi, 1st edition,
5. Introduction to Biofuels, David M Mousdale, Prentice Hall, UK, 1st edition, 1990.

Web resources

1. <https://lecturenotes.in/subject/57/non-conventional-energy-systems-nces>
2. <https://swayam.gov.in/courses/4894-july-2018-non-conventional-energy-resources>.
3. https://onlinecourses.nptel.ac.in/noc18_ge09.

MOOCS

1. Solar Energy Engineering and Technology, Swayam
2. Wind Resources for Renewable eenergies

<https://www.mooc-list.com/course/wind-resources-renewable->

3. Renewable Energy and Green Building Entrepreneurship,
4. Elements of Renewable Energy

LIST OF EXPERIMENTS:

1. Study of solar Energy
2. Study of solar radiation measuring instruments
3. Study of modern solar distillation or solar still.
4. Study of solar water pumping
5. Study the constructional various types solar cooker
6. Study about solar power generation and lighting
7. Study solar drying and solar pond system
8. Study of Wind energy
9. Study Thermochemical and Biochemical route of biomass energy conversion
10. Study of Tidal energy and Ocean thermal energy

Subject: Internship								
Program: B. Tech. (Mechanical)				Subject Code: ME0521			Semester: III	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuou sInternal Evaluation (CIE) Theory	Continuou sInternal Evaluation (CIE) Practical	Total Marks
0	0	0	2	NA	40/100	NA	NA	100

Note: At the end of 4th Semester – during summer break each student has to complete one month internship in the industry and submit certificate, report and appear for presentation in 5th semester.

SEMESTER-VI

Subject: Heat and Mass Transfer (PCC)								
Program: B. Tech. (Mechanical)				Subject Code: ME0621			Semester: VI	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
2	1	2	4	16/40	16/40	24/60	24/60	200

Course Objective

1. This course is designed to introduce a basic study of the phenomena of heat and mass transfer, to develop methodologies for solving a wide variety of practical engineering problems,
2. The subject will provide useful information concerning the performance and design of particular systems and processes like heat exchangers etc.
3. Course is designed to develop the ideology of problem solving techniques and methods in relation with heat conduction, convection and radiation.

Course Outcome

After learning the course the students should be able to:

1. Understand basic concept of heat transfer
2. Able to do basic calculations involving heat transfer as is typical for a mechanical engineer.
3. This includes conduction, convection and radiation heat transfer as well as heat exchanger design.
4. Apply scientific and engineering principles to analyze and design aspects of engineering systems that relate to conduction, convection and radiation heat transfer.

COURSE CONTENT

UNIT-1

[06]

1 Mass Transfer

Diffusion mass transfer, Fick's law of diffusion, steady state molecular diffusion, convective mass transfer, convective mass transfer correlation heat and mass transfer analogy.

UNIT-2

[08]

2 Thermal Radiation-Basic Relations

Absorptivity, reflectivity and transmissivity, black, white and grey body, emissive power and emissivity, laws of radiation – Planck, Stefan-Boltzmann,

Wein's displacement, Kirchoff, intensity of radiation and solid angle, Lambert's cosinelaw.

3 Radiation Exchange Between Surfaces

Radiation heat exchange between black bodies, radiation shield, electrical analogy.

UNIT-3

[10]

4 Conduction – Steady State

Fourier's law of heat conduction, derivation of generalized equation in Cartesian coordinates and its reduction to specific cases, three dimensional heat conduction equations in cylindrical and spherical co-ordinates, One dimensional steady state conduction, heat conduction through plane and composite walls, hollow and composite cylinders, hollow and composite spheres, electrical analogy, overall heat transfer coefficient, Critical thickness of insulation, Types of fin, heat flow through rectangular fin.

5 Conduction-Unsteady State (Transient)

Transient heat conduction- lumped heat capacity analysis, time constant, transient heat conduction in solids with finite conduction and convective resistances, Biot number.

UNIT-4

[10]

6 Forced and Free Convection

Newton's law of cooling, Dimensional analysis applied to forced and free convection, empirical correlations for free and forced convection, Continuity, momentum and energy equations, thermal and hydrodynamic boundary layer.

7 Heat Exchanger

Types, LMTD for parallel and counter flow exchanger, condenser and evaporator, overall heat transfer coefficient, effectiveness and number of transfer unit for parallel and counter flow heat exchanger, introduction to heat pipe, compact heat exchangers. Design parameters for radiator & water pump design, hoses, Thermostat Valve, Radiators Cap, Radiator fan, Radiator Fan shroud, Surge Tank. Design parameters and Synchronization of vehicular Engine cooling system for dissipation of heat generated in Engine. Cooling system trouble diagnosis

Text Books

1. Heat & Mass Transfer by R.K. Rajput, S. Chand & Co. New Delhi
2. Heat & Mass Transfer by P.K. Nag, Tata McGraw Hill, New Delhi.
3. Engineering Heat & Mass Transfer by M.M. Rathore, LaxmiPrakshan

Reference Books

1. Heat & Mass Transfer by R. C. Sachdeva, New Age International, New Delhi
2. Heat & Mass Transfer by Arora & Domkundwar, Dhanpatrai and Co., NewDelhi

3. Heat & Mass Transfer by Mills and Ganesan, Pearson Publication, New Delhi
4. Heat & Mass Transfer by B.K. Venkanna, PHI Learning, New Delhi.
5. Heat & mass transfer by D.S. Kumar, S.K. Kataria & Sons

Web resources:

1. <https://nptel.ac.in/courses/103103032/>
2. <https://nptel.ac.in/courses/112101097/>
3. <https://nptel.ac.in/courses/112101097/18>
4. [www.learnerstv.com/heat transfer lectures/](http://www.learnerstv.com/heat-transfer-lectures/)
5. <https://cosmolearning.org/mechanical-engineering/>

LIST OF EXPERIMENTS

1. To study fundamentals of heat transfer.
2. To determine thermal conductivity of insulating powder.
3. To determine the thermal conductivity of the given composite walls.
4. To measure convective heat transfer co-efficient and effectiveness of the fin under free & forced convection.
5. To determine heat transfer co-efficient by natural convection.
6. To determine heat transfer co-efficient by forced convection.
7. To determine Stephan Boltzmann constant experimentally.
8. To determine the emissivity of body.
9. To study of heat exchanger.
10. To study of mass transfer.

Subject: Dynamics of Machines (PCC)								
Program: B. Tech. (Mechanical)				Subject Code: ME0622			Semester: VI	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
2	1	2	4	16/40	16/40	24/60	24/60	200

Course Objectives

1. To Familiarity with common mechanisms used in machines and everyday life.
2. To design machine parts considering the dynamic situation.
3. To conduct a complete velocity, acceleration analysis of piston and connecting rod Mechanism.

Course Outcomes

1. Students will able to analyze effect of gyroscopic couple on vehicles, ships and aeroplanes.
2. Students will able to design flywheels for IC engines and punching press.
3. Students will able to apply fundamentals of dynamics analysis to various mechanical systems.

COURSE CONTENT

UNIT-1

[08]

1 Governors

Introduction, types of governors, centrifugal governors, spring loaded governors, sensitiveness of a governor, hunting, isochronisms, stability, effort and power of a governor, controlling force.

2 Gyroscope

Precessional angular velocity, angular acceleration, gyroscopic couple, effect of gyroscopic couple on aero plane, effect of gyroscopic couple on naval ships, stability of an four wheel vehicle , stability of a two wheel vehicle.

UNIT-2

[08]

3 Inertial Forces in Reciprocating Parts

Velocity and acceleration of the piston, forces on the reciprocating parts of an engine, equivalent dynamical system.

4 Turning Moment Diagram and Flywheel

Turning moment diagrams, fluctuation of energy and speed, coefficient of fluctuation of energy, coefficient of fluctuation of speed, energy stored in flywheel.

UNIT-3

[08]

5 Static Force Analysis

constraint and applied forces, static equilibrium, equilibrium of two and threeforce members, members with two force, equilibrium of four force members, force convection, free body diagram.

6 Dynamic Force Analysis

D' Alembert's Principles, equivalent of inertia force, dynamic analysis of four link mechanisms, dynamic analysis of slider crank mechanism, velocity and acceleration of piston, angular velocity and angular acceleration of connecting rod, engine force analysis, turning moment on crank shaft, dynamically equivalent system.

UNIT-4

[08]

7 Balancing

Introduction, static balancing, dynamic balancing, balancing of several rotating masses in single and in different planes. Primary and secondary unbalanced forces of reciprocating masses, Balancing of reciprocating masses, variation of tractive force, sway couple, hammer blow, balancing of inline engines.

8 Vibrations

Vibration terminology, Harmonic and periodic motions, Beats phenomenon, uses and effects, practical applications and current research trends, Free undamped vibrations using Newton's second law, D' Alembert's principles, Energy method, Rayleigh's method, free damped vibrations, logarithmic decrement, under damped, over damped and critically damped conditions.

Text Books

1. Shigley, J.E., and Uicker, J.J., Theory of Machines and Mechanisms, McGraw Hill International Editions, New York, Edition II, 2003.
2. Norton, R.L., Design of Machinery – An introduction to Synthesis and Analysis of Mechanisms and Machines, McGraw Hill International Editions, New York, Edition II, 2000.

Reference Books

1. Uicker, J.J. Jr., Pennock, G.R., and Shigley, J.E., Theory of Machines and Mechanisms, Oxford University Press, 2009.
2. Mabie, H.H., and Reinholtz, C.F., Mechanisms and Dynamics of Machinery, 4d ed., John Wiley & sons, 1987.

3. Ghosh, A, and Mallik, A.K., Theory of Mechanisms and Machines, 3d ed., Affiliated East- West Press, 1998.
4. Holowenko, A.R., Dynamics of Machinery, John Wiley & Sons, 1965.
5. Waldron, K. J., and Kinzel, G. L., Kinematics, Dynamics and Design of Machinery, John Wiley & Sons, Inc., 2004.
6. Norton, R.L., Design of Machinery, Tata McGraw-Hill, 2004.
7. Rattan, S.S., Theory of Machines, 3d ed., Tata McGraw-Hill, 2009.
8. Nikravesh, P.E., Planar Multibody Dynamics, CRC Press, 2008.
9. Thomson, W.T., Dahleh, M.D., and Padmanabhan, C, 5d ed., Theory of Vibrations with Applications, Pearson Education, 2008.
10. Meirovitch, L., Elements of Vibration Analysis, 2d ed., McGraw-Hill, 2007.
11. Den Hartog, J.P., Mechanical Vibrations, 4d ed., McGraw-Hill, 1985.

Web resources

1. <https://nptel.ac.in/courses/112104114/>
2. <https://nptel.ac.in/downloads/112101096/>

MOOCS

1. <https://onlinecourses.nptel.ac.in>

List of Experiments

1. To study Porter Governor and verify experimentally.
2. To study Proell Governor and verify experimentally.
3. To study Hartnell Governor and verify experimentally.
4. To find radius of gyration of component suspended on two ends (Bifilar suspension).
5. To find radius of gyration of component suspended on three points (Trifilar Suspension).
6. Study of Gyroscope and its effect and to verify experimentally.
7. To study the principal method of Static balancing.
8. To study and experimentally validate dynamic balancing system.
9. To study static force analysis of a mechanism.
10. To study dynamic force analysis.

