



Bansilal Ramnath Agarwal Charitable Trust's

# **Vishwakarma Institute of Technology**

(An Autonomous Institute affiliated to Savitribai Phule Pune University formerly University of Pune)

**Structure & Syllabus of**

## **B.Tech. (Mechanical Engineering)**

(SY, TY and Final year B. Tech Mechanical Engineering Applicable for AY 2023-24)

**Prepared by: - Board of Studies in Mechanical Engineering**

**Approved by: - Academic Board, Vishwakarma Institute of Technology, Pune**

**Signed by**

**Chairman – BOS Chairman – Academic Board**

## Department of Mechanical Engineering Index

Sr. No.	Subject Code	Title	Page
		Vision and Mission of the Department	4
		Course Structure	7
		<b>Course Contents SY Mechanical Module – III</b>	
1	MD2201	Data Science	15
2	CS2221	Internet of Things	21
3	CS2218	Object Oriented Programming	27
4	ME2205	3-D Printing	45
5	ME2206	Mechanics of Materials	54
6	MD2291	Engineering Design & Innovation – III	58
7	ME2295	Design Thinking	
		<b>Course Contents SY Mechanical Module – IV</b>	
8	ME2201	Fluid Engineering	63
9	ME2202	Machine Design	68
10	ME2203	Thermodynamics	74
11	ME2204	Analysis And Simulation Of Machines And Mechanisms	81
12	ME2207	Machine Drawing	87
13	MD2292	Engineering Design And Innovation – IV	89
14	ME2296	Design Thinking	
		<b>Course Contents TY Mechanical Module – V</b>	
15	ME3253	Hydraulic Machines And Fluid Power	95
16	ME3262	Dynamics Of Machines	101
17	ME3263	Hybrid And Electric Vehicles	106
18	ME3254	Mechatronics	114
19	ME3293	Engineering Design And Innovation – V	120
20	ME 3295	Design Thinking – I	
		<b>Course Contents TY Mechanical Module – VI</b>	
21	ME3266	Applied Thermal Engineering	125
22	ME3301	Materials And Process Engineering	131
23	ME3302	Heat Transfer	139
24	ME3276	Mechanical System Design	144
25	ME3293	Engineering Design And Innovation – VI	153
26	ME3295	Design Thinking – I	
		<b>Course Contents B.Tech Mechanical Module -VII</b>	
27	ME4251	CAD/CAM/CAE	158
28	ME4280	Computational Fluid Dynamics	161
29	PR4203	Die and Mold Design	164
30	ME4253	Vibration Analysis	169
31	ME4254	Refrigeration And Air Conditioning	173
32	ME4261	Power Plant Engineering	178
33	MD4206	Marketing Management	186
34	PR4213	World Class Manufacturing & Industry 4.0	190
35	IE4211	Design for X and Product Lifecycle Management	193

36	IE4212	Data Analytics for Engineers	198
37	MD4202	Project Management	201
38	IE4214	Operation Scheduling	205
39	ME4202	Computer Integrated Manufacturing	209
40	ME4255	Major Project	213
	<b>Course Contents B.Tech Mech. Module – VIII</b>		
41	ME4273	Research Internship	218
42	ME4275	Project Internship	221
43	ME4276	Industry Internship / (Capstone Project)	224
44	ME4277	International Internship	227

## **Vishwakarma Institute of Technology, Pune**

### **Vision and Mission of the Institute**

#### **Vision:**

To be a globally acclaimed Institute in Technical Education and Research for holistic Socio-economic development

#### **Mission:**

- To ensure 100% students are employable and employed in Industry, Higher Studies, become Entrepreneurs, civil/Defence Services/Govt Jobs and other areas like Sports and Theatres.
- To strengthen academic practices in terms of curriculum, pedagogy, assessment and faculty competence
- Promote research culture among students and faculty through projects and consultancy
- To make students socially responsible citizens

#### **Core Values**

1. Faculty Centric Initiatives
2. Academic Practices
3. Research Culture
4. Use of Technology for Social and National Development

### **Vision and Mission of the Department**

#### **Vision:**

To be recognized as one of the pre-eminent Mechanical Engineering Programs

#### **Mission:**

- To prepare students competent to make their careers in Mechanical Engineering
- To provide value education to students to make them responsible citizen
- To strengthen collaborations with Industries, Academia and Research Organizations to enrich learning environment and to enhance Research Culture
- To be recognized as a leading Mechanical Engineering Department in the field of knowledge, skill and research

## Program Educational Objectives

- To work independently as well as in team to formulate, design, execute solutions for engineering problems and also analyse, synthesize technical data for application to product, process, system design & development
- To understand & contribute towards social, environmental issues, following professional ethics and codes of conduct and embrace lifelong learning for continuous improvement
- To develop expertise towards use of modern engineering tools, instruments, programming languages and software's
- To acquire and develop careers in industries, Research organizations, academia and demonstrate entrepreneurial skill

## Program Outcomes and Program Specific Outcomes (POs & PSOs)

**PO1:-Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**PO2:-Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**PO3:-Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**PO4:-Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**PO5:-Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

**PO6:-The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**PO7:-Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**PO8:-Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**PO9:-Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**PO10:-Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**PO11:-Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**PO12:-Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

### **Program Specific Outcomes (PSO) Mechanical Engineering**

**Mechanical Engineering Graduates will be able to:**

**PSO1:-** Demonstrate knowledge and understanding about machine drawing and modelling of mechanical engineering components & systems and selection of appropriate materials and manufacturing processes for their production.

**PSO2:-** Understand the working of mechanical engineering components & systems and thereby design, analyse and conduct experiments for enhancement of performance.

**PSO3:-** Ability to apply multidisciplinary approach and usage of modern hardware & software tools for the development of smart mechanical engineering components & systems

**COURSE STRUCTURE****Department: Mechanical****Course Structure- FF. No: 653****SY MECH.****MODULE-III****AY: 2023-24**

S r. N o .	Subject Code	Subject Name	Teaching Scheme (Hrs/Week)			Examination scheme						Tota l	Credi ts
			T he or y	La b	Tu t	CA			MSE	ESA			
						H A	Lab/C P	PPT/G D	MSE	ESE	CVV		
S 1	MD220 1	DATA SCIENCE	2	2	1	20	20	20		20	20	100	4
S 2	CS2221	INTERNET OF THINGS	2	2	1	20	20	20		20	20	100	4
S 3	CS2218	OBJECT ORIENTED PROGRAMMING	2	2	1	20	20	20		20	20	100	4
S 4	IT2201	COMPUTER ORGANIZATION AND ARCHITECTURE	2	2	1	20	20	20		20	20	100	4
	ME 2205	3-D PRINTING	2	2	1	20	20	20		20	20	100	
S 5	ME 2206	MCHANICS OF MATERIALS	2	-	-	20	-	-	20	40	20	100	2
S 6	MD229 1*	ENGINEERING DESIGN & INNOVATION – III	-	12	-	-	-	-	30	70	-	10	6
S 7	ME229 5*	DESIGN THINKING	-	-	1	-	-	-	- -	-	-	100	1
Total			8	20	5								25

**SY MECH. MODULE-IV AY: 2023-24**

Su b. No .	Sub. Code	Subject Name	Teaching Scheme(Hrs. /Week)			Examination scheme						Tot al	Cr ed its
			Th .	L a b	Tut	CA			MSE	ESA			
						H A	LAB/ CP	PPT/ GD		ESE	CVV		
S1	ME 2201	FLUID ENGINEERING	2	2	1	20	20	20		20	20	100	4
S2	ME 2202	MACHINE DESIGN	2	2	1	20	20	20		20	20	100	4
S3	ME 2203	THERMODYNAMI CS	2	2	1	20	20	20		20	20	100	4
S4	ME 2204	ANALYSIS AND SIMULATION OF MACHINES AND MECHANISMS	2	2	1	20	20	20		20	20	100	4
S5	ME 2207	MACHINE DRAWING	2	-	-	20	-	-	20	40	20	100	2
S6	ME 2292**	ENGINEERING DESIGN AND INNOVATION -IV		12					30	70		100	6
S7	ME 2296**	DESIGN THINKING	-		1					100		100	1
Total			8	20	5								25

\* Irrespective of module in sem.- 1 \*\* Irrespective of module in sem.- 2



**TY MECH. MODULE-V AY: 2023-24**

Sub · No.	Sub. Code	Subject Name	Teaching Scheme(Hrs./Wee k)			Examination scheme						Tota l	Credit s
			Th.	Lab	Tut	CA			MS E	ESA			
						H A	LAB/C P	PPT/G D		ES E	CV V		
S1	ME325 3	HYDRAULIC MACHINES AND FLUID POWER	2	2	1	20	20	20		20	20	100	4
S2	ME326 2	DYNAMICS OF MACHINES	2	2	1	20	20	20		20	20	100	4
S3	ME326 3	HYBRID AND ELECTRIC VEHICLES	2	2	1	20	20	20		20	20	100	4
S4	ME325 4	MECHATRONI CS	2	2	1	20	20	20		20	20	100	4
S5	ME329 3*	ENGINEERING DESIGN AND INNOVATION - V	-	12	-				30		70	100	6
S6	ME 3295*	DESIGN THINKING –I	-		1					10 0		100	1
Total			8	20	5								23