Subject: Machine Design - I								
Program: B. Tech. (Mechanical)				Subject Code: ME0623			Semester: VI	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
2	0	2	3	16/40	16/40	24/60	24/60	200

Course Objectives

1. To develop an ability to design mechanical springs, clutch, brakes and Pressure vessels.
2. To develop an ability to design coil springs (compression, tension and torsion) under various loading conditions.
3. To learn to draft 3D model of mechanical part in AutoCAD or any other 3D software

Course Outcomes

1. To apply appropriate theories of elastic failures as per application
2. To design mechanical components like springs, clutches, brackes, Pressure vessels
3. To select type of spring, clutch and brake based on application
4. To carry out static and dynamic analysis of various mechanical components
5. To draft 3D model of any component in AutoCAD or other 3D software

UNIT-1

[06]

Mechanical Springs

Helical springs – stress and deflection equation, spring materials, design against static load and fluctuating load, optimum design of helical springs, helical torsion springs, multi-leaf springs, nipping of leaf spring

UNIT-2

[06]

Clutches

Classification, positive clutches, friction clutches, material for friction surfaces, types of friction clutches, considerations in designing a friction clutch, single disc or plate clutch, design of a disc or plate clutch, multiple disc clutch, cone clutch

and centrifugal clutch, Energy equation and thermal consideration

UNIT-3

[06]

Brakes

Types of brakes, design of band brake, pressure between band and drum, average pressure, heat generation and dissipation. Band and Block brake, Disk brake

UNIT-4

(06)

Cylinders and Pressure Vessels

Thin cylinders, change in the volume of cylindrical shell due to internal pressure, thin spherical shell subjected to internal pressure, thin spherical shell- change in dimensions, thick cylinders, Lamé's equation, Clavarino's and Birnie's equations, compound cylinders, cylinder heads and cylinder plates.

Text Books

1. Design of Machine Elements, V. B. Bhandari, Tata McGraw Hill Publishing Co, 4th Edition.
2. Design of Machine Elements, M. F. Spotts, T.E. Shoup, L.E. Hornberger, S. R. Jayaram and C.V. Venkatesh, Pearson Education, 3rd edition.
3. Mechanical Engineering Design, Joseph Shigley, Tata McGraw Hill Book Co., 3rd edition

Reference Books

1. Standard Handbook of Machine Design, Joseph Shigley, Charles Mischke, Thomas Brown, McGraw-Hill Publishing Co, 3rd edition
2. Machine Design: An Integrated Approach, Norton and Norton, Pearson Publication, 4th edition
3. Machine Design - Volume 1, 2, Farazdak Haideri, Nirali Prakashan, 3rd edition
4. Machine Design, Dr. S.S. Wadhwa, Dhanpat Rai & Co, 4th edition
5. Machine Design, P. C. Sharma & Aggarwal, Katariya & Sons, 5th edition

Web resources

1. www.nptel.ac.in
2. www.learnengineering.org
3. <http://www.freestudy.co.uk/>

MOOCS

1. Machine Design Part I (Coursera), <https://www.mooc-list.com/course/machine-design-part-i-coursera>
2. Mechanical Engineering (MIT open courseware), <https://ocw.mit.edu/courses/mechanical-engineering/>
3. Design Courses (edX), <https://www.edx.org/course/subject/design>

List of Practical

1. Drawing of various types of Springs
2. Drawing of any one/two clutches
3. Drawing of any one/two brakes
4. Drafting of assembly of any one type of Brake/Clutch system using AutoCAD

Subject: Robotics (PCC)								
Program: B. Tech. Mechanical Engineering				Subject Code: ME 0624			Semester: VI	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
2	0	0	2	16/40	0	24/60	0	100

Course Objectives:

1. To be familiar with Evolution of robot, robotics and automation.
2. To educate the student with robot anatomy and Kinematics.
3. To Impart knowledge on robotics sensors, vision and actuators
4. To be familiar about Robot Programming methods & Languages of robot.
5. To give awareness about recent and futuristic trends of robotics and its applications.

Course Outcomes:

After study this course students will be able

1. Describe the different types robots, its anatomy and kinematics of motion.
2. Identify the needs and applications of sensors, vision devices and actuators in robots
3. Describe methods of programming a robot and recent advancement in robotics as well futurist trends of the technology.

COURSE CONTENT

Unit -1

[8]

Fundamentals of Robot Basic concepts – Classification- Advantages and disadvantages of robot - Robot anatomy-- Manipulators - Precision movement- Degree of Freedom – Joints- Robot coordinates-robot specifications and Work volume, Kinematics: Forward and inverse kinematics.

Unit -2

[8]

Robot drive systems & motion planning Types of drive systems, Basic robot motions, Point to point control, continuous path control, Robot control - unit control system concept - D.C. servo motors, stepper motor and A.C. servo motors – Salient features, applications and comparison of all these drives. Robot vision & Robot motion planning

Unit -3

[8]

End effector & sensors End effectors - classification - mechanical, magnetic, vacuum and adhesive gripper - gripper force analysis and design. Sensor devices, Types of sensors - contact, position and displacement sensors, Force and torque sensors – Proximity and range sensors - acoustic sensors.

Unit -4

[6]

Robot communications & Applications : Wireless communication modules , wires communication .Robot cell design-types and control. Application of robots - Material handling - Machine loading and unloading, Assembly, Inspection, Welding, Spray painting, Mobile robot, Microbots – Drones & Industrial robots -Recent developments in robotics- safety considerations.

TEXT BOOKS:

1. Mittal R. K. "Robotics and Control", Tata McGraw Hill, New Delhi, 2003.
2. Robot dynamics & control by M W Spong & M. Vidhyasagar, John Wiley & Sons New York.
3. Automation and Robotics by Juan Manuel Ramos Arreguin, InTech 2008.

REFERENCES:

1. John. J. Craig, "Introduction to Robotics: Mechanics and Control", Pearson education
2. E. Rich, K. Knight and S. B. Nair, "Artificial Intelligence", Tata McGraw-Hill publication
3. Zilouchian and M. Jamshidi, "Intelligent control systems using soft computing methodologies", CRC Press

Subject: Mechanical Vibrations								
Program: B.Tech. Mechanical Engineering				Subject Code: ME0625			Semester: VI (PE-3)	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
2	0	2	3	16/40	16/40	24/60	24/60	200

Course Objectives

1. To study basics of vibrations of structure.
2. To study how to prepare mathematical model of single and multi-degree of freedom systems- free and forced, undamped and damped vibrations systems.
3. To study how to find frequencies and mode shapes of any systems.
4. To study to calculate natural frequencies using various classical methods.
5. To study continuous system.

Course Outcomes

1. Student will be able to prepare mathematical model of free/forced, undamped/damped as well as single/multi-degree of freedom systems.
2. Student will be able to calculate natural frequencies and mode shapes of any system
3. Student will be able to match natural frequencies of theoretical, simulated and experimental frequencies of any system.

Content

UNIT-I

[10]

Introduction

Vibration terminology, Harmonic and periodic motions, Beats phenomenon, uses and effects, practical applications and current research trends

Single Degree of Freedom Systems – Free Undamped and Damped Vibrations

Free undamped vibrations using Newton's second law, D'Alemberts principles, Energy method, Rayleigh's method, free damped vibrations, and logarithmic decrement, under damped, over damped and critically damped conditions.

UNIT-II

[08]

Single Degree of Freedom Systems – Forced Undamped and Damped Vibrations

Forced harmonic undamped vibration, Damped free Magnification factor, Transmissibility, Vibration Isolation, Equivalent viscous damping, Rotor unbalance, Excitation and Stability analysis

UNIT-III

[14]

Two Degree of Freedom Systems

Generalized and Principal coordinates, derivation of equations of motion, Lagrange's equation, Coordinate coupling, Forced Harmonic vibration.

Multi-Degree of Freedom Systems

Derivation of equations of motion for MDOFs, influence coefficient method, Properties of undamped and damped vibrating systems: flexibility and stiffness matrices, reciprocity theorem, Modal analysis.

UNIT-IV

[14]

Natural Frequency Calculations

Rayleigh method, Stodala method, Matrix iteration method, Holzer's method and Dunkerley's method, Whirling Speed of shaft.

Vibration Measurement Apparatus

Vibration measuring instruments, acceleration and frequency measuring instruments, FFT analyzer.

Reference Books

1. Mechanical Vibration by Singiresu S. Rao, Pearson Education
2. Mechanical Vibrations by G.K. Groover, Nemchand & Bro
3. Theory of Vibration with Application by William T Thomson, Pearson Education
4. Theory and Problems of Mechanical Vibrations by Graham Kelly, schaum series
5. Fundamental of Mechanical Vibrations by Graham Kelly Mcgraw hill

Web resources: www.nptel.ac.in

List of Experiments

1. To study frequency of simple pendulum.
2. To study frequency of compound pendulum.
3. To study frequency of sprig mass system.
4. To study frequency of lateral vibration system.
5. To study frequency of torsion vibration system (single Rotor).
6. To study free damped vibration system.
7. To study whirling speed of shaft.
8. To study forced damped vibration system.

9. To study frequency of simple pendulum with considering mass of rod
10. To study frequency of roller rolls without slip inside cylinder.
11. To study frequency of U tube filled with liquid.

Subject: Automobile Systems (PE-3)								
Program: B. Tech. (Mechanical)				Subject Code: ME0626			Semester: VI	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
2	0	2	3	16/40	16/40	24/60	24/60	200

Course Objectives:

1. The purpose of this course is to impart adequate knowledge in both ways practically as well as theoretically.
2. Imparting knowledge of various types of power-driven vehicles.
3. To familiarize the students with the fundamentals of Automotive Engine System, Chassis suspension system, braking and transmission system.
4. The students are acquainted with the location and importance of operation, maintenance and Repair of all components of the various transportation vehicles.

Course Outcomes:

1. Identify the various parts of the automobile
2. Explain the working of various parts like engine, transmission, clutch, brakes.
3. Describe how the steering and the suspension systems operate.
4. Develop a strong base for understanding future developments in the automobile industry

COURSE CONTENT

UNIT-1

[08]

1 Introduction to Automotive Systems

Study various vehicle layouts as front engine & front wheel drive, Front engine & Rear wheel drive, Rear engine & Rear wheel drive. Four wheel drive, Classification based on controls positioning.

2 Performance of Vehicle

Vehicle motion, Resistances during motion, Accelerated and constant velocity motions, Tractive force, Gradeability, Power required to propel vehicle, Engine characteristics, Gear ratio requirement.

3 Frames & Body

Types of chassis and frames, Construction of chassis and frames, Vehicular body

UNIT-2

[08]

4 Clutch

Functions Of Clutch, Desirable Qualities Of Clutch, Requirements of Clutch, Types Of Clutch, Friction Clutch, Cone Clutch, Single Plate Clutch, Multiplate Clutch, Centrifugal And Semi Centrifugal Clutch, Hydraulic Clutch, Vacuum Operated Clutch, Electromagnetic Clutch.

5 Transmission System

Manual transmission: sliding mesh gearbox, constant mesh gearbox, Synchromesh gearbox, Selector mechanism, 4x4 transfer case, automatic transmission: Torque converter, Free wheel unit, Epicyclical gear boxes and continuously variable transmission.

UNIT-3

[08]

6 Drive Line and Axles

Propellers shaft, Types of final drive- torque tube drive- hotch kiss drive-hypoid drive, Drive axles, Types of axle, Fully or semi-floating and three quarter floating, Dead axle, constant velocity joints, Differential, Differential lock, Limited slip differential.

7 Steering System

Requirements of steering, Steering system and linkages, Steering geometry, Steering ratio, Types of steering gears box- worm and wheel- worm and nut-recirculating ball- rack and pinion-cam and lever steering gearbox, Wheel alignment, Toe-in, Toe-out, Caster, Camber, Power steering system

8 Suspension System

Purpose of front and rear suspension, Types of suspension system, Coil spring, leaf spring, Torsion bars, Shock absorbers, Air suspensions, Independent suspension systems

UNIT-4

[08]

9 Brakes

Function and requirements of brakes, Internal expanding shoe brakes, Shoes and lining material, Leading and trailing shoe, Hydraulic braking system, Brake oils, Bleeding of brakes, Pneumatic braking system, Vacuum brakes, Exhaust brakes,

Parking brake.

10 Wheels and Tyres

Types of wheel, wheel dimensions, Wheel balance, Types of tyres, Desirable properties of tyre, Tread patterns of tire, tyre construction, Designation of tyre.

11 Modern Vehicles

Introduction to electric vehicles & hybrid vehicles

Reference Books

1. Automobile engineering, GBS Narang, Khanna Publishers.
2. Automobile Engineering, R.K. Rajput, Laxmi Publications.
3. Automotive Mechanics Course, William H., and William Harry Crouse. Tata McGraw Hill Education, 1982. Advanced vehicle technology Heisler, Heinz, Elsevier, 2002

Web resources:

1. <http://www.carbibles.com>
2. <http://www.sae.org>

List of Experiments:

1. Study constructional features of vehicle body, various layouts, vehicle classifications and Specifications.
2. Load analysis of two to three different classes of four wheelers.
3. Study vehicle Aerodynamics: Vehicle features and Loading.
4. Study components of transmission system.
5. Study constructional features and working of clutches and automatic transmission system.
6. Develop mathematical model of a suspension system and analyse the same.
7. Study different types of steering systems, constructional features and related configurations.
8. Study different types of braking systems, their constructional features and typical layout for hydraulic pneumatic and electronic brakes.
9. Study features, requirement and components of electrical and lighting system.
10. Study electronic systems of a vehicle along with different types of sensors, safety features and their integration.

Subject: Industrial Engineering (PE-3)								
Program: B. Tech. (Mechanical)				Subject Code: ME0627			Semester: VI	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
2	0	2	3	24/60	24/60	16/40	16/40	200

Course Objectives:

1. Comprehend all the aspects of industrial engineering.
2. Understand the procedure of location selection.
3. Understand the production planning and its procedures.
4. Apply the work study techniques
5. Analyze the procedures of increasing productivity.
6. Design a plant layout for specific industrial need
7. Generate entrepreneurship ideas
8. Know and understand the industrial legislations
9. Understand the need of inspection and to apply quality control procedures.

Course Outcomes:

1. Ability to apply the knowledge of industrial engineering
2. Ability to function on multi-disciplinary teams
3. Ability to identify and solve the industrial engineering problems
4. Ability to use modern techniques, tools and skills of industrial engineering.
5. An ability to design a system, component or process to meet the desired needs within realistic constraints
6. Ability to communicate effectively.
7. An ability to design and conduct experiments as well as analyze and interpret data.
8. Grooming of entrepreneurial skills of the students.

COURSE CONTENT

UNIT-1

[08]

1 Site Selection

Nature of location decisions, Importance of plant location, Dynamic nature of plant location, choice of site for location, State regulations of location, Backward Area and Industrial policy, Government policies for decentralization, Industrial Estates, Comparisons of locations, Suburban area, Economic survey of site

Selection

2 Factory Building and Plant Layout

Factors affecting the factory building, Types of factory building, Specific parts of factory building, Plant layout, Objectives of good plant layout, Importance of plant layout, Situation in which layout problem may arise, Factors affecting plant layout, Principles of plant layout, Techniques used in plant layout, Steps in planning in layout for new enterprise, Types of plant layout its advantages and

limitations, Symptoms of bad layout, Flow pattern, Line balancing

UNIT-2

[09]

3 Productivity

Productivity and production, Measurement of productivity, Productivity Index, Importance of productivity, Means of increasing productivity, Improving productivity by reducing work content, Productivity improvement procedure, Six

lines of attack to improve productivity, The benefits of increasing productivity.

4 Work Study

Introduction to work study, Method study, Steps in method study, Recording techniques, critical examination, Micro-motion study, Therbligs, SIMO chart, Principles of motion study Introduction to work measurement and its uses, Techniques of work measurement, Time study, Recording the information, Number of cycles to be timed, Method of timing, Allowances, Work sampling, Predetermined motion time and system (PMTS), Method time measurement (MTM), work factor.

UNIT-3

[10]

5 Plant Maintenance

Objective of maintenance, Importance of maintenance, Functions of maintenance, Types of maintenance, Economic aspect of maintenance, comparison of breakdown and preventive maintenance, Requirement of good preventive maintenance, Procedure for preventive maintenance, Organization of maintenance department, Total productive maintenance (TPM), Total planned quality Maintenance (TPQM), Management techniques used in plant maintenance.

6 **Material Handling**

Functions of Material Handling, Factors to be considered in material handling problems, Principles of material handling, Material Handling devices, Relation between Plant layout and material handling, Material handling in process layout, Material handling in line layouts, Procedure for establishing or improving a material handling system.

UNIT-4

[10]

7 **Job Evaluation, Merit Rating, Wages and Incentives**

Objectives of job evaluation, Principles of Job evaluation, Steps in Job evaluation, Methods of Job evaluation, Merit Rating, Selection of factors in setting up Rating method, Methods of Merit rating, Concept of wages, Desirable characteristics of good wage/incentive plans, Factors affecting wages, Types of wage plans, incentives, Wage incentive plans

8 **Ergonomics**

Concept of ergonomics, Objectives of ergonomics, Man-Machine system interface, Important aspect of man machine system, Anthropometry, Principles in the application of anthropometric data, Body Measurement, posture Movement and work place design, Ergonomics and safety, Ergonomics and fatigue.

Text Books:

1. Industrial Engineering and production Management, M. Mahajan, Dhanpat rai and co
2. Industrial engineering and management, O.P. Khanna, Dhanpat Rai Publications
3. Industrial Engineering and Production Management by Banga and Sharma, Khanna

Reference Books:

1. Industrial Engineering and Organization Management by S K Sharma, SavitaSharma,
2. Industrial Engineering and Management by Dr. B.Kumar Khanna Publishers
3. Maintenance Engineering and Management; Sushil Kumar Srivastava, S. Chand
4. Industrial Engineering and Production Management Martand Telsang S Chand
5. Production System, Planning, Analysis and Control – By J. L. Riggs 3rd ed. Wiley

Web resources

1. www.nptel.ac.in
2. <http://www.e-booksdirectory.com/listing.php?category=278>
3. <https://www.myclassroom.com/Engineering.../Industrial-Engineering-and-Management>

List of Practical

1. P-chart for fraction defectives
2. C-chart for number of defectives (constant sample size)
3. Operating characteristic curve of single sampling Attributes plan
4. Test for normality of sample means(normal distribution)
5. Test for normality of sample means(universal distribution rectangular)
6. X bar, r charts & process capability
7. Pin board study experiment
8. Tread mill exercise
9. Rating practice using pack of cards
10. To draw two handed process chart for bolt, washer & Nut assembly
11. Multiple activity chart (or) man machine chart
12. Ergocycle exercise

Subject: Computer Aided Design and Analysis (PE-4)								
Program: B. Tech. (Mechanical)				Subject Code: ME0628			Semester: VI	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
2	0	2	3	16/40	16/40	24/60	24/60	200

Course Objectives

1. To impart fundamental knowledge to students in the latest technological topics on Computer Aided Design and Computer Aided Engineering Analysis and to prepare them for taking up further research in the areas.
2. To create congenial environment that promotes learning, growth and imparts ability to work with inter-disciplinary groups in professional, industry and research organizations.
3. To broaden and deepen their capabilities in analytical and experimental research methods, analysis of data, and drawing relevant conclusions for scholarly writing and presentation.
4. To provide guidance to students for their choices in research and professional career outlook and to encourage students to take up research

Course Outcomes

1. Apply/develop solutions or to do research in the areas of Design and simulation in Mechanical Engineering.
2. Have abilities and capabilities in developing and applying computer software and hardware to mechanical design and manufacturing fields.
3. Review and document the knowledge developed by scholarly predecessors and critically assess the relevant technological issues.
4. Formulate relevant research problems; conduct experimental and/or analytical study and analyzing results with modern mathematical / scientific methods and use of software tools.
5. Design and validate technological solutions to defined problems and communicate clearly and effectively for the practical application of their work.

COURSE CONTENT

UNIT-1

[08]

1 Fundamentals of Computer Aided Design:

Introduction, Conventional Design VS. CAD, Benefits of CAD, typical product cycle, CAD tools for the design process of product cycle Reason for implementing CAD system & Computer applications in design, Technical specification of CAD workstation, CAD Hardware, CAD software, Computer Software & Operating system for CAD, Input and Output devices; Graphics Displays: Refresh display, DVST, Raster display, pixel value.

UNIT-2

[08]

2 Computer Graphics:

Introduction, Scan conversions, Concept of Coordinate Systems: Working Coordinate System, Model Coordinate System, Screen Coordinate System. Line and Curve generation algorithm: DDA, Bresenham's algorithms.

3 Geometric Transformations:

Homogeneous representation; Translation, Scaling, Reflection, Rotation, Shearing in 2D and 3D; Orthographic and perspective projections.

UNIT-3

[08]

4 Geometric Modeling:

Introduction, Real Objects and Wire Frame Models, Representing Curves in CAD /CAM, Types of Geometrical Models & Mathematical representation of curves, Wire frame models, Geometric entities, Geometrical representations, parametric representations. Parametric representation of synthetic curves, cubic curves, features, formulations and limitations of B – spline and Bezier curves, sweep curves. Surfaces & solids – model, entities, representations, fundamentals of surface and solid modeling, B-rep, constructive solid geometry (CSG), analytical modeling, sweep.

5 Graphics Standards:

Standards for graphics programming, features of GKS, other graphics standards, PHIGS, IGES, PDES. Standards in CAD

UNIT-4

[08]

6 Finite Element Analysis:

Introduction, Steps in Finite Element Analysis, Types Of Elements, One Dimensional Linear Modeling, Natural or Intrinsic Coordinate System, Shape Function in Natural Coordinate System, Displacement, Strain and Stress Relationships, Element Stiffness Matrix - Potential Energy Approach, Element Stiffness Matrix - Galerkin Approach, Elimination Approach, Penalty Approach, Quadratic Shape Function, Displacement, Strain and Stress for Quadratic Element, Element Stiffness Matrix for Quadratic Element, Analysis of Trusses, Functions and Phases in FEA Software.