**TY MECH. MODULE-VI AY: 2023-24**

Sub · No.	Sub. Code	Subject Name	Teaching Scheme(Hrs/Wee k)			Examination scheme						Tota l	Credit s
			Th.	Lab	Tut	CA			MS E	ESA			
						H A	CP/LA B	PPT/G D		ES E	CV V		
S1	ME3266	APPLIED THERMAL ENGINEERIN G	2	2	1	20	20	20		20	20	100	4
S2	ME3301	MATERIALS AND PROCESS ENGINEERIN G	2	2	1	20	20	20		20	20	100	4
S3	ME3302	HEAT TRANSFER	2	2	1	20	20	20		20	20	100	4
S4	ME3276	MECHANICA L SYSTEM DESIGN	2	2	1	20	20	20		20	20	100	4
S5	ME3294* *	ENGINEERIN G DESIGN AND INNOVATIO N - VI	-	12	-				30	70		100	4
S6	ME3296* *	DESIGN THINKING-II	-	-	1					10 0		100	1
Total			8	20	5								23

\* Irrespective of module in sem.- 1 \*\* Irrespective of module in sem.- 2

Department: Mechanical

Course Structure- FF. No: 653

B.Tech. MECH.

MODULE-VII AY: 2023-24

Sub No.	Sub. Code	Subject Name	Teaching Scheme(Hrs/Week)			Examination scheme						Total	Credits
			Th.	Lab	Tut	CA			MSE	ESA			
						HA	LAB	PPT/GD		ESE	CVV		
S1	-	Open Elective -I	2			10			30	30	30	100	2
S2	-	Open Elective -II	2			10			30	30	30	100	2
S3	-	Open Elective -III	2			10			30	30	30	100	2
S4	ME4255/56	Major Project		20					30	70		100	10
Total			6	20									16

**List of Open Electives**

Course code	Course name	Contact hours per week			Credits
		Theory	Lab	Tut	
MD4206	MARKETING MANAGEMENT	2	-	-	2
ME4251	CAD/CAM/CAE	2	-	-	2
ME4280	COMPUTATIONAL FLUID DYNAMICS	2	-	-	2
ME4202	COMPUTER INTEGRATED MANUFACTURING	2	-	-	2
IE4211	DESIGN FOR X & PRODUCT LIFE CYCLE MANAGEMENT	2	-	-	2
PR4203	DIE & MOLD DESIGN	2	-	-	2
ME4253	VIBRATION ANALYSIS	2	-	-	2
ME4254	REFRIGERATION AND AIR CONDITIONING	2	-	-	2
ME4261	POWER PLANT ENGINEERING	2	-	-	2
PR4215	HUMAN FACTOR ENGINEERING	2	-	-	2
IE4212	DATA ANALYTICS FOR ENGINEERS	2	-	-	2
IE4214	OPERATION SCHEDULING	2	-	-	2
PR4213	WORLD CLASS MANUFACTURING & INDUSTRY 4.0	2	-	-	2
MD4202	PROJECT MANAGEMENT	2	-	-	2

Department: Mechanical

Course Structure- FF. No: 653

B.Tech. MECH. MODULE-VIII AY: 2023-24

(Internship / (CAPSTONE PROJECT))

Su b. No.	Sub. Code	Subject Name	Teaching Scheme(Hrs/Wee k)			Examination scheme						Tot al	Credit s
			Th.	Lab	Tut	CA			MS E	ESA			
						H A	LA B	PPT/G D		ES E	CV V		
S1	All internshi ps	Internshi p							30	70		100	16
Total													16

**Internships**

Subject head	Course code	Course name	Contact hours per week			Credits
			Theory	Lab	Tut	
OE	ME4276	INDUSTRY INTERNSHIP / (CAPSTONE PROJECT)	-	-	-	16
OE	ME4273	RESEARCH INTERNSHIP	-	-	-	16
OE	ME4275	PROJECT INTERNSHIP	-	-	-	16
OE	ME4277	INTERNATIONAL INTERNSHIP	-	-	-	16
OE	ME4278	CAPSTONE PROJECT-(offered for students going for one year industry internship)	-	-	-	16
OE	ME4279	CAPSTONE PROJECT-INTERNATIONAL-(offered for students going for one year international internship)	-	-	-	16
		TOTAL	-	-	-	16

**SY MECH. MODULE-III AY: 2022-23**

Sr. No	Subject Code	Subject Name	Teaching Scheme (Hrs/Week)			Examination scheme						Total	Credits
			Theory	Lab	Tut	CA			MS E	ESA			
						HA	Lab/CP	PPT/GD	MS E	ES E	CV V		
S1	MD2201	DATA SCIENCE	2	2	1	20	20	20		20	20	100	4
S2	CS2221	INTERNET OF THINGS	2	2	1	20	20	20		20	20	100	4
S3	CS2218	OBJECT ORIENTED PROGRAMMING	2	2	1	20	20	20		20	20	100	4
S4	IT2201	COMPUTER ORGANIZATION AND ARCHITECTURE	2	2	1	20	20	20		20	20	100	4
	ME 2205	3-D PRINTING	2	2	1	20	20	20		20	20	100	
S5	ME 2206	MCHANICS OF MATERIALS	2	-	-	20	-	-	20	40	20	100	2
S6	MD2291*	ENGINEERING DESIGN & INNOVATION – III	-	12	-	-	-	-	30	70	-	10	6
S7	ME2295*	DESIGN THINKING – III*	-	-	1	-	-	-	-	-	-	100	1
8				20	5								25

# **SY MECHANICAL MODULE-III**

FF No. : 654

Syllabus Template  
**MD2201: DATA SCIENCE**

**Course Prerequisites:**

1. Linear Algebra Basics
2. Central Tendency & Measures of Dispersion – Mean, Mode, Median
3. Probability
4. Some exposure to programming environment – C programming; Python

**Course Objectives:**

1. Understand data processing pipeline
2. Perform dimensionality reduction operations
3. Optimize the performance of functions
4. Apply descriptive statistics tools
5. Deduce meaningful statistical inferences
6. Use unsupervised classification algorithms
7. Use supervised classification algorithms
8. Utilize the data science principles for an entire project life cycle as a case study

**Credits: 4****Teaching Scheme Theory: 2 Hours/Week****Tut: 1 Hours/Week****Lab: 2 Hours/Week****Course Relevance:**

The course is offered in S.Y. B.Tech. to all branches of Engineering

Data Science is a multidisciplinary field. It uses scientific approaches, procedures, algorithms and frameworks to extract knowledge and insight from a huge amount of data.

Data Science uses concepts and methods which belong to fields like information technology, Mathematics, Statistics, Computer Science etc.

Data Science influences the growth and improvements of the product by providing a lot of intelligence about customers and operations, by using methods such as data mining and data analysis.

The course is relevant to all branches of Engineering and beyond, since data is generated as an obvious outcome of many processes.

Data science definition, raw data, processed data and their attributes, meta data, data cleaning, data science pipeline. **(3 Hours)**

Normal distribution, evaluating normal distribution, Binomial distribution, confidence Intervals, central limit Theorem, hypothesis testing **(6 Hours)**

Vector norms, Unconstrained Optimization **(4 Hours)**

Simple and multiple linear regression; Logistic regression, non-linear regression, polynomial regression **(4 Hours)**

Nearest Neighbor Classification – Knn approach, branch and bound algorithm, projection algorithm; Naïve Bayes Classification; Classification using decision trees, divisive and agglomerative clustering, K-means clustering **(6 Hours)**

Evaluation of model performance – Confusion matrices, sensitivity, specificity, precision, recall, F-measure, Classifier performance measurement metrics – Training & Testing strategies – Resubstitution, Hold-out, Cross validation, Bootstrap **(3 Hours)**

**List of Tutorials:**

1. Data Visualization
2. Distances and Projections
3. Singular Value Decomposition
4. Principal Component Analysis
5. Optimization
6. Normal & Binomial Distribution
7. Hypothesis Testing
8. ANOVA test
9. Linear Regression
10. Logistic Regression
11. Nearest Neighbor Classification
12. Decision Trees based classification
13. Naive Bayes classification
14. Clustering
15. Evaluation of model performance
16. Bagging & Boosting approaches



**List of Practical's: (Any Six)**

1. Data visualization
2. Unconstrained Optimization
3. Hypothesis Testing
4. Linear regression
5. Logistic Regression
6. Nearest Neighbor classification
7. Naive Bayes classification
8. Clustering
9. Classifier performance using Confusion matrix and other attributes
10. Cross Validation methods