Text Books

1. CAD/CAM and automation by Farazdak Haideri
2. CAD/CAM Theory & Practice by Ibrahim Zeid, Tata Mc Graw Hill
3. CAD/CAM Principles and Applications by P N RAO, Mc Graw Hill
4. CAD/CAM: Computer Aided design and Manufacturing by Mikell Groover and Zimmer, Pearson Education
5. Finite Element Analysis by Chendraupatla, EEE Publication

Reference Books

1. Computer Aided Engineering & Design by Jim Browne, New Age International Publications,
2. Computer Graphics & design by P. Radhakrishnan, C.P. Kothanadaraman, New Age Publication
3. Computer Aided Manufacturing by Tien Chien Chang, Richard, Wang Pearson Education
4. Computer Aided Analysis and Design of Machine Elements by Rao V. Dukkipati, M. Ananda Rao, Rama Bhat, New Age International Publications
5. Fundamentals of Computer Aided Design, by Vikram Sharma, KATSON educational series
6. Mathematical Elements for Computer Graphics - David F. Rogers & J. Alan Adams McGraw Hill
7. CAD / CAM - Chris McMohan, Jimmie Brown Addison – Wesley
8. CAD/CAM/CAE by Chougule N K, Scitech Publications Pvt. Ltd

Web resources

1. <https://nptel.ac.in/courses/112102101/>
2. <https://nptel.ac.in/courses/112104116/>
3. <https://www.edx.org/>

MOOCS

1. <https://www.coursera.org/specializations/cad-design-digital-manufacturing>

LIST OF EXPERIMENTS

1. To learn fundamentals of CAD System, Software and hardware
2. To prepare a computer program for scan converting a line using DDA Line Method
3. To prepare a computer program for scan converting a line using Bresanham LineMethod
4. To prepare a computer program for scan converting a Circle using BresanhamMethod
5. To solve the problem of 2D & 3D Transformation
6. To Study various graphics standards
7. To Study of Surface & Solid modeling
8. To Study Geometric curves
9. To Study Computer Analysis Engineering Techniques
10. To Study structural Analysis in ANSYS software

Subject: Gas Dynamics (PE-4)								
Program: B. Tech. (Mechanical)				Subject Code: ME0629			Semester: VI	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
2	0	2	3	16/40	16/40	24/60	24/60	200

Course Objective

1. Define basic concept and importance of gas dynamics
2. To prepare the student for engineering analysis and design of high-speed flow systems
3. By providing a foundation in compressible fluid mechanics and introducing techniques for treatment of practical applications.
4. Interpret the flow pattern in flow and non-flow systems
5. Evaluate basic supersonic flight and associated propulsion systems

Course Outcome

1. Apply the fundamental flow equations (conservation of mass and momentum and energy) and basic solution techniques in solving compressible one dimensional flows
2. Obtain first order solutions for compressible internal flows for variable geometry ducts
3. Obtain first order solutions for compressible internal flows with friction and heat transfer.
4. Analyze flow through oblique shocks, using normal shock equations, graphs or tables.
5. Explain and apply the method of characteristics to simple unsteady one-dimensional homoentropic flow, shock tube flow, and steady two-dimensional flow.

COURSE CONTENT

UNIT-1

[05]

1 Fundamentals of compressible flow:

Continuity, momentum and energy equation, control volume, sonic velocity, Mach number and its significance, Mach waves, Mach cone and Mach angle, Von Karman rules of supersonic flow, static and stagnation states, relationship between stagnation temperature, pressure, density and enthalpy in terms of Mach number, stagnation velocity of sound, reference speeds, various regions of flow, Effect of Mach number on compressibility.

UNIT-2

[05]

2 Isentropic flow with variable area:

One dimensional isentropic flow in ducts of varying cross-section- nozzles and diffusers, mass flow rate in nozzles, critical properties and choking, area ratio as function of Mach number, Impulse function, effect of back pressure variation of convergent and convergent divergent nozzles, non- dimensional mass flow rate in terms of pressure ratio, area ratio and Mach number, flow through diffusers, use of gas tables.

UNIT-3

[10]

3 Flow in constant area duct with friction (Fanno flow):

Fanno curve and Fanno flow equations, solution of Fanno flow equations, variation of flow properties, variation of Mach no. with duct length, isothermal flow in constant area duct with friction, tables and charts for Fanno flow.

4 Flow in constant area duct with heat transfer (Rayleigh flow):

Rayleigh curve and Rayleigh flow equations, variations of flow properties, maximum heat transfer, tables and charts for Rayleigh flow.

UNIT-4

[10]

5 Normal shock:

Development of shock wave, governing equations, Prandtl-Mayer relation, Rankine-Hugoniot relation, strength of shock wave, Mach number in the downstream of normal shock, variation of flow parameters across the normal shock, normal shock in Fanno and Rayleigh flows, impossibility of a rarefaction shock, supersonic diffusers. Wind tunnel: Types of wind tunnels and its basics.

Text Books

1. Dynamics of compressible flow – S.M. Yahya, New Age Publishers, Delhi
Engineering Thermodynamics by P.K. Nag, McGraw-Hill, New Delhi
2. Fundamentals of compressible fluid dynamics- P. Balachandran, PHI Learning, New Delhi.
3. Gas Dynamics and Jet Propulsion- P. Murugaperumal, Scitech Publication, Chennai.

Reference Books

1. Gas Dynamics and Jet Propulsion- B.L. Singhal, Macmillan Publishers India Ltd, New Delhi.
2. Gas Turbines and Jet Propulsion – Nirali Prakshan, Pune.
3. Gas turbine theory and jet propulsion – J.K. Jain, Khanna publishers, New Delhi.
4. Gas Dynamics – James John and Theo Keith, Pearson, New Delhi.

List of Experiments:

1. To study the energy equation for flow and non-flow process, significance of Mach number, Mach cone, Mach angle and various regions of flow.
2. To study the static and stagnation properties of compressible fluid in terms of Mach number and its effect on compressibility
3. To study the expansion in nozzle, compression in diffuser, variation of area ratio with Mach number and impulse function for the isentropic flow
4. To study the effect of pressure ratio and isentropic flow through convergent, convergent-divergent nozzle and diffuser
5. To study the different types of wind tunnels.
6. To study the development of shock wave, Rarefaction of wave and develop the Prandtl- Mayer equation for normal shock wave
7. To study the effect of Mach number on static and stagnation properties across the normal shock.
8. To develop the governing equation for Fanno flow and its solution.
9. To study the variation of flow properties for Fanno flow.
10. To study the frictionless flow process with heat transfer in constant area duct and develop Rayleigh flow relation

Web Resources:

1. <https://nptel.ac.in/courses/112103021/>

Subject: Industrial Safety Law and Maintenance (PE-4)								
Program: B. Tech. (Mechanical)				Subject Code: ME0630			Semester: VI	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuou sInternal Evaluation (CIE) Theory	Continuou sInternal Evaluation (CIE) Practical	Total Marks
2	0	2	3	16/40	16/40	24/60	24/60	200

Course objectives:

1. Possess a mastery of Health safety and environment knowledge and safety managementskills, to reach higher levels in their profession.
2. Competent safety Engineer rendering professional expertise to the industrial andsocietal needs at national and global level subject to legal requirements.
3. Effectively communicate information on Health safety and environment facilitating collaboration with experts across various disciplines so as to create and execute safemethodology in complex engineering activities.

Course Outcomes:

1. Students will be able to
2. Understand the functions and activities of safety engineering department.
3. Carry out a safety audit and prepare a report for the audit.
4. Prepare an accident investigation report.
5. Understand the functions and activities of safety engineering department.

COURSE CONTENT

UNIT-1

[07]

1 Introduction

Introduction to The Development of Industrial Safety and Management History and development of Industrial safety: Implementation of factories act, Formation of various councils, Safety and productivity, Safety organizations. Safety committees, safety committee structure, roll of management and roll of Govt. in industrial safety, Safety analysis. Accident Preventions, Protective Equipment and The Acts Personal protective equipment, Survey the causes and cost of accident, Housekeeping, First aid, Firefighting equipment plant for locations and hazards, Part of body to be protected, Education and training in safety, Prevention, Accident reporting, Investigations, Industrial psychology in accident prevention,

Safety trials.

UNIT-2

[07]

2 Safety Acts

Features of Factory Act, Introduction of Explosive Act, Boiler Act, ESI Act, Workman's compensation Act, Industrial hygiene, Occupational safety, Diseases prevention, Ergonomics, Occupational diseases, stress, fatigue, health, safety and the physical environment, Engineering methods of controlling chemical hazards, safety and the physical environment, Control of industrial noise and protection against it, Code and regulations for worker safety and health.

3 Safety Education & Training

Importance of Training, Identification of training needs, training Methods – Programme, Seminars, conferences, competition, Method of promoting safe practices, motivation, communication, Role of government agencies & private agencies for safety training, Safety Posters, Safety displays, Safety pledges, Safety incentive schemes, Domestic Safety & Training.

UNIT-3

[08]

4 Principles and Practices of Maintenance Planning

Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity – Importance and benefits of sound Maintenance systems – Reliability and machine availability, Equipment Life cycle, Measures for Maintenance Performance: Equipment breakdowns, Mean Time Between Failures, Mean Time To Repair, Factors of availability, Maintenance organization, Maintenance economics.

5 Maintenance Policies and Preventive Maintenance

Maintenance categories – Comparative merits of each category – Preventive maintenance, Maintenance schedules: Repair cycle, Principles and methods of lubrication, Fault Tree Analysis, Total Productive Maintenance: Methodology and Implementation.

UNIT-4

[08]

6 Condition Monitoring

Condition Monitoring: Cost comparison with and without Condition Monitoring, On load testing and off load. Methods and instruments for Condition Monitoring, Temperature sensitive tapes, Pistol thermometers, wear-debris analysis, noise vibration and harshness analysis of machines

Text Books

1. Industrial Safety and Health Management By Ray Asfahl, C. Prentice Hall Publication.

2. Reliability & Maintenance Engineering By S. C. Mishra , New Age Publishing House
3. Handbook of Condition Monitoring By Davis, Chapman & Hall Publication

Reference Books

1. Maintenance Engineering Handbook By Higgins, L.R. by McGraw Hill Publication
2. Industrial Maintenance By Garg, M.R. By S.Chand & Co.
3. Industrial Engineering , Dhanpat Rai Publication. & Production Management By M. Mahajan

MOOCs

1. www.nptel.com

List of Practical's:

1. Safety and maintenance of Lathe machine
2. Safety and maintenance of Drilling machine
3. Safety and maintenance of Shaper machine

List of Practical's:

1. Study about maintainability.
2. Study about wear and service life of equipment.
3. Study about maintenance and repair of production equipment. (Lathe, Shaper, Planner M/c etc.)
4. Study about restoring of the guide ways of machine tools.
5. To study maintenance planning and scheduling.
6. Study about VAIN analysis.
7. Study about preventive maintenance.
8. Study about industrial safety.
9. Study about accidents and industrial hazards.
10. Study about safety measurement

Subject: Rapid Prototyping (OE-8)								
Program: B. Tech. (Mechanical)				Subject Code: ME 0631			Semester: VI	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
3	0	0	3	16/40	0	24/60	0	100

Course Objectives:

1. To acquaint students with the concept of Additive Manufacturing (AM)
2. To explore various Rapid Prototyping (RP) Techniques.
3. Selection of Materials and suitable RP Techniques for the given application.
4. To explore different application areas and limitations of AM.
5. To aware about use of Reverse Engineering in context of AM.

Course Outcomes:

1. Student will learn about the basic principle of Additive Manufacturing.
2. Students will learn about construction, working and parameters of various RP processes.
3. Students will be able to select the right materials and identify the suitable RP process.
4. Students will learn about the different application areas and limitations of AM.
5. Students will learn about Reverse Engineering and it's applications for AM.

COURSE CONTENT**UNIT-1****[10]****1 Introduction to Additive Manufacturing (AM)**

General overview, Definitions, Terminology of AM, Traditional manufacturing v/s AM. Different AM processes and relevant process physics, AM process chain/steps. Discussion on different materials used, Use of multiple materials, multifunctional and graded materials in AM. Application level: Direct processes – Rapid Prototyping, Rapid Tooling. Rapid Manufacturing; Indirect Processes - Indirect Prototyping. Indirect Tooling, Indirect Manufacturing, Latest trends and emerging areas

UNIT-2**[14]****2 Liquid Based And Solid Based Additive Manufacturing Systems**

Classification – Liquid based system: i) Stereo lithography Apparatus (SLA) - Principle, process, advantages and applications, Limitations. – Solid based

system: i) Fused Deposition Modeling – Principle, process, advantages and applications, Limitations. ii) Laminated Object Manufacturing - Principle, process, advantages and applications, Limitations.

UNIT-3

[12]

3 Powder Based Additive Manufacturing Systems

Selective Laser Sintering – Principles of SLS process – Process, advantages and applications, Three Dimensional Printing (with binder jet) – Principle, process, advantages, application

UNIT-4

[12]

4 CAD & Reverse Engineering

Basic Concept – Digitization techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology: CAD model preparation – Part Orientation and support generation – Model Slicing –Tool path Generation – Softwares for Additive Manufacturing Technology: MIMICS, MAGICS, Repitier, Cura, etc

Text Books

1. Additive manufacturing technologies: rapid prototyping to direct digital manufacturing, Ian Gibson, David W. Rosen, Brent Stucker, Springer, 2010.
2. Understanding additive manufacturing: rapid prototyping, rapid tooling, and rapid manufacturing. By Andreas Gebhardt, Hanser Publishers, 2011
3. Rapid prototyping: principles and applications, C.K. Chua, K.F. Leong and C.S. Lim, World Scientific, 3rd Edition, 2010.

Reference Books

1. Rapid Prototyping: Principles and Applications in Manufacturing, Noorani R, John Wiley & Sons, 2006.
2. Rapid Prototyping and Engineering applications: A tool box for prototype development, Liou W L, Liou F W, CRC Press
3. A, Rapid Prototyping: Theory and practice, Kamrani A K, Nasr E A, Springer.
4. Rapid Manufacturing: An Industrial Revolution for Digital Age, Hopkinson, N, Haque, R., and Dickens P, Wiley, 2005.
5. Rapid Manufacturing, Pham. D.T., and Dimov. S.S., Springer Verlag 2001.
6. Rapid Prototyping and Manufacturing: Fundamentals of Stereo lithography, Paul

Web resources

1. additivemanufacturing.com/basics/
2. <https://www.optomec.com/additive-manufacturing/>
3. <https://nptel.ac.in/courses/112107077/38>
4. <https://nptel.ac.in/courses/112102103/16>

5. <https://nptel.ac.in/courses/112104230/26>

MOOCS

1. https://onlinecourses.nptel.ac.in/noc19_me24/preview.
2. <https://mitxpro.mit.edu/courses/course-v1:MITxPRO+AMx+1T2018/about>
3. <https://www.edx.org/course/digital-manufacturing-industrial-design-delftx-idemc-3x>
4. <https://www.edx.org/course/fundamentals-manufacturing-processes-mitx-2-008x-0>

Subject: Operation Research (HS)								
Program: B. Tech. (Mechanical)				Subject Code: ME 0632			Semester: VI	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
2	1	0	3	16/40	***	24/60	***	100

Course Objectives:

1. To introduce and formulate optimization problems
2. Decision Making & improve its quality.
3. Minimize the Cost & Maximize the Profit.
4. Improve the Productivity.
5. To understand and apply the concept of optimality criteria for various type of optimization problems.
6. Solve various constrained and unconstrained problems in single variable as well as multivariable.
7. Apply the methods of optimization in real life situation.

Course Outcomes:

1. Students will be able to describe the scope & Characteristics of OR.
2. Students will be able to define & Formulate Mathematical Problems.
3. Students will be able to demonstrate and solve simple models of Game theory.
4. Students will be able to evaluate optimum solution using dynamic programming for different applications.
5. Students will be able to solve different problems related to Network.
6. Students will be able to formulate and solve optimization problems related to job/work assignments.
7. Students will be able to formulate and solve transportation, travelling sales man and transshipment problems.

COURSE CONTENT

UNIT-1

[07]

1 Introduction to Operation Research

Definition, characteristics, necessity, scope, phases, models, applications, advantages, limitations of OR

2 Linear Programming

Introduction, Assumption, Mathematical Model, Formulation of LPP, Graphical solution of LPP. Simplex method, Big-M method, Two-phase method, degeneracy, Special cases in LPP, Duality

UNIT-2

[07]

3 Transportation Model

Introduction, Assumption, Mathematical Model, Formulation of TP, Types of Transportation problem. Methods of finding basic feasible solutions – Northwest corner rule, row minima method, column minima method, least cost method and Vogel's approximation method, Optimality test – Stepping stone method and MODI method, Degeneracy in TP.

4 Assignment Model

Introduction, Assumption, Mathematical Model, Formulation of Assignment model, Hungarian method for optimal solution, Solving unbalanced problem, Traveling salesman problem and assignment problem

UNIT-3

[08]

5 Replacement Models

Introduction, Need of replacement, replacement of Items that deteriorate whose maintenance costs increase with time without change in the money value, replacement of items that fail suddenly, individual replacement policy, group replacement policy.

6 Inventory models

Introduction, Need of Inventory, Inventory costs, ABC Analysis, Models with deterministic demand – (a) Classical EOQ model, (b) EOQ with price breaks

UNIT-4

[08]

7 Network Analysis in Project Management

Introduction, Network diagram, event, activity, defects in network, PERT & CPM, float in network, variance and probability of completion time, project cost- direct, indirect, total, optimal project cost by crashing of network

Text Books:

1. Operation Research – P.K. Gupta & D.S. Hira, S. Chand & Company Ltd, New Delhi
2. Quantitative Techniques in Management – N.D. Vohra , Tata McGraw Hill, New Delhi
3. Operation research – P. Rama Murthy, New Age, New Delhi

Reference Books:

1. J. K. Sharma, "Operations Research Theory and Practice", McMillan India. Ltd. New Delhi

2. H M Wagher, "Principles of operation Research (with Applications to ManagerialDecisions)", Prentice Hall of India, New Delhi
3. Ackoff, Churchaman, Arnoff, "Principle of Operations Research", Oxford IBH, New Delhi.

Web resources:

1. <http://cbom.atozmath.com/Menu/CBomMenu.aspx>
2. <https://www.gatexplore.com/transportation-problem-study-notes/>
3. [http://www.math.harvard.edu/archive/20_spring_05/handouts/assignment_overhead s. pdf](http://www.math.harvard.edu/archive/20_spring_05/handouts/assignment_overhead_s.pdf)
4. <https://searchsoftwarequality.techtarget.com/definition/PERT-chart>

SEMESTER-VII

Subject: Machine Design – II (PCC)								
Program: B. Tech. (Mechanical)				Subject Code: ME 0721			Semester: VII	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
2	0	2	3	16/40	16/40	24/60	24/60	200

Course Objectives:

1. To introduce design consideration for various types of gear.
2. To design various types of bearing for different service conditions.
3. To design various I. C. Engine components by consideration mechanical conditions.
4. To design gear box for various applications

Course Outcomes:

1. Student will learn to make proper assumption/ perform correct analysis while designing specific mechanical components.
2. Ability to design various mechanical systems like gears, machine tool gear boxes, bearings for the specification stated/formulated.
3. Ability to prepare ray diagram for variable speeds.

COURSE CONTENT

UNIT-1

[09]

Spur Gear & Helical Gear

Introduction, Classification of Gears, terminology, Selection of types of gears, Gear materials selection, law of gearing, Standard system of gear tooth, force analysis of spur gear, tooth failure, beam strength equation, design of spur gear, check for dynamic-static and wear loading condition, Equivalent no. of teeth, Design of helical gear with checking for dynamic-static and wear loading condition.

UNIT-2

[09]

Bevel Gear & Worm Gear

Introduction, Classification, terminology, formative no. of teeth, Beam strength of bevel gears, Design of bevel gear, Design of worm gear, efficiency, force analysis of worm gear, thermal consideration worm gear

Design of Gearbox

Geometric progression – Standard step ratio – Ray diagram, kinematics layout -Design of sliding mesh gear box

UNIT-3

[10]

Sliding contact bearing

Introduction, Classification, Properties of bearing material, lubrication – types of lubrication, lubricants -properties, selection. Hydrostatic bearings, petroff's equation, hydrostatic footstep bearing, Terms used in hydrodynamic bearing, hydrodynamic lubrication-Reynold's equation, Bearing characteristics number, Journal bearing

Rolling contact bearing

Selection, types, stribeck's equation, Static & dynamic load rating, bearing life, selection of bearing from manual catalog, bearing designation, failure of rolling contact bearing.

UNIT-4

[08]

Internal Combustion Engine Components

Introduction, Design of principal parts – cylinder, cylinder head, piston, connecting rod, crank, valve gear mechanism, flywheel.

Text Books

1. Machine Design, Dr. P. C. Sharma, Dr. D. K. Aggarwal, Kataria Publication, New Delhi, Twelfth Edition, 2015.
2. Design of Machine Elements, V. B. Bhandari, McGraw Hill Publishing Co.
3. Machine Design, Farazdak Haideri, Nirali Prakashan.

Reference Books

1. Machine Design by Robert L Norton, Pearson Education
2. Mechanical engineering design by Joseph shigley, McGraw Hill Publishing Co.
3. Fundamentals of Machine component design by Juvinall & Marshek, Wiley India
4. Machine Design by Dr. S.S. Wadhwa, Dhanpatrai & Co.
5. Material Handling Equipement by Rudenko, MIR publishers, Moscow.
6. PSG design data book, DPV printers, Coimbatore.

Web resource:

1. www.nptel.ac.in

MOOCS:

1. <https://www.asme.org/wwwasmeorg/media/ResourceFiles/AboutASME/Who%20We>
2. [%20Are/Standards_and_Certification/ASME_Codes_and_Standards-Examples_of_Use_for_Mechanical_Engineering_Students.pdf](#)
3. <https://www.asme.org/products/books/life-ratings-modern-rolling-bearings-design>

List of Practical

1. Drawing of Spur Gear assembly.
2. Drawing of Worm and worm gear assembly.
3. Drawing of Gearbox with Ray diagram
4. Drawing of assembly of IC engine components in AutoCAD.

Subject: Computer Integrated Manufacturing (PCC)								
Program: B. Tech. (Mechanical)				Subject Code: ME0722			Semester: VII	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
2	0	2	3	16/40	16/40	24/60	24/60	200

Course Objective:

1. Recognize the importance of CIM in today's technology and its impacts on market competition.
2. Automate tasks for preparing most appropriate manufacturing and assembly processes and their sequences.
3. Understand Robot Programming.
4. Analyze the engineering and economical aspects of AS/RS systems.