**List of Course Projects:**

1. Movie recommendation system
2. Customer Segmentation using Machine Learning
3. Sentiment analysis
4. Uber Data analysis
5. Loan prediction
6. HVAC needs forecasting
7. Customer relationship management
8. Clinical decision support systems
9. Development of machine learning solutions using available data sets (multiple projects)
10. Fraud detection

**List of Course Seminar Topics:**

1. Data wrangling
2. Predictive modeling
3. Data analytics in life science (multiple topics)
4. Ensemble modeling techniques
5. Text pre-processing
6. Feature scaling for machine learning
7. Multivariate normal distribution applications
8. Distance metrics and their applications
9. Visualization techniques such as Chernoff's faces
10. Tree based algorithms
11. Ridge regression
12. LASSO

**List of Course Group Discussion Topics:**

1. PCA and ICA
2. Hierarchical and non hierarchical systems
3. Linear - Non linear regression
4. Parametric-non parametric estimation
5. Over fitting and under fitting in the context of classification
6. Linear and Quadratic discriminant analysis
7. Regression v/s classification
8. Classifier performance measures
9. Supervised and unsupervised learning
10. Various clustering approaches
11. Classifiers and classifier combinations
12. Balancing errors in hypothesis testing
13. Standard sampling practices for a successful survey for reliable sample data

**List of Home Assignments:**

**Case Study:** A very large number of resources are available for data generated out of case study. Unique Home assignments will be set up for all groups

**Surveys:** Principles of surveying will be implemented by groups to demonstrate use of data science principles in home assignments

**Text Books: (As per IEEE format)**

1. 'A Beginner's Guide to R' – Zuur, Leno, Meesters; Springer, 2009
2. 'Introduction to Data Science' – Iguar, Segui; Springer, 2017
3. 'Mathematics for Machine Learning' – Densenroth, Faisal, Ong; Cambridge University Press, 2017
4. 'Machine Learning with R' – Lantz, Packt Publishing, 2018

**Reference Books: (As per IEEE format)**

1. 'Elements of Statistical Learning' - Hastie, Tibshirani, Friedman; Springer; 2011
2. 'Data Science from Scratch' - Grus; Google Books; 2015
3. 'The art of Data Science' - Matsui, Peng; 2016
4. 'Machine Learning for absolute beginners' - Theobald; Google Books; 2017

**Moocs Links and additional reading material:** [www.nptelvideos.in](http://www.nptelvideos.in)

1. <https://www.edx.org/course/machine-learning-fundamentals-2>
2. <https://www.edx.org/course/foundations-of-data-analysis-part-1-statistics-usi>
3. <https://www.coursera.org/learn/statistical-inference/home/welcome>
4. <https://www.coursera.org/learn/data-scientists-tools/home/welcome>

**Course Outcomes:**

Upon completion of the course, student will be able to –

1. Apply data processing and data visualization techniques
2. Perform descriptive and inferential statistical analysis
3. Utilize appropriate distance metrics and optimization techniques
4. Implement supervised algorithms for classification and prediction
5. Implement unsupervised classification algorithms
6. Evaluate the performance metrics of supervised and unsupervised algorithms

**Future Courses Mapping:**

1. Deep Learning
2. Reinforcement Learning
3. DBMS
4. Big Data
5. Data Mining
6. Information Retrieval
7. Recommendation Systems
8. Cloud Computing – AWS
9. IOT
10. Artificial Intelligence
11. Pattern Recognition
12. Natural Language Processing
13. Computer Vision
14. Machine Vision
15. Fault Diagnosis
16. Optimization
17. Bioinformatics
18. Computational Biology
19. Econometrics
20. Supply Chain
21. Ergonomics
22. Operations Research
23. Nano-informatics

**Job Mapping:**

*Job opportunities that one can get after learning this course*

1. Data Scientist
2. Data Analyst
3. AI Engineer
4. Data Architect.
5. Data Engineer.
6. Statistician.

7. Database Administrator.
8. Business Analyst
9. Business Intelligence Developer
10. Infrastructure Architect
11. Enterprise Architect
12. Machine Learning Engineering
13. Machine Learning Scientist

## Syllabus Template

**CS2221: INTERNET OF THINGS****Course Prerequisites:**

Students should have a basic Understanding of the Internet, Cloud, Networking Concepts and Sensors

**Course Objectives:**

The student will be able to

1. Understand IoT Architecture and framework.
2. Recognize and differentiate between the various use cases of different sensors, actuators, solenoid valve etc
3. Learn about fundamental concepts of net working and protocols.
4. Understand IoT Physical, Data link and Higher layer Protocols.
5. Apply theoretical knowledge for Cloud computing.
6. Implement an IoT solution practically

**Credits: 4****Teaching Scheme Theory: 2 Hours/Week****Tut: 1 Hours/Week****Lab: 2 Hours/Week****Course Relevance:**

The Internet of Things is transforming our physical world into a complex and dynamic system of connected devices on an unprecedented scale. Internet of Things is a system of inter related computing and sensing devices and has the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

Advances in technology are making possible a more widespread adoption of IoT, from pill-shaped micro-cameras that can pinpoint thousands of images within the body, to smart sensors that can assess crop conditions on a farm, to the smart home devices that are becoming increasingly popular.

**Introduction to IoT**

Physical Design of IOT, Logical Design of IOT, IOT Enabling Technologies, IOT Levels & Deployment Templates (4 Hours)

**IOT Platform Design Methodology**

IoT Design Methodology Steps, Home Automation Case Study, Smart Cities, Health Care, Agriculture (4 Hours)

**IoT Devices**

IoT System Design Cycle, Sensors - Terminologies, Calibration, Types, Specification, Use, Actuators - Types and Use, Prototype Development Platform - Arduino / Raspberry pi / Node MCU, Interface with Embedded System. (6 Hours)

**Introduction to Wireless Sensor Network**

Sensor Node, Smart Sensor Network, Wireless Sensor Network, RFID - Principles and Components, Node MCU (4 Hours)

**Connectivity Technologies**

Network Configuration in IoT, IoT Stack and Web Stack, IEEE 802.15.4 Standard, Zigbee, Bluetooth, MQTT, Cloud Architecture and Types, Cloud Service Providers (8 Hours)

**Case Studies (Any Two from following List to be covered)**

Smart lighting, Home Intrusion Detection, Smart Parking, Weather Monitoring System, Weather Report Bot, Air Pollution Monitoring, Forest fire Detection, Smart Irrigation, IoT Printer, IoT in Manufacturing Industry, IoT in Process Industry, IoT in Quality, Control Applications in Industry, IoT in Material Handling System in Industry, IoT in Automobile Industry, Navigation System, Connected Vehicles, Industry 4.0 (4 Hours)

**List of Practical's: (Minimum Six)**

1. Setting up Arduino / Raspberry Pi/ Node MCU ESP8266 : Basic handling , programming
2. LED Interfacing
3. Sensor interface to Node MCU/Arduino / Raspberry Pi Temperature measurement using LM35
4. Actuator interface to Node MCU /Arduino / Raspberry Pi Traffic Signal Control
5. Node MCU /Arduino / Raspberry Pi wireless communication Raspberry Pi as a web server
6. Node MCU/Arduino / Raspberry Pi Cloud interfacing and programming like Thingspeak Email alert using SMTP protocol
7. Sensor data acquisition on Mobile (Mobile APP) / Developing Application (WEB APP) with Django Text transfer using MQTT protocol
8. Home Automation using Cisco Packet Tracer

**List of Course Projects:**

1. Smart Agriculture System
2. Weather Reporting System
3. Home Automation System
4. Face Recognition Bot
5. Smart Garage Door
6. Smart Alarm Clock
7. Air Pollution Monitoring System
8. Smart Parking System
9. Smart Traffic Management System
10. Smart Cradle System
11. Smart Gas Leakage Detector Bot
12. Streetlight Monitoring System
13. Smart Anti-Theft System
14. Liquid Level Monitoring System
15. Night Patrol Robot
16. Health Monitoring System
17. Smart Irrigation System
18. Flood Detection System
19. Mining Worker Safety Helmet
20. Smart Energy Grid

**List of Course Seminar Topics:**

1. IoT Architecture
2. Sensor Characteristics
3. IoT for supply chain management and inventory systems
4. IoT Ethics
5. Security in IoT
6. Cloud Computing Platform
7. IoT Best Practices
8. 5G in IoT
9. Middle ware Technology
10. M2M energy efficiency routing protocol
11. IoT based Biometric Implementation
12. Complete IoT solution using AWS
13. A smart patient health monitoring system
14. IoT for intelligent traffic monitoring
15. Home automation of lights and fan using IoT

**List of Group Discussion Topics:**

1. Role of Internet of Things in development of India.
2. Manufacturing industries should make efforts to limit contribution to IoT.
3. Should countries put a ban on IoT for children?
4. Should IoT pay more attention to security rather than just expanding its horizon to the extremes?
5. IoT is the next big thing in technology.
6. IoT poses a huge risk to privacy, if they your system is hacked.
7. IoT is the next big thing for hackers trying to have access to your intimate data.
8. Pros and cons of over-usage of IoT at homes and offices.
9. IoT at battlefields will make life of soldiers safer and easier.
10. IoT will make way for robots to rule over humans one day.
11. IoT devices are making people lazier and obese.
12. IoT needs to be regulated before it goes out of limits and poses serious threat.