Course Outcome:

After learning the course the students should be able to:

1. Students will describe basic concepts of CAM application and understand CIM wheel
2. Prepare part programs using ISO format for given simple components with and without use of MACRO, CANNED CYCLE and SUBROUTINE using ISO format.
3. Students will classify different components using different techniques of group technology.
4. Students will select layouts of FMS for industrial applications
5. Students will describe Robot for preliminary industrial applications like pick and place.
6. Student will identify application of PPC, JIT, MRP-I, MRP-II, and Expert system to CAM

COURSE CONTENT

UNIT-1

[07]

1 Introduction

Introduction to CIM Concepts & Scope of CIM, Nature & Type of Manufacturing System, Evolution, Benefits of CIM, Role of Manufacturing Engineers, CIM Wheel, CIM CASA wheel.

2 Group Technology

Introduction, Part Families, Part Classification and Coding, Machining Cells, Benefits of Group Technology.

UNIT-2

[07]

3 Computer Aided Production Management

Introduction, PPC fundamentals, Problems with traditional PPC, Use of Computer in PPC such as CAPP, MRPI, MRPII, CAGC etc.

4 Material Handling and Storage

Types, Characteristics, Automated Material Movement & AS/RS AGVS, RGV Vehicles, Control and Application, Bar code Reader, Walking Beam theory. Carousel Storage Systems, Engineering Analysis of AS/RS and Carousel Systems.

UNIT-3

[08]

5 Robot Technology

Introduction, Industrial Robots, Robot physical Configuration, Basic Robot Motions, Robotic Power Sources, Sensors, Actuators, Transducer and Grippers. Programming of the Robot, Introduction to Robot Languages, Robot Applications & Economics.

6 Maintenance of CNC Machines

Types of machine tools maintenance, Systems and Sub systems of CNC machines, CNC Maintenance practice: Tools required, Daily checklist, Problems related to mechanical systems, Backlash, Causes and precautions of electronics system

UNIT-4

[08]

7 Numerical Control in machine tools

Types-Numerical, Direct Numerical, Computerized Numerical and Distributive Numerical, Evolution of Controllers, Components of NC/CNC System, Specification of CNC System. Classification of NC/CNC Machines, Transducers Used, Salient Features, Tape, Tape Codes and Tape Readers Used in NC Machines,

8 Computer Numerical Control

Constructional Details of CNC Machines, Machine structure- Requirements and reasons. Elements of CNC machines - Types, sketch, working and importance of Axis Designation, NC/CNC Tooling.

Manual part programming :- Various types of programming formats, G codes, M codes and other codes, Canned cycles, radius compensation, programming exercises for drilling, milling and turning, subroutine, parametric subroutine.

Computer assisted programming: - Enlist languages, Automated programmed Tools (APT)-geometrical motion, auxiliary and post processor statements, APT programs for drilling, milling and turning, tool path generation and verification. CNC programming based on CAD/CAM.

Text Books:

1. Computer Aided Manufacturing by Tien Chien Chang, Pearson Education

2. Automation, Production Systems and Computer Integrated Manufacturing by Groover, Pearson Education.
3. CAD/CAM, Groovers and Zimmers, Pearson

Reference Books:

1. CNC programming – Dr. S.K.Sinha – Goltotia publications.
2. Flexible Manufacturing Cells and System -William. W. Luggen Prentice Hall, EnglandCliffs, New jersey
3. P. Radhakrishnan, "Computer Numerical Control ", New Central Book Agency, 1992.
4. Computer integrated manufacturing -S. Kant Vajpayee – Prentice Hall of India.
5. Computer Aided Manufacturing- Rao, Tewari, Kundra, McGraw Hill, 1993
6. CAD/CAM, Principles and Applications –P N Rao, McGraw Hill, 2010
7. CAD/CAM, Introduction, -Ibrahim Zeid, Tata McGraw Hill, 2007

Digital Learning Resources

1. www.Nptel.ac.in

LIST OF EXPERIMENTS:

1. To prepare case study on CIM technology.
2. To study about Group Technology.
3. To Study about Flexible Manufacturing System.
4. To Study about Robot Technology.
5. To Study about Computer aided Production and Operation Management.
6. To study about Numerical Control in Machine Tool.
7. Manual Part Programming for Turning.
8. Manual Part Programming for Milling.
9. Manual Part Programming for Drilling.
10. Manual part programming for Parametric Subroutine.
11. APT programming for Turning, Drillingand Milling.

Subject: Finite Element Method (PE-5)								
Program: B. Tech. Mechanical Engineering				Subject Code: ME0723			Semester: VII (PE-5)	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
2	0	2	3	16/40	16/40	24/60	24/60	200

Course Objective

1. Understand the general steps of finite element methods.
2. Understand the basic finite element formulation techniques.

Course Outcomes

1. Be able to formulate and solve basic problems in heat transfer, solid mechanics and fluid mechanics.
2. Be able to carry out 1D, 2D and 3D simulations of any structural, thermal, modal analysis using software.
3. Be able to validate FEM based simulation results.

Content

UNIT-I

[10]

Introduction

Basic Concepts of Finite Element Analysis, Introduction to Elasticity, Steps in Finite Element Analysis

Finite Element Formulation Techniques

Virtual Work and Variational Principle, Galerkin Method, Finite Element Method: Displacement Approach, Stiffness Matrix and Boundary Conditions.

UNIT-II

[06]

Element Properties

Natural Coordinates, Triangular Elements, Rectangular Elements, Solid Elements, Isoparametric elements

UNIT-III

[08]

Analysis of Truss & Beams

Stiffness of Truss Members, Analysis of Truss, Stiffness of Beam Members, Finite Element Analysis of Continuous Beam

UNIT-IV

[08]

Thermal and Fluid Problems

Steady state heat transfer: Element formulations, treatment to boundary conditions with application to 1-D heat conduction, heat transfer through thin fins; Potential flow problems

Reference Books

1. T. Chandrupatla and A. G. Belegundu, "Introduction to Finite Elements in Engineering", Prentice Hall Inc., 2002
2. Rao S S, "The Finite Element Method in Engineering" Butterworth-Heinemann, 2010
3. J. N. Reddy, "Introduction to the Finite Element Method", McGraw-Hill Education, 2005
4. Zienkiewicz & Taylor, "The Finite Element Method", 5/e, Butterworth-Heinemann, 2000
5. Thompson, "Introduction to the FEM : Theory, Programming and Applications".
6. P.Seshu, "Text Book of Finite Element Analysis", Prentice Hall of India Pvt. Ltd. New Delhi, 2007.M.H. Sadd, "Elastic
7. ity: Theory, Applications and Numerics", Academic Press, 2006.

List of Experiments/Practical

Sr. No.	Practical/ Experiment title
1	To find deflection and stresses in one dimensional bar problem and validate with analytical method.
2	To find deflection and stresses in cantilever beam problem and validate with analytical method.
3	To find temperature distribution and heat transfer in one dimensional bar problem and validate with analytical method.
4	To find frequency and mode shapes of Fixed-Fixed beam and validate with

analytical method.

- 5** To study two dimensional structural problem using FE software.
- 6** To study two dimensional axis symmetric problem using FE software.
- 7** To study three dimensional structural problem using FE software.

Subject: Steam and Gas Turbine (PE-5)								
Program: B. Tech. (Mechanical)				Subject Code: ME0724			Semester: VII	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuou sInternal Evaluation (CIE) Theory	Continuou sInternal Evaluation (CIE) Practical	Total Marks
2	0	2	3	16/40	16/40	24/60	24/60	200

Course Objective

1. The course is designed to give fundamental knowledge of construction and working of various types of turbines and their components
2. To create knowledge and understanding of steam turbine, gas turbine, nozzles etc.

Course Outcomes

1. Analyse thermodynamic cycles of steam turbine and understand construction, working and significance of its various components
2. Analyse thermodynamic cycles of gas turbine power plant and jet propulsion systems

COURSE CONTENT

UNIT-1

[08]

1 Steam Nozzles

Types of nozzles, velocity of steam, discharge through nozzle, critical pressure ratio and condition for maximum discharge, physical significance of critical pressure ratio, nozzle efficiency

UNIT-2

[10]

2 Steam Turbine

Principle of operation, types of steam turbines, compounding of steam turbines, impulse turbine velocity diagram, calculation of work, power and efficiency, condition for maximum efficiency, Reaction turbines –velocity diagram, degree of reaction, reheat factor, governing of steam turbine–throttle, nozzle and bypass governing, Methods of attachment of blades to turbine rotor, Labyrinth packing, Losses in steam turbine, Special types of steam turbine-back pressure, pass out and mixed pressure turbine

UNIT-3

[10]

3 Gas Turbine

Classification, open and closed cycle, gas turbine fuels, actual Brayton cycle, optimum pressure ratio for maximum thermal efficiency, work ratio, air rate, effect of operating variables on the thermal efficiency and work ratio, and air rate, simple open cycle turbine with regeneration, reheating and Intercooling, Combined steam and gas turbine plant, requirements of combustion chamber, types of combustion chambers .

UNIT-4

[08]

4 Gas Dynamics and Jet Propulsion

Fundamentals of gas dynamics, energy equation, stagnation properties, isentropic flow through nozzle and diffusers, Introduction to shock waves, introduction to jet propulsion, advantages and disadvantages of jet propulsion – turbojet engine with and without after burner, turboprop, ram jet, pulse jet, rocket engines – operation, solid and liquid propellants

Texts Books

1. Power Plant Engineering, P.K. Nag, McGraw-Hill Education
2. Steam & Gas turbines, R. Yadav, Central publishing House, Allahabad.

Reference Books

1. Power Plant Engineering, R. K. Hegde, Pearson India Education
2. Gas Turbines, V. Ganeshan, McGraw Hill Education
3. Thermal Engineering, R.K.Rajput, Laxmi Publication
4. Steam Turbine Theory and Practice, William J. Kearton, CBS Publication
5. Gas Turbines, Cohen & Rogers, Pearson Prentice Hall

Web Resources

1. <http://nptel.ac.in/courses/112104117/18>
2. <http://nptel.ac.in/courses/112104117/4>
3. <http://nptel.ac.in/courses/112104117/17>

List of Experiments

1. To study various types of steam nozzles
2. To study various types of steam turbine
3. To study various types of gas turbines
4. To study various types of vapour power cycles
5. To study various types of gas dynamics
6. To study about jet propulsion

Subject: I.O.T for Smart Manufacturing (PE-5)								
Program: B. Tech (Mechanical)				Subject Code: ME0725		Semester: VII		
Teaching Scheme				Examination Evaluation Scheme (Marks)				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total
2	0	2	3	16/40	16/40	24/60	24/60	200

Course Objective:

1. To present a problem oriented in depth knowledge of IOT for Smart Manufacturing.
2. To address the underlying concepts and methods behind IOT & Smart Manufacturing.
3. To understand the basic concept of industry 4.0
4. Application of various technology in industry 4.0
5. Implementation of various production philosophy in industry 4.0
6. Analysis of various processes to implement the industry 4.0

Course Outcome:

After study this course students will be able

1. To know and learn the basics of IOT
2. To identify and select best technology for smart manufacturing
3. To convert the traditional manufacturing into smart manufacturing
4. To implement various production philosophy in industry 4.0
5. To apply the industrial internet of things

COURSE CONTENT**UNIT-1****[09]****1. Introduction of I.O.T**

The Internet of Things: An overview; Design Principles for Connected Devices; Internet Principles. Prototyping – Costs versus ease of prototyping, prototyping and Production, open source versus Closed Source. Prototyping Embedded devices – Electronics, Embedded Computing Basics, Arduino/ Raspberry Pi/ Beagle Bone Black/ etc., Electric Imp and other notable platforms Prototyping of Physical Design. Prototyping online Components – Getting Started with an API, Writing a New API

2. Internet of Things Privacy, Security and Governance

Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7, Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security

UNIT-2

[09]

3. Introduction of Industries 4.0

Introduction to First, second and third industrial revolution, challenges in third revolution, Opportunity and challenges in Industry 4.0 characteristic of industry 4.0, Industry 4.0 environment, Advantage and disadvantage of industry 4.0

4. Technologies in Industry 4.0

The vision of ubiquitous Computing, Cyber physical system, Internet of Things and Service (IoTS), Intelligent object, Intelligent system, Automatic identification and localization, Machine to Machine communication, Sensing and actuating, Data and information processing, Human machine interaction, Artificial Intelligence, Autonomy of action, Digital integration platforms

UNIT-3

[04]

5. Sensor, Actuators and Connectivity in Industry 4.0

Definition, Classification, Principle, Selection Criteria, Signal Conditioning, Calibration, Static and Dynamic characteristics, Introduction of communication protocols i.e., IEEE 802.15.4, Zigbee, 6LoWPAN, Wireless HART, Z- Wave, ISA-100, Bluetooth, NFC, RFID

UNIT-4

[08]

6. Production Systems in Industry 4.0

Sustainability assessment of manufacturing, Lean Production system, Just in Time production system, Agile Manufacturing, Smart and Business perspective, collaboration platform and product life cycle

7. IIoT Application

Machining, Casting, and Fabrication industries Factories and assembly line, Food industry, Healthcare, Power plant, Production planning and control Inventory management and quality control, Plant security and safety, facility management

Reference Books:

1. Bahga and V. Madiseti, Internet of Things, A hands-on approach, CreateSpace Independent Publishing Platform, 1st edition, 2014, ISBN: 978-09960255

2. D. Boswarthick, O. Elloumi, and O. Hersent, M2M communications: A systems approach, Wiley, 1st edition, 2012, ISBN: 978-1119994756
3. K. Laudon and J. Laudon, Management Information Systems, 14th edition, Pearson Higher Education, 2016, ISBN: 9780136093688.
4. A Rajaraman, J. Leskovec, J. Ullmann, Mining of Massive Data sets, Cambridge University Press, 2011, ISBN: 1107015359.
5. A. McEwen and H. Cassimally, Designing the Internet of Things, 1st edition, Wiley, 2013, ISBN-10: 111843062X.
6. N. Vengurlekar and P. Bagal, Database Cloud Storage: The Essential Guide to Oracle Automatic Storage Management, 1st edition, McGraw-Hill Education, 2013, ISBN-10: 0071790152.
7. M. Kuniavsky, Smart Things: Ubiquitous Computing User Experience Design, 1st edition, Morgan Kaufmann, 2010, ISBN-10: 0123748992.
8. F. Lamb, Industrial Automation: Hands on, 1st edition, McGraw-Hill Education, 2013, ISBN-10:0071816453.

List of Open-Source Software/learning website:

1. <https://www.edvicer.com/course/Introduction-to-Industry-4-0-and-Industrial-Internet-of-Things-105>
2. <https://www.tinkercad.com>

List of Practical:

1. Sketch the architecture of IoT Toolkit and explain each entity in brief
2. Study about Sensors, Gateway and Cloud interface
3. Study about Data analysis from cloud and reporting
4. Case study on application of IoT in casting industry
5. Case study on application of IoT in fabrication industry
6. Case study on application of IoT in machining industry
7. Case study on application of IoT in forming industry
8. Case study on application of IoT in quality control
9. Case study on application of IoT in production planning
10. Case study on application of IoT in maintenance

Subject: Artificial Intelligence (PE-6)								
Program: B. Tech. (Mechanical)				Subject Code: ME0726			Semester: VII	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuou sInternal Evaluation (CIE) Theory	Continuou sInternal Evaluation (CIE) Practical	Total Marks
2	0	2	3	16/40	16/40	24/60	24/60	200

Course Objectives

1. To be familiar with fundamentals of Artificial Intelligence (AI), history of AI, applications of AI.
2. To aware learner about AI environment and agents.
3. To acknowledge learner Problem definition, problem solving algorithms.
4. To learn about different strategies for searching of solution.
5. To aware learner about representation of knowledge based on logical agents.

Course Outcomes

1. Learner will be able to understand fundamentals of AI and requirement of AI.
2. Learner will be able to familiar with AI environment and its working.
3. Learner will be able to understand various search techniques to define problems and solutions
4. Learner will be able to apply different search strategies for solving problems.
5. Learner will be able to represent knowledge base with logical agents.

COURSE CONTENT

UNIT-1

[08]

1 Introduction to Artificial Intelligence

What is Artificial Intelligence?, Foundation of Artificial Intelligence, History of Artificial Intelligence, Applications of Artificial Intelligence.

UNIT-2

[08]

2 Intelligent Agents & Environment

Agents & Environment, The concept of Rationality, Nature of Environment, The structure of agents- Agent programs; Simple reflex agents; Model-based reflex agents; Goal-based agents; and Utility- based agents.

UNIT-3

[08]

3 Problem Solving & Search Techniques

Problem solving agents- Defining problems & Solution; Formulating problems; Real world problems, Searching for solutions- Infrastructure of searching algorithm; measuring problem solving performance, Search strategy-breadth first search; uniform cost search; depth first search; depth limited search; bidirectional search; Heuristic search- greedy best first search; A* Search; memory bounded search, Hill-climbing search, Introduction to Genetic Algorithm.

UNIT-4

[08]

4 Knowledge representation by logical agents

Knowledge based agents, Wumpus world, propositional logic; Proof of propositional theorem, propositional model checking and agent based propositional logic.

Text Books

1. Artificial Intelligence-A Modern Approach, Stuart Russel & Peter Norvig, Prentice Hall(Pearson Education), New Jersey, Third Edition, 2010
2. Artificial Intelligence, Elaine Rich, Kevin Knight, Shivashankar B. Nair, Tata McGraw-Hill, New Delhi, 3rd Edition, 2008.

Reference Books

1. Stefan Edelkamp and Stefan Schroedl, Heuristic Search: Theory and Applications, Morgan Kaufmann, 2011.
2. John Haugeland, Artificial Intelligence: The Very Idea, A Bradford Book, The MIT Press, 1985.
3. Pamela McCorduck, Machines Who Think: A Personal Inquiry into the History and Prospects of Artificial Intelligence, A K Peters/CRC Press; 2 edition, 2004.
4. Zbigniew Michalewicz and David B. Fogel. How to Solve It: Modern Heuristics. Springer; 2nd edition, 2004.
5. Judea Pearl. Heuristics: Intelligent Search Strategies for Computer Problem Solving, Addison-Wesley, 1984.

Web resources

1. <https://nptel.ac.in/courses/106105079/>
2. <https://nptel.ac.in/courses/106105077/>
3. <https://www.edx.org/course/artificialintelligence>
4. <https://www.coursera.org/specializations/artificialintelligence>

MOOCS

1. <https://www.edx.org/course/robotics-artificial-intelligence-pennx-robo1x>
2. <https://www.edx.org/learn/artificial-intelligence>
3. <https://www.my-mooc.com/en/categorie/artificial-intelligence>
4. <https://www.classcentral.com/subject/artificial-intelligence>

5. <https://www.my-mooc.com/en/categorie/artificial-intelligence>

LIST OF EXPERIMENTS

1. Write a program to implement Tic-Tac-Toe game problem
2. Write a program to implement BFS for Water Jug problem
3. Write a program to implement Single Player chess game(Using Heuristic Function)
4. Write a program to solve N-Queens problem using MATLAB.
5. Write a program to solve 8 puzzle problem using MATLAB.
6. Write a program to solve travelling salesman problem using MATLAB.
7. Write a program to implement DFS for 8 puzzle problem.
8. Write a program to Implement A* Algorithm.

Subject: Refrigeration & Air Conditioning (PE-6)								
Program: B. Tech. Mechanical Engineering				Subject Code: ME0727			Semester: VII	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuou sInternal Evaluation (CIE) Theory	Continuou sInternal Evaluation (CIE) Practical	Total Marks
2	0	2	4	16/40	16/40	24/60	24/60	200

Course Objectives

1. To identify various methods of Refrigeration.
2. To understand various applications of Refrigeration & Air Conditioning.
3. To understand the importance of various equipments used in Refrigerator & AirConditioning Systems.

Course Outcome

1. To understand the fundamental concepts of Refrigeration & Air Conditioning Systems.
2. To analyze different Refrigeration cycles.
3. Compare the performance of different refrigerants.
4. Estimate Heating & Cooling Loads for various applications.

COURSE CONTENT

UNIT-1

[08]

1 Introduction:

Brief history and need of refrigeration and air conditioning, methods of producing cooling, ton of refrigeration, coefficient of performance, Ideal refrigeration cycles; air- refrigeration, Bell-Coleman cycle, open and dense air systems, actual air-refrigeration system.

UNIT-2

[08]

2 Vapour Compression System

Working principle and essential components of the plant – simple vapour compression refrigeration cycle – COP – representation of cycle on T-S and p-h charts, actual cycle influence of various parameters on system performance – use of p-h charts – numerical problems.

3 Vapour Absorption Refrigeration System

Comparison of VCRS & VARS , Advantages of VARS Refrigeration Systems, Types of VARS Systems (practical water -NH₃ cycle Li-Br system) and its working, Electrolux Refrigeration Systems.

UNIT-3

[08]

4 Refrigerants

Development, classification, designation of refrigerants, secondary refrigerants, future industrial refrigerants

5 Psychrometry & Human Comfort

Psychometric – Composition of air and its effect on human comfort; psychometric terms – specific humidity, relative humidity percentage humidity and absolute humidity; temperatures – dry bulb, wet bulb and dew point; Psychometric processes: different types of psychometric processes sensible heating and cooling process, Latent heating and cooling process, heating with humidification, cooling with dehumidification, adiabatic cooling; air washer process; contact and bypass factor; apparatus dew point; condition line; sensible heat factor; calculation of ADP with the help of the chart; Requirement of human comfort.

UNIT-4

[08]

6 Air-conditioning systems:

Classification, system components, all air; all water; and air-water systems, room air conditioners, packaged air conditioning plant, central air conditioning systems, split air conditioning systems

7 Load analysis:

Site survey, outdoor and indoor design conditions, classification of loads, flywheel effect of building material and its use in design, effect of wall construction on cooling load, instantaneous heat gain (IHG) and instantaneous cooling load (ICL) heat transmission through sunlit and shaded glass using tables, method of reduction of solar heat gain through glass, calculations of cooling load TETD due to sunlight and shaded roof and walls using tables, ventilation and air infiltration, load due to outside air, heat gain from occupants; electric lights; product; electric motor and appliances, load calculations.

Text Books

1. Refrigeration and air conditioning; Rajput R.K, S. K. Kataria & Sons; Delhi, 2009
2. Textbook of Refrigeration and Air-conditioning, R.S.Khurmi, S.Chand Publication.
3. Refrigeration and Air Conditioning, Arora. C.P Tata McGraw-Hill New Delhi, 1988.