**List of Home Assignments:****Design:**

1. Smart City
2. Smart Transportation
3. Smart Healthcare
4. Smart Industry using IoT
5. Design of IoT framework



**CaseStudy:**

1. Open Source in IoT
2. IoT solutions for automobile
3. Cloud Computing
4. AWS
5. Microsoft Azure

**Blog:**

1. Network Selection for IoT
2. Need of secure protocols
3. Future of IoT
4. IIoT
5. IoT and Industry4.0

**Surveys:**

Autonomous Vehicles

1. List of Indian companies which offer IoT solutions for agriculture and farming. Describe the problem they are addressing and their solution.
2. Make a list of Indian companies which offer IoT solutions for healthcare. Describe the problem they are addressing and their solution.
3. Compare different Cloud Service providers in the market.

**Text Books:(As per IEEE format)**

1. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", (Universities Press)
2. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", (CRC Press)

**Reference Books:**

1. Adrian McEwen, Hakim Cassimally "Designing the Internet of Things", Wiley
2. Ovidiu Vermesan & Peter Friess "Internet of Things Applications - From Research and Innovation to Market Deployment", ISBN: 987-87-93102-94-1, River Publishers
3. Joe Biron and Jonathan Follett, "Foundational Elements of an IoT Solution", by Joe Biron

**MOOCs Links and additional reading material:**

1. <https://proed.stanford.edu/course/view.php?id=191>
2. <https://nptel.ac.in/courses/106/105/106105166/>
3. <https://create.arduino.cc/projecthub/electropeak/getting-started-w-nodemcu-esp8266-on-arduino-ide-28184f>

**Course Outcomes**

1. Demonstrate fundamental concepts of Internet of Things(CO Attainmentlevel:2)
2. Recognize IoT Design Methodology Steps(COAttainmentlevel:3)
3. Select sensors for different IoT applications (COAttainmentlevel:3)
4. Analyze fundamentals of networking (COAttainmentlevel:4)
5. Apply basic Protocols in IoT(CO Attainmentlevel:4)
6. Provide IoT solutions practically with the help of case study(COAttainmentlevel:5)

**Future Courses Mapping:**

Other courses that can be taken after completion of this course

1. Ad-Hoc Networks
2. Cyber Security
3. Wireless Networks
4. Industry 4.0
5. Big Data

**Job Mapping:**

The Internet of Things (IoT) is the most emerging field in today's world. It is revolutionizing every industry, from home appliances to agriculture to space exploration. Since the advent of cloud computing, there has been an exponential growth in the number of sensor-enabled devices connected to the internet and expecting further growth accelerating in the coming years. There are diversified career opportunities in this field. The various career positions available as IoT Research Developer, IoT Design Engineer, IoT Product Manager, IoT Software Developer, IoT Solution Architect, IoT Service Manager and many more.

## Syllabus Template

**CS2218: OBJECT ORIENTED PROGRAMMING****Course Prerequisites:**

Basic course on programming

**Course Objectives:**

1. Understand Object Oriented programming concepts
2. Demonstrate Object Oriented programming concepts by writing suitable Java programs
3. Model a given computational problem in Object Oriented fashion
4. To develop problem solving ability using Object Oriented programming constructs like multithreading
5. Develop effective solutions using for real world problems using the concepts such as file handling and GUI
6. Implement applications using Java I/O and event-based GUI handling principles
- 7.

**Credits: 4****Teaching Scheme Theory: 2 Hours/Week****Tut: 1 Hours/Week****Lab: 2 Hours/Week****Course Relevance:**

This is an important course for engineering students. It develops computational problem solving and logic building capability of students. Acquiring programming skills has a high relevance in all branches of Engineering. Once the student gains expertise in coding, this course proves to be beneficial to them to excel in industry demanding coding in specific software.

**Introduction:**

What is Object Oriented Programming (OOP)? The need of OOP, Characteristics of OOP.

**Java overview:** Classes and Objects, Java object storage, Access Modifiers, this reference, main method, Static vs Instance block, Static methods vs Instance methods in Java.

**Constructors:** Constructors in Java, Default constructor, Parameterized constructor.

**Input and Output:** Byte Stream vs Character Stream, use of Scanner Class.

**Arrays in Java:** Arrays in Java, initialization, Default Array values, multi-dimensional array, java.util .Arrays class, string class, string buffer, string builder.

**Methods in Java:** Methods, Parameters passing, Returning Multiple values.

**Inheritance:** Inheritance in Java, Types, Constructor in Inheritance, Using final with Inheritance, Accessing super class member, Parent and Child classes having same data member, Base vs derived class reference. Polymorphism: Method Overloading, Overloading main(), Static vs Dynamic Binding, Method Hiding. Private and final methods, Passing and Returning Objects in Java

**Exception Handling:** Exceptions, types, types of handling exception, Checked vs Unchecked Exceptions, Throw and Throws, User-defined Exception.

**Interfaces and Abstract Classes:** Interface and its usage, Abstract Class and its usage, Difference between Abstract Class and Interface, Nested Interface, Nested Class, Inner class, Anonymous

**Collection in Java:** Collections Class, Using Iterators, Iterator vs Foreach, Array List, Vector, Map, Set.

**Multithreading:** Thread life Cycle, Thread Priority, Thread Methods.

**File Handling:** File Processing, Primitive Data Processing, Object Data Processing, Connecting Java with database (JDBC/ODBC).

**Java GUI:** Swing, Components. Layout Manager: Flow, Border, Grid and Card. Label, Button, Choice, List, Event Handling (mouse, key).

**List of Course Seminar Topics:**

1. Introduction of Arrays and 1D Array programming examples
2. Multidimensional arrays
3. Variants of main() and command line arguments
4. Input and Output stream classes
5. String concepts and various methods of comparing strings
6. Methods in Java
7. Java String Methods
8. Passing array to a function and Jagged array examples
9. Reading input using Scanner and Buffer Reader Class
10. String, String buffer and String builder
11. Types of Inheritance in Java
12. Implementation of Types using Constructor in Inheritance
13. Using final with Inheritance
14. Base vs derived class reference in Inheritance
15. Using final with Inheritance, Accessing super class member
16. Parent and Child classes having same data member
17. Overriding, Hiding Fields & Methods
18. Static vs Dynamic Binding & Hiding Methods
19. Private and final methods
20. Passing and Returning Objects in Java
21. Java Memory Management
22. File handling in Java vs C++
23. Data types used in Java vs C++
24. Java Object Serialization and Deserialization
25. Operator precedence
26. Use of Object Class Methods
27. Garbage collection in JAVA
28. Use of Static Blocks in various applications
29. Keywords used in JAVA
30. Types of Variables In JAVA

**List of Group Discussion Topics:**

1. Introduction of Arrays and 1D Array programming examples
2. Multidimensional arrays
3. Variants of main () and command line arguments
4. Input and Output stream classes
5. String concepts and various methods of comparing strings
6. Methods in Java
7. Java String Methods
8. Passing array to a function and Jagged array examples
9. Reading input using Scanner and Buffer Reader Class
10. String, String buffer and String builder
11. Types of Inheritance in Java
12. Implementation of Types using Constructor in Inheritance
13. Using final with Inheritance

14. Base vs derived class reference in Inheritance
15. Using final with Inheritance, Accessing superclass member
16. Parent and Child classes having same data member
17. Overriding, Hiding Fields & Methods
18. Static vs Dynamic Binding & Hiding Methods
19. Private and final methods
20. Passing and Returning Objects in Java
21. Java Memory Management
22. File handling in Java vs C++
23. Data types used in Java vs C++
24. Java Object Serialization and Deserialization
25. Operator precedence
26. Use of Object Class Methods
27. Garbage collection in JAVA
28. Use of Static Blocks in various applications
29. Keywords used in JAVA
30. Types of Variables In JAVA
31. Data types used in java and Wrapper classes in java
32. Checked and unchecked exception, user defined and standard exception
33. Abstraction in Java and different ways to achieve Abstraction
34. Packages in Java – Types, Advantages & Techniques to Access Packages
35. Inner classes, nested interfaces in Java
36. Difference between Interfaces and abstract classes in Java
37. Exception Handling in Java Vs CPP
38. Difference between 1) throw and throws. 2) Final, finally and finalize in Java
39. Discuss Exception propagation and Discuss Exception handling with method overriding in Java
40. Discuss Packages, Access specifiers and Encapsulation in java.
41. Difference between abstraction and encapsulation in Java.
42. Daemon Threads Vs user threads
43. Preemptive scheduling Vs slicing
44. Is it possible to call the run() method directly to start a new thread? pls comment
45. ArrayList Vs Vector
46. Arrays Vs Collections
47. is Iterator a class or an Interface? what is its use?
48. List Vs Set
49. Buffered Writer and Buffered Reader classes in java
50. Buffered Reader Vs Scanner class in java
51. Buffered Reader Vs File Reader in java
52. Instance of java
53. Difference between CPP and JAVA
54. Difference between JDBC and ODBC connectivity
55. file processing in java
56. Difference between primitive data processing and object data processing
57. Creating GUI using swing
58. comparison between Swing, SWT, AWT, SwingX, JGoodies, JavaFX
59. Introduction To JFC And GUI Programming In Java

60. Introduction to wrapper classes
61. Why java uses Unicode System?
62. Checked and unchecked exception, user defined and standard exception
63. Abstraction in Java and different ways to achieve Abstraction
64. Packages in Java – Types, Advantages & Techniques to Access Packages
65. Inner classes, nested interfaces in Java
66. Difference between Interfaces and abstract classes in Java
67. Exception Handling in Java Vs CPP
68. Difference between 1) throw and throws. 2) Final, finally and finalize in Java
69. Discuss Exception propagation and Discuss Exception handling with method overriding in Java
70. Discuss Packages, Access specifiers and Encapsulation in java.
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75. ArrayList Vs Vector
76. Arrays Vs Collections
77. is Iterator a class or an Interface? what is its use?
78. List Vs Set
79. Buffered Writer and Buffered Reader classes in java
80. Buffered Reader Vs Scanner class in java
81. Buffered Reader Vs File Reader in java
82. Instance of java
83. Difference between CPP and JAVA
84. Difference between JDBC and ODBC connectivity
85. file processing in java
86. Difference between primitive data processing and object data processing
87. Creating GUI using swing
88. comparison between Swing, SWT, AWT, Swing X, J Goodies, Java FX
89. Introduction To JFC And GUI Programming In Java
90. Introduction to wrapper classes
91. Why java uses Unicode System?

**List of Practical's:**

1. Implement Student class using following Concepts
  - All types of Constructors
  - Static variables and instance variables
  - Static blocks and instance blocks
  - Static methods and instance methods
2. There is a class Adder which has two data members of type 1D int array and int variable. It has two functions: get data and num sum. Function get data accepts non-empty array of distinct integers from user in 1D int array data member and a targetsum in another data member. The function numsum adds any two elements from an input array which is equal to targetsum and return an array of resulting two

elements, in any order. If no two numbers sum up to the target sum, the function should return an empty array. Note that the target sum is to be obtained by summing two different integers in the array; you can't add a single integer to itself in order to obtain the target sum. You can assume that there will be at most one pair of numbers summing up to the target sum. Use constructor. Use extra variables if needed

Input:

Array=[3,5,-4,8,11,1,-1,7]     targetsum=15

Output: [8,7]

Input:

Array=[3,5,-4,8,11,1,-1,6]     targetsum=15

Output: []

3. Write Java program to calculate area of triangle, square & circle using function overloading. Function parameter accept from user (Use function Overloading concepts and Inheritance).
4. Write a program for following exception, develop a suitable scenario in which the following exceptions occur:
  - a. divide by zero
  - b. Array index out of bounds exception
  - c. Null pointer Exception
5. Write a java program to solve producer-consumer problem where there are two producer threads and one consumer thread.
6. Implement various operations using JDBC Connectivity.
7. Display bank account information ( Use interface and inheritance using java)
8. Develop a GUI in java which reads, update the file.

**List of Course Projects:**

1. Airline reservation system
2. Course management system
3. Data visualization software
4. Electricity billing system
5. e-Healthcare management system
6. Email client software
7. Library management system
8. Network packet sniffer
9. Online bank management system
10. Online medical management system
11. Online quiz management system
12. Online Survey System
13. RSS feed reader
14. Smart city project
15. Stock management system
16. Supply chain management system
17. Virtual private network
18. Pocket Tanks Game Java Project
19. Internet Banking



20. Hospital Management Java Project
21. Teachers Feedback Form Java Project
22. Online Job Portal Java Project
23. Online Examination Java Project
24. Alumni Database Java Project
25. Virtual Classroom Java Project
26. Lan Chat and File Sharing Java Project
27. Payroll System Java Project
28. Online Exam Java Project
29. Java Game mini Project
30. Online Shopping Java Project
31. Online Library Management System
32. Feedback Collection System java project
33. Text Editor in Java Project
34. Moving Balls using Java Applet
35. Online Reservation System Project
36. Web skeletonizer service
37. Web Enabled Manufacturing Process Project
38. Album Manager Project
39. Global Communication Network
40. Library System project
41. Link Handler System Project
42. Crypto system Project
43. Scheduling and Dispatching project
44. Intranet Mailing System
45. Online Examination System Project
46. Business to Customer System Project
47. University Admission & Maintenance System
48. Campaign Management System Project
49. Content Management System Project
50. Digital Library System Project
51. Contract Labour Management System Project
52. Pay Roll System Project using Java
53. Revenue Recovery System Project
54. Online medical Booking Store Project
55. Client Management System Project
56. Tele Dormitory System Project
57. Reusable CAPTCHA security engine Project
58. Mobile Service Provider System
59. Forestry Management System
60. Distributed Channel management System
61. Online Tenders Management System
62. Noble Job Portal System
63. Energy Audit Processing System
64. Collector Monthly Review System
65. Grievance Handling System
66. Student Project Allocation and Management Project

67. Web Based Reporting System
68. Vehicle Identification System
69. Diamond Shipping System
70. Visa Processing System
71. Enterprise Fleet Management System
72. Global Communication Media
73. HR Help Desk System
74. SQL Workbench Project
75. Remarketing System project
76. Cargo Express Courier project
77. Automated Sports Club Project
78. Multi Banking System Project
79. Java Application World
80. Cricket Game Java Project
81. Email Program System
82. Employee Information and Payroll System
83. Complete Mailing System
84. Complete Banking System
85. College Library Application System
86. Colleges Enrollment System
87. Car Sales System
88. Bus Booking System
89. Bug Tracking System
90. University Admission Management System Java Project
91. Beat It Game in Java
92. Civilization Game Project
93. Airways Reservation System
94. Airstrike System Game
95. Pong Game Java Project
96. Faculty Book System
97. Bank Application System
98. ATM Database System
99. Advanced Payroll System
100. Virtual Private Network Java Project
101. ISP Automation System
102. Life Insurance Management System
103. Help Desk Management System
104. Datamart Management System
105. Automated Sports Club System
106. University Search Engine Project
107. Online Exam Suite Project
108. Forensic Management System
109. Student Registration System
110. E Mail Scanning Project
111. Criminal Face Detection System
112. Web Server Management System Java Project
113. Stores Management System

114. Bug Tracking System Java Project
115. Career Information Management System Java Project
116. Course Management System Java Project
117. Data Visualization Software Java Project
118. Digital Steganography Java Project
119. E Health Care Management System Java Project
120. Electricity Billing System Java Project
121. Email Client Software Java Project
122. Event Management System Java Project
123. Farmers Buddy Java Project Java Project
124. File Transfer and Chat Java Project
125. Knowledge Evaluator Software Java Project
126. Library Management System Java Project
127. Mail Server Java Project
128. Network Packet Sniffer Java Project
129. Number Guessing Game Java Project
130. Online Attendance Management System Java Project
131. Online Bank Management System Java Project
132. Online Book Store
133. Online Customer Care and Service Center Java Project
134. Online Document Management System Java Project
135. Online Examination Management System Java Project
136. Online Medical Management System Java Project
137. Online Quiz System Java Project
138. Online Survey System Java Project
139. Photo Lab Management System Java Project
140. RSS Feed Reader Java Project
141. Smart City Project Java Project
142. Stock Management System Java Project
143. Student Result Processing System Java Project
144. Supply Chain Management System Java Project
145. Telephone Billing System Java Project
146. Travel Management System Java Project
147. Currency Converter
148. Career Information Management System
149. Digital Steganography
150. Event Management System
151. Farmers Buddy
152. File Transfer and Chat
153. Knowledge Evaluator Software
154. Mail Server
155. Number Guessing Game
156. Online Attendance Management System
157. Online Customer Care and Service Center
158. Online Document Management System
159. Online Examination Management System
160. Online Quiz System

161. Photo Lab Management System
162. Student Result Processing System
163. Travel Management System
164. University Admission Management System
165. Web Server Management System
166. Address Book Management System
167. Affiliate Manager
168. Ajax Browser
169. Application Installer Software
170. Application Re-installer Software
171. ATM Simulator System
172. Automatic File Update
173. Bookmark Sync
174. Bus Ticket Reservation System
175. Calendar Icon Maker Application
176. CSS Color and Image Annotator
177. Cyber cafe Management System
178. Data Encryption
179. Database Explorer
180. Directory and File Explorer
181. Domain Search Engine
182. E-Acquisition
183. E-Advertisement
184. E-Learning
185. Enterprise Scheme Planner
186. Face Identification
187. File and Folder Explorer
188. Font Detector/Finder
189. HTML Color Code Finder
190. HTML Spell Checker
191. Image Compressor Application
192. Image to Text Converter
193. Internet Credit Card System
194. Internet Usage Monitoring System
195. Intrusion Detection in Wireless Sensor Network
196. Keyword Finder and Number Calculator
197. Language Emulator
198. Mac Ethernet Address
199. Malware Scanner
200. MP4 Video Converter
201. Online Auction
202. Online Magazine
203. Password Protector and Reminder
204. PDF Converter
205. Pharmacy Management System
206. Port Scanner
207. Process Analysis in Asynchronous System

208. Remote Desktop Administrator
209. Resource Planner and Organizer
210. Search Engine
211. Security System for DNS using Cryptography
212. Smart FTP Uploads
213. Synchronous Conferencing System
214. Text to HTML Converter
215. Unicode Font
216. Voice Chatting and Video Conferencing
217. Voice Compressor Software
218. Windows Fixer
219. XML Compactor

**List of Home Assignments:****Blog:**

1. Single and Multidimensional arrays in Java
2. Comparison Inheritance & Polymorphism
3. Need of abstract classes and interfaces in Java
4. Multithreading concept in Java
5. Signed & Unsigned arithmetic operations using JAVA
6. Role of start() and run() methods in multithreading

**Survey:**

1. Strategies for Migration from C++ to Java
2. Product development using Inheritance and Polymorphism in Industry
3. on Java/OOP features popular amongst developers
4. Which other (non-JVM) languages does your application use?
5. How Java Impacted the Internet
6. How can an ArrayList be synchronised without using vector?

**Design:**

1. Implementation of Singleton design pattern in Java
2. Notes Repository System for Academic
3. Design for employee management system
4. Design for student management system
5. Inventory Management System
6. Write a program to delete duplicate numbers from the file

**Case Study:**

1. Java development milestones from 1.0 to 16.0
2. Implementation of Different Methods in Polymorphism
3. Real world systems which use java for its implementation
4. Drawing a flag using java
5. Use of different methods of Class object
6. Drawing a flag using java

**Text Books:**

*Herbert Schildt, "JAVA- The Complete Reference", , 11th Edition, McGraw Hill Education*

**Reference Books:**

1. Bruce Eckel, "Thinking In Java – The Definitive Introduction to Object-Oriented Programming in the Language of the World-Wide Web", Fourth Edition, Pearson Education, Inc.
2. R. Morelli and R. Walde, "Java, java, Java – Object-Oriented Problem Solving", 3<sup>rd</sup> edition, Pearson Education, Inc.

**Moocs Links and additional reading material:**

Programming using Java | Java Tutorial | By Infosys Technology  
[https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_01304972186110361645\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01304972186110361645_shared/overview)

An Introduction to Programming through C++ – Prof A.G. Ranade- NPTEL- computer science and engineering – NOC <https://nptel.ac.in/courses/106/101/106101208/#>

**Course Outcomes:**

The student will be able to –

1. Understand object-oriented programming features
2. Develop real world applications using class, inheritance and polymorphism
3. Adapt Best Practices of Class Design by using Standard Templates Library
4. Solve computing problems by applying the knowledge of Exception handling and Multithreading
5. Design solutions by choosing suitable data structures such as Array, Vector, Map etc
6. Implement applications using Java I/O and event-based GUI handling principles

**Future Courses Mapping:**

Advanced Data Structures, Advanced Java, Spring Frame Work, Grails Frame Work

**Job Mapping:**

Java Programmer, Application Developer, Design Engineer, Senior Software Developer

## Syllabus Template

**CS2227: DATABASE MANAGEMENT SYSTEMS****Course Prerequisites:**

Basics of computer system and any programming language.

**Course Objectives:**

1. To study the fundamental concepts of structural Computer system and Computer Arithmetic
2. To understand the basic concepts and functions of Microprocessor
3. To gain knowledge of Computer Memory System
4. To get familiar with GPU and CPU architecture
5. To identify solutions for real world design issues using processors.

**Credits: 4****Teaching Scheme Theory: 2 Hours/Week****Tut: 1 Hours/Week****Lab: 2 Hours/Week****Course Relevance:**

Modern computer technology requires an understanding of both hardware and software, since the interaction between the two offers a framework for mastering the fundamentals of computing.

The purpose of this course is to cultivate an understanding of modern computing technology through an in-depth study of the interface between hardware and software.

In this course, you will study the history of modern computing technology before learning about modern computer architecture and a number of its essential features, including instruction sets, processor arithmetic and control, the Von Neumann architecture, pipelining, memory management, storage, and other input/output topics.

The course will conclude with a look at the recent switch from sequential processing to parallel processing by looking at the parallel computing models and their programming implications.

Basic concepts of Digital Electronics, Organization and Architecture, Structure & Function, Brief History of computers, Von Neumann Architecture, Integer Representation: Fixed point & Signed numbers. Integer Arithmetic: 2's Complement arithmetic, multiplication, Booth's Algorithm, Division Restoring Algorithm, Non Restoring algorithm, Floating point representation: IEEE Standards for Floating point representations.

8086 Microprocessor Architecture, Register Organization, Instruction types, Types of operands, Instruction formats, addressing modes and address translation. Near & FAR procedure, Instruction cycles. RISC Processors: RISC- Features, CISC Features, Comparison of RISC & CISC Superscalar Processors. Case study of Processor.

Fundamental Concepts: Single Bus CPU organization, Register transfers, Performing an arithmetic/ logic operations, fetching a word from memory, storing a word in memory, Execution of a complete instruction. Micro-operations, Hardwired Control, Example-Multiplier CU. Micro-programmed Control: Microinstructions, Microinstruction-sequencing: Sequencing techniques, Micro-program sequencing

Need, Hierarchical memory system, Characteristics, Size, Access time, Read Cycle time and address space. Main Memory Organization: ROM, RAM, EPROM, E 2 PROM, DRAM, Design examples on DRAM, SDRAM, DDR3, Cache memory Organization: Address mapping. Basic concepts: role of cache memory, Virtual Memory concept. Pipeline and its performance, Data hazards: operand forwarding, handling data hazards in software, side effects. Instruction hazards: unconditional branches, conditional branches and branch prediction.

Parallelism in Uniprocessor system, Evolution of parallel processors, Architectural Classification, Flynn's, Fengs, Handler's Classification, Multiprocessors architecture basics, Parallel Programming Models : Shared memory, Message passing, Performance considerations : Amdahl's law, performance indications.

Parallel computing architectures (multi-core CPUs, GPUs, traditional multi-processor system, Xeon-Phi, Jetson Kit, Kilocore processor), multiprocessor and multicomputer systems, interconnection networks, Modern GPU architecture (in brief), Performance comparison: Speedup, Gain time and scalability.



**List of Practical's: (Any Six)**

1. Study of 8086 Architecture and Execution of sample programs.
2. Write 8086 ALP to access marks of 5 subjects stored in array and find overall percentage and display grade according to it.
3. Write 8086 ALP to perform block transfer operation. (Don't use string operations) Data bytes in a block stored in one array transfer to another array. Use debugger to show execution of program.
4. Write 8086 ALP to find and count zeros, positive number and negative number from the array of signed number stored in memory and display magnitude of negative numbers.
5. Write 8086 ALP to convert 4-digit HEX number into equivalent 5-digit BCD number.
6. Write 8086 ALP to convert 5-digit BCD number into equivalent 4-digit HEX number.
7. Write 8086 ALP for following operations on the string entered by the user.
  - a. String length
  - b. Reverse of the String
  - c. Palindrome
8. Write 8086 ALP for following operations on the string entered by the user (Use Extern Far Procedure).
  - a. Concatenation of two strings
  - b. Find number of words, lines.
  - c. Find number of occurrences of substring in the given string.
9. Write 8086 ALP to initialize in graphics mode and display following object on screen.
10. Write 8086 ALP to encrypt and decrypt the given message.
11. Write 8086 ALP to perform following operations on file
  - a. Open File
  - b. Write data in the file.
  - c. Delete data in the file.
  - d. Close the file.

**List of Course Projects:**

1. Combinational and Sequential circuits
2. Memory Management
3. Graphics Mode
4. IOT based projects.
5. IoT based atmospheric CO2 administration.
6. IoT based flood risk predictor.
7. Simulate modern traffic control system.
8. Online Parallel Examination.

**List of Course Seminar Topics:**

1. Computer Architecture VS Computer Organization
2. Evolution of Computing Devices
3. Instructions types , formats and execution
4. Interrupts in Microprocessor
5. Trends in computer architecture
6. RISC Vs CISC architecture : A Case Study
7. ARM processor architecture
8. Latest Technology in Embedded systems
9. Multiplier Control Unit
10. Booth's Encoding Pattern for Fast Scalar Point Multiplication in ECC for Wireless Sensor Networks
11. Internet of Things (IoT) in 5G Wireless Communications
12. State of the art parallel processor design.
13. Memory management in mobile OS.
14. Evolution of processors.
15. Ultra SPARC Processor Architecture.

**List of Course Group Discussion Topics:**

1. GPU computing: CUDA
2. Memory System
3. Replacement Algorithms
4. Pipelining
5. Cache Coherance
6. Virtual Memory
7. Hazards in pipelining
8. Super Computer
9. Modern computer generations
10. Parallel computing models

**List of Home Assignments:****Design:**

1. Write the sequence of control steps required for the single bus organization for each of the following instructions:
  1. ADD the (immediate) number NUM to register R1
  2. ADD the contents of memory location NUM to register R1Assume that each instruction consists of two words. The first word specifies the operation and addressing mode, and second word contains the number NUM
2. Configure a 32 Mb DRAM chip. Consider cells to be organized in 8K X 4 array. Find out the number of address lines.
3. A set associative cache consists of 64 lines, or slots, divided into four-line sets. Main memory contains 4K blocks of 128 words each. Analyze the format of main memory

addresses with proper explanation.

4. A one pipeline system takes 50 ns to process a task. The same task can be processed in 6 segment pipeline with a clock cycle of 10 ns. Determine the speedup ratio of pipeline for 100 tasks. What is maximum speedup ratio?

**Case Study:**

1. Micro-programmed Control Unit and Hardwired Control Unit.
2. Pipeline Hazards
3. Flynn's architectural classification scheme.
4. Modern Processor units

**Survey:**

1. New memory technologies and their potential impact on **architecture**
2. Virtual Memory
3. Simulation of a superscalar processor and analyzing impact of design tradeoffs
4. Cache Consistency Models in Modern Microprocessors

**Blog:**

1. Super Computer
2. Intel Journey
3. New Arm Interconnect technologies
4. Distributed Systems and Parallel Computing

**Text Books:**

1. William Stallings, "Computer Organization and Architecture: Designing for Performance", 7th Edition, Pearson Prentice Hall Publication, ISBN 81-7758-9 93-8.
2. C. Hamacher, V. Zvonko, S. Zaky, "Computer Organization", 5th Edition, Tata McGraw Hill Publication, ISBN 007-120411-3.
3. Kai Hwang, "Advanced Computer Architecture", Tata McGraw-Hill ISBN 0-07-113342-9
4. Douglas Hall, "Microprocessors and Interfacing", 2nd Edition, Tata McGraw Hill Publications, ISBN 0-07-025742-6.
5. Peter Abel, "Assembly Language Programming," 5th Edition, Pearson Education Publications, ISBN 10:013030655.

**Reference Books:**

1. Hwang and Briggs, "Computer Architecture and Parallel Processing", Tata McGraw Hill Publication ISBN 13: 9780070315563.
2. A. Tanenbaum, "Structured Computer Organization", Prentice Hall Publication, ISBN 81 -203 - 1553 - 7, 4th Edition.

**MOOCs Links and additional reading material:**

1. [www.nptelvideos.in](http://www.nptelvideos.in)
2. <https://www.udemy.com/>

3. <a href="https://learn.saylor.org/">https://learn.saylor.org/</a> 4. <a href="https://www.coursera.org/">https://www.coursera.org/</a> 5. <a href="https://swayam.gov.in/">https://swayam.gov.in/</a>
<b>Course Outcomes:</b>  Upon completion of the course, post graduates will be able to – 1. Demonstrate computer architecture concepts related to design of modern processors, memories and I/Os. (2) 2. Illustrate the micro operations sequencing. (3) 3. Evaluate various alternatives in processor organization. (3) 4. Understand concepts related to memory & IO organization (2) 5. Adapt the knowledge based on Pipeline and its performance (3) 6. Design real world applications using processors. (4)
<b>Future Courses Mapping:</b> Advance Computer Architecture, Advance Operating Systems
<b>Job Mapping:</b> Application Developers, System programmer

Syllabus Template

**ME2205: 3D PRINTING**

**Course Prerequisites:**

Basic manufacturing, Materials

**Course Objectives:**

Additive Manufacturing (AM) is a technology supporting the sustainable rapid development of personalized complex design in various disruptive applications, especially in manufacturing and medical.

**Credits: 4**

**Teaching Scheme Theory: 2 Hours/Week**

**Tut: 1 Hours/Week**

**Lab: 2 Hours/Week**

**Course Relevance:**

This course aims to build student competence in AM and related technology. The students will learn fundamental knowledge of Additive Manufacturing and Reverse Engineering (RE) and their applications in manufacturing, medical and other sectors. Besides, the students will be proficient in practice design for additive manufacturing.

**SECTION-1****Design Thinking (4Hrs)**

- Engineering Design, Product Development Process, Problem,
- Types of Design, Phases of Engineering design, Definition and Need Identification to Detailed Design,
- Ergonomic and Aesthetic Aspects in Design, Design for Manufacturing,
- Limits, fits and tolerancing
- Concept of Geometric dimensioning and tolerancing.

**3D Printing Materials (5Hrs)**

- Types of Materials, Properties of materials,
- Application of materials in mechanical, chemical, electronics and software industry,
- Selection of Materials,
- Smart materials
- Materials for 3D Printing
- Bio materials, composite materials etc.

**Introduction to Manufacturing and 3D Printing (5Hrs)**

- Introduction to conventional manufacturing processes like casting, forming, machining etc.
- Introduction Overview, Basic principle need and advantages of additive manufacturing,
- Classification of additive manufacturing processes,
- Challenges in Additive Manufacturing.

**SECTION-2****Pre-Processing in 3D Printing (3D Modeling and Design) (4Hrs)**

- Creation of 2D geometry using Auto CAD, 2D drawing space
- AutoCAD Modify commands.
- Construct orthographic sectional views of brackets with dimension in different layers.
- 3D solid Modeling Create 3D solid and edit solid.
- Create a new assembly, insert components into an assembly, add mates (degree of freedom) and perform components configuration in an assembly.
- Design for 3D printing
- Topology optimization

**Advance Thermal Manufacturing Processes (5Hrs)**

- Laser principles, Properties of Lasers, Types of Lasers,
- Laser Beam Machining Processes,
- Introduction to electron beam machining, Comparison of E-beam machining with other thermal processes, Setup for EBM, Power requirement in E-Beam,
- Models and specifications, process, working, principle, applications, advantages and

disadvantages, case studies.

**Additive Manufacturing Processes (5Hrs)**

- Stereolithography (SLA), Fused deposition modeling (FDM), Laminated Object Manufacturing (LOM), Selective deposition lamination (SDL), Selective laser sintering (SLS), Direct Metal deposition (DMD),
- 3D Printing of Metals
- Post processing requirements & Techniques

Applications of Additive Manufacturing Applications in Aerospace, Automotive, Tooling, Defense, Jewelry, Repair and Biomedical industries

**List of Tutorials: (Any Three)**

In tutorial students are expected to present technical seminar (PPT) relevant to 3D Printing and Design. Also, students (in a group of 4/5 students) are expected to discuss any technical novel topic related to 3D Printing and Design..

**List of Practical: (Any Six)**

- 1) Design & develop a CAD model of a product
- 2) Tension test on Mild Steel and Aluminum
- 3) Brinell hardness test on different materials
- 4) Study of different 3D Printing Machines
- 5) Demonstration of CNC Lathe Machine Operation
- 6) Laser Beam Machining
- 7) 3D Printing Machine
- 8) Design and 3D print a master part
- 9) Design and 3D print a non-demountable assembly
- 10) Reverse engineering of a mechanical part
- 11) Design and 3D print a complex part
- 12) Optimize the 3D printing parameters for the function of the product

**List of Projects:**

Students can do course projects on

1. Reverse Engineering
2. 3D Printing Machine
3. Dynamics of Machinery
4. Smart Materials
5. Smart Manufacturing
6. Industrial Automation
7. 3D Printing for Electronics
8. Prototyping
9. Ergonomics
10. Design for Additive Manufacturing
11. Quality in Additive Manufacturing
12. Precision Engineering
13. Process Planning and Cost Estimation
14. Tool Design
15. Green Manufacturing

**List of Course Seminar Topics:**

1. High Performance Production line for small series metal parts
2. Additive Manufacturing Aiming Towards Zero Waste & Efficient Production of High- Tech Metal Products
3. Smart production of Microsystems



4. High-Precision micro-forming of complex 3D parts
5. Additive Manufacturing for Wear and Corrosion Applications
6. Flexible and on-demand manufacturing of customized Products
7. Manufacturing decision and supply chain management system for additive manufacturing
8. Toolless Manufacturing of Complex Structures
9. Computer Aided Technologies for Additive Manufacturing
10. Hybrid Additive Manufacturing
11. Laser-based Additive Manufacturing
12. Making our Workforce Fit for the Factory of the Future
13. Sensor package fabrication via additive manufacturing for automotive sector
14. Additive Manufacture of High Temperature Components
15. Dynamic Properties of Additive Manufacturing
16. Material characterization of additively manufactured part
17. Biomaterials and Additive Manufacturing
18. Materials for 3D Printing
19. Rapid Manufacturing of lightweight metal components
20. Additive Manufacturing and Nature-based solutions
21. Functionally Graded Materials to Extra-Large Structures
22. Additive Manufacturing technologies in the Aerospace sector
23. Additive Manufacturing technologies in the Medical sector
24. METAL ADDITIVE MANUFACTURING (AM)
25. Topology optimisation in Additive Manufacturing
26. Design against Distortion of metallic aerospace parts based on combination of numerical modelling activities and topology optimization
27. Comparison AM with a conventional manufacturing process
28. Assessment of additive manufacturing parts
29. New EDM electrodes manufactured with electrically conductive materials by Additive Manufacturing

**List of Course Group Discussion Topics:**

1. Methods of force measurement
2. Force sensing technology
3. Surface modification technology
4. Application and use of carbon fiber reinforced plastic
5. Use of simulation in manufacturing
6. Electro chemical machining
7. Electro beam machining
8. Water jet machining
9. Laser metrology
10. Virtual gauging
11. Design for inspection
12. Electronic gauges

13. Gauging automation
14. Use of nanotechnology in material science
15. Use of computers in design and development process. including CAE, CAM.
16. Use of highly reliable plastic materials in engineering.
17. 3D printing in industrial scale
18. Computer aided manufacturing
19. smart materials
20. Bio and composite materials
21. Conventional machining vs 3D printing
22. limitations of additive manufacturing
23. challenges for additive manufacturing
24. design for 3D printing
25. laser beam machining
26. EBM process
27. SLA
28. FDM
29. LOM SDL
30. SLS
31. DMD
32. 3D printing of metals
33. Micro 3D printing
34. Nano 3D printing
35. Bio 3D printing
36. Applications of 3Dprinting

**List of Home Assignments: List of Home Assignments:**

1. Engineering materials and their properties
2. Alloys and Composite materials
3. Materials for various Engineering applications
4. Selection of material for various industrial applications
5. Heat treatment of engineering materials
6. Selection of manufacturing processes for various industrial applications
7. Conventional and non-conventional machining processes
8. Additive manufacturing: concept and applications
9. Geometric dimensioning and tolerancing
10. Industrial automation: History and development
11. Computer integrated manufacturing
12. Hybrid Additive Manufacturing
13. Laser-based Additive Manufacturing
14. Making our Workforce Fit for the Factory of the Future
15. Sensor package fabrication via additive manufacturing for automotive sector
16. Additive Manufacture of High Temperature Components
17. Dynamic Properties of Additive Manufacturing

18. Material characterization of additively manufactured part
19. Biomaterials and Additive Manufacturing
20. Materials for 3D Printing
21. Rapid Manufacturing of lightweight metal components
22. Additive Manufacturing and Nature-based solutions
23. Functionally Graded Materials to Extra-Large Structures
24. Additive Manufacturing technologies in the Aerospace sector
25. Additive Manufacturing technologies in the Medical sector
26. METAL ADDITIVE MANUFACTURING (AM)

**Survey/Design (Broad areas)**

1. Design of simple components for manufacturability
2. Materials for additive manufacturing
3. Design for Additive Manufacturing
4. Selection of additive manufacturing process
5. Hybrid additive manufacturing
6. Application of additive manufacturing
7. Optimization of 3D printing

**Design:**

1. Design of simple components for manufacturability
2. Materials for additive manufacturing
3. Design for Additive Manufacturing
4. Selection of additive manufacturing process
5. Hybrid additive manufacturing
6. Application of additive manufacturing
7. Optimization of 3D printing

**Case Study:**

1. Case study on material selection for electronic industry, chemical industry, aerospace and automobile industry etc.
2. Case study on selection of manufacturing process for given component
3. Difficult to cut materials and effective strategies to manufacture for the same
4. Design of simple components for manufacturability
5. Materials for additive manufacturing
6. Design for Additive Manufacturing
7. Selection of additive manufacturing process
8. Hybrid additive manufacturing
9. Application of additive manufacturing
10. Optimization of 3D printing

**Blog**

1. New materials for manufacturing industry
2. Materials for industry 4.0

3. Smart Materials
4. New product development
5. Micro Machining
6. Advance machining Processes
7. Optimization of 3D printing
8. 3 D Metal printing
9. Material characterization of additively manufactured part
10. Biomaterials and Additive Manufacturing
11. Materials for 3D Printing
12. Rapid Manufacturing of lightweight metal components
13. Additive Manufacturing and Nature-based solutions
14. Functionally Graded Materials to Extra-Large Structures
15. Additive Manufacturing technologies in the Aerospace sector
16. Additive Manufacturing technologies in the Medical sector

**Surveys**

1. New materials for manufacturing industry
2. Materials for industry 4.0
3. Smart Materials
4. New product development
5. Micro Machining
6. Advance machining Processes
7. Optimization of 3D printing
8. 3 D Metal printing
9. Material characterization of additively manufactured part
10. Biomaterials and Additive Manufacturing
11. Materials for 3D Printing
12. Rapid Manufacturing of lightweight metal components
13. Additive Manufacturing and Nature-based solutions
14. Functionally Graded Materials to Extra-Large Structures
15. Additive Manufacturing technologies in the Aerospace sector
16. Additive Manufacturing technologies in the Medical sector

**Text Books: (As per IEEE format)**

Textbook: No designated textbook, but class notes and handouts will be provided

**Reference Books: (As per IEEE format)**

1. ISO/ ASTM DIS 52900:2018 (E), (2018), Additive manufacturing – General principles – Terminology, ISO/ ASTM International 2018.
2. Wohlers T., (2018), Wohlers Report 2018, 3D Printing and Additive Manufacturing State of the Industry: Annual Worldwide Progress Report, Wohlers Associates, ISBN ISBN 978-0-9913332-4-0.
3. Redwood B., Schöffner F., Garret B., (2017), The 3D Printing Handbook: Technologies, design and applications, Editura 3D Hubs, ISBN 978-90-827485-0-5.
4. Zhang J., Jung Y.G., (2018), Additive Manufacturing: Materials, Processes, Quantifications and Applications, Elsevier, ISBN 978-0-12-812155-9
5. Gibson I., Rosen D., Stucker B., (2015), Additive Manufacturing Technologies - 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Editura Springer, ISBN 978-1-4939-2112-6.

**MOOCs Links and additional reading material:****Course Outcomes:**

1. Apply design for additive manufacturing (DfAM) in practice for the development of new products (apply).
2. Select an appropriate material for AM technology based on mechanical, physical and thermal properties (Select);
3. Apply knowledge on manufacturing, additive manufacturing, and reverse engineering in a variety of domains (apply);
4. To develop an ability to design a system, component, or process to meet desired needs within realistic constraints (Develop)
5. Investigate process parameters for effective additive manufacturing (create);
1. Select an appropriate AM technology based on preset optimisation criteria (eg. cost, quality, time/ available resources) (evaluate)

**Future Courses Mapping:**

Mention other courses that can be taken after completion of this course

**Job Mapping:** What are the Job opportunities that one can get after learning this course

## Syllabus Template

**ME2206 Mechanics of Materials****Course Prerequisites:**

Physics, Engineering Mathematics

**Course objectives:**

1. Understand application of the principles of mechanics to practical engineering problems.
2. To acquire basic knowledge of stress, strain due to various types of loading.
3. To draw Shear Force and Bending Moment Diagram for transverse loading & to determine Bending, Shear stress, Slope and Deflection on Beam.
4. To solve problems of Torsional shear stress for shaft.
5. Analysis of long and short columns subjected to axial loads for buckling.
6. To utilize the concepts of Solid Mechanics on application based combined mode of loading.

**Credits: 02****Teaching Scheme: Theory: 2 Hours/Week****Course Relevance**

Engineering mechanics is a branch of science that deals with forces causing bulk motion in bodies and the effect that these forces cause on the bodies. Engineering mechanics does not deal with the internal changes that occur on account of these external forces. The internal effects in a body or a material under the action of external forces are studied in Mechanics of Materials or the Mechanical Behavior of Engineering Materials.

**Topics and Contents****Unit 1 : Engineering mechanics- Statics**

Fundamental Concepts and laws of mechanics , Force Systems and Resultants , Equilibrium of Rigid body , Free body diagram, Analysis of Trusses and Frames ; Properties of surfaces and solids- Centroid