Reference Books

1. Refrigeration and Air Conditioning, Manohar Prasad, Wiley Eastern Ltd.
2. Refrigeration and Air-Conditioning, S C Arora & S Domkundwar, Dhanpat Rai Publication, 2009
3. Refrigeration and Air Conditioning, AhmadulAmeen, Prentice Hall of India Pvt. Ltd.

4. Refrigeration and Air-conditioning ,Ramesh Arora, Prentice Hall of India, 2010

Web resources

1. <https://www.ashrae.org/>
2. <http://textofvideo.nptel.ac.in/112107208/lec4.pdf>
3. <https://nptel.ac.in/downloads/112105129/>

MOOCS

1. https://onlinecourses.nptel.ac.in/noc18_me42/preview
2. <https://swayam.gov.in/search?keyword=Refrigeration%20and%20air-conditioning>
3. <http://nptel.ac.in/courses/112105128>

LIST OF EXPERIMENTS

1. To study Heat Engine, eat pump and refrigerator.
2. To understand different components of VCR system and to determine its COP
3. To study and calculate capacity & COP of Vapour Absorption Refrigeration(VAR)(Electrolux Refrigeration) system
4. To carry out heating process of fresh air and find out relevant parameter of air and also plot the process on psychrometric chart.
5. To carry out cooling process of fresh air and find out relevant parameter of air and also plot the process on psychrometric chart.
6. Study of Air Conditioning system and calculate COP of Air Conditioning system with the help of P-H Chart.
7. To determine COP and apparatus dew point of an air conditioning test rig.
8. To calculate cooling load of a confined space using table and compare the same with load estimation sheet.
9. To find out Performance parameters of Cooling Tower
10. To find the performance parameters of Ice Plant.

Subject: Theory of Metal Forming Technology (PE-6)								
Program: B. Tech. (Mechanical)				Subject Code: ME0728			Semester: VII	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
2	0	2	3	16/40	16/40	24/60	24/60	200

Course Objectives:

1. Understand the basics of metal forming.
2. Understanding of working principle of various forming processes

Course Outcomes:

After learning the course the students should be able to:

1. Identify various forming process
2. Identify and determine various methods rolling processes
3. Identify and determine various methods to forging processes
4. Identify and determine various methods to extraction processes
5. Identify and determine various methods to Drawing processes
6. Identify and determine various methods to Sheet metal forming processes

**COURSE
CONTENT
UNIT-1**

[08]

Introduction:

Classification of forming processes and advantages of metal forming, Introduction to hot forming, cold forming, warm forming its advantages and disadvantages Typical stress strain diagram for ductile materials Forming properties of metals and alloys (yield strength/flow stress, ductility, strain hardening, strain rate sensitivity, effect of temperature and hydrostatic pressure on yield strength), State of stress at a point, stresses on an inclined plane, Principal Stress, Two and three dimensional Mohr's circle for stress analysis,

Deformation and strain, Stress of strain at a point.

UNIT-2

[08]

Theory of Elasticity:

Review of theory of elasticity, Stress tensor, stress transformations, principal stresses, differential equations of equilibrium, spherical and deviatoric stress

tensors, octahedral stresses, infinitesimal and affine transformation for deformation, rotation and strain tensors, strain transformations, principal strains, spherical and deviator strain tensors, octahedral strains, finite deformations, Mohr's circles for state of stress and state of strain, generalized Hooke's law, Hooke's law for isotropic and homogeneous materials, plane stress and plane strain.

Theory of Plasticity:

Introduction to the theory of plasticity, stress space, yield criterion for metals, Von-Mises' yield criterion, Tresca's yield criterion, representation of the above in stress space, yield surface. Basic considerations of plasticity theory, simple models of material behavior, Levy-Mises (flow rule) and Prandtl - Reuss stress strain relations.

UNIT-3

[08]

Theory of slip lines:

Slip Line Field Theory, Incompressible two-dimensional flow, slip lines, equilibrium equations (referred to slip lines), Henkey's theorems, hodograph, simplest slip line fields, application in forming processes—extrusion and forging. Upper bound theorem and Lower bound theorem. Introduction to forming limit diagram, Friction and lubrication in forming processes

UNIT-4

[08]

Metal forming processes:

Rolling- types of rolling, determination of rolling pressure, driving torque and power, power loss in bearings, defects.

Wire drawing- determination of drawing force and power, maximum allowable reduction, effects.

Extrusion-determination of work load, defects.

Forging— types of forging, determination of maximum force required for forging a strip and a disc between two parallel dies (open die forging), defects.

Deep-drawing- analysis to correlate the initial and final dimensions of the job, estimation of the drawing force, defects.

Bending- determination of work load, estimation of spring back. Punching and blanking –mode of metal deformation and failure, deformation model and fracture analysis, determination of working force, Friction and Lubrication in metal forming.

High Energy Rate Forming processes:

Explosive forming, Electro-hydraulic forming, Electromagnetic Forming.

Text Books:

1. Principles of Metal Castings - Heine, Loper and Rosenthal (TMH)
2. Principles of Foundry Technology - P.L. Jain (TMH)
3. Metal Castings – Principles & Practice - T.V. Ramana Rao. (New Age International Pvt.Ltd. Publishers)

Reference Books:

1. Mechanization of Foundry Shops – Machine Construction - P.N. Aeksenov (MIR)
2. Fundamentals of Metal Casting Technology - P.C. Mukherjee (Oxford, IBH)
3. Foundry Engineering – Taylor, Fleming & Wulff (John Wiley)

Web resources:

1. <https://nptel.ac.in/courses/112107083/>
2. <http://www.industry.siemens.com/verticals/metals-industry/en/metals/steelmaking/ld-steelmaking/Pages/home.aspx>
3. http://www.carbonandgraphite.org/pdf/steel_production.pdf
4. <http://corporate.arcelormittal.com/who-we-are/from-ore-to-steel>
5. <http://www.topforge.co.uk/Processes.htm>
6. <http://en.wikipedia.org/wiki/Steelmaking>

List of Experiments:

1. To construct a slip-line net for upsetting a work piece.
2. Experimental determination of stress strain behavior for ductile material and to evaluate the various elastic and plastic constants.

Subject: Introduction to Research (OE-9)								
Program: B. Tech. (Mechanical)				Subject Code: ME0729			Semester: VII	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
3	0	0	3	16/40	***	24/60	***	100

Course Objectives:

1. To familiarize participants with basic of research and the research process.
2. To understand difference between discovery and research.
3. To select and define appropriate research problem and parameters.
4. To organize and conduct research (advanced project) in a more appropriate manner
5. To enable the participants in conducting research work and formulating research synopsis and report.

Course Outcomes:

1. After learning the course, the students should be able to:
2. Develop understanding of the basic framework of research process.
3. Develop understanding of various research designs and techniques.
4. Identify various sources of information for literature review and data collection.
5. Develop an understanding of the ethical dimensions of conducting applied research.
6. Appreciate the components of scholarly writing and evaluate its quality.
7. Be aware of the ethical principles of research, ethical challenges and approval processes
8. Describe quantitative, qualitative and mixed methods approaches to research.
9. Critically analyze published research.

COURSE CONTENT UNIT-1

[10]

Research Methodology:

An Introduction: Meaning, Objectives, Motivation, Types of Research, Research Approaches, Significance of Research, Research Process, Criteria of Good Research

Strategy and Tools for Discovery

Strategic Planning Development Strategy and Process Assessment, Applying Search Strategies to Find Information, Discovery Procedures, types of discovery,

Method of discovery, Techniques of discovery, Different between discovery and research

UNIT-2

[10]

Research Problem Formulation:

Selecting the Problem, Necessity of Defining the Problem, Literature Survey, Guidelines for literature review

Research Design:

Meaning of Research Design, Need for Research Design, Different Research Designs, and Basic Principles of Design.

UNIT-3

[12]

Probability, Sampling and its Distributions:

Probability laws, Probability distributions, Normal Distribution, Exponential distribution, Binomial distribution, Poisson distribution, Sampling, Sampling Design Process, Sampling Methods, Sampling distributions

Design of Experiments and Regression Analysis:

Planning of experiments, Taguchi Approach, Curve fitting, Types of regression analysis: Simple and Multiple regression analysis, Data analysis, Interpretation of results

UNIT-4

[14]

Structure of Thesis Report and thesis writing:

Preliminary Pages, Main body of Thesis, Summary, Appendices, References Steps in writing the report, mechanics of writing, Presentation of figures and tables

Writing of papers and Synopsis:

Audience Analysis, Preparing papers for Journals, Preparation of Synopsis

Text Books:

1. Research Methodology for Engineers – R. Ganesan, MJP Publishers
2. Research Methodology: Methods and Techniques – C. R. Kothari, Publisher New – Age International
3. Research Methodology by Deepak Chawla & Neena Sodhi S. Chand Publication

References:

1. Business Research Methods- Naval Bajpai Pearson Publication
2. Uma Sekaran, Research Methods for Business, John Wiley and Sons Inc., New York, 2000.

3. Gupta, S.P. Statistical Methods, 30th Sultan Chand, New Delhi

Web Resources:

1. <http://computationalengineering.mit.edu/research/methodology>
2. <http://www.asce.org/>
3. <http://www.asme.org/>

MOOC:

1. <https://nptel.ac.in/courses/121106007/>
2. <https://nptel.ac.in/courses/107108011/>

Subject: Fundamentals of Research (PROJ)								
Program: B. Tech. (Mechanical)				Subject Code: ME0730			Semester: VII	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
0	0	4	2	-	16/40	-	24/60	100

Students will carry out following activities step by step in this semester,

1. Select domain of their interest
2. Select tentative title from the domain along with like minded colleagues (maximum four, who are interested to work with this title)
3. Consultations and selection of probable supervisor/guide best suit for the title.
4. To collect (Twenty five to fifty) literatures (research papers, articles, technical notes, surveys, case studies etc. of REPUTED publishers) on origin of domain to latest technological updates
5. To search (TEN) patents relevant to the probable title
6. To identify research gaps and state systematically
7. Finalise more specific and defining Title after feasibility check
8. To state objectives on which work can be carried out
9. These group of the students are required to carry out PROJECT work in the final semester (Semester-VIII) with the same TITLE and OBJECTIVES

Subject: Internship								
Program: B. Tech. (Mechanical)				Subject Code: ME0731			Semester: III	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE) Theory	Continuous Internal Evaluation (CIE) Practical	Total Marks
0	0	0	2	NA	40/100	NA	NA	100

Note: At the end of 6th Semester – during summer break each student has to complete one month internship in the industry and submit certificate, report and appear for presentation in 7th semester.

SEMESTER-VIII

Indus University, Ahmedabad

Mechanical Engineering Department

B. Tech Mechanical Engineering Teaching Scheme 2021-2025

B. Tech Semester-VIII

Subject Details				Teaching Scheme					Evaluation Scheme				
									Theory		Practical		Total
Sr. No.	Subject Type	Subject Code	Subject Name	L	T	P	Credits	Hours	CIE	ESE	CIE	ESE	Marks
1	PROJ	ME08158	Project	0	0	26	13	26	0	0	60	40	100
Total				0	0	26	13	26	0	0	60	40	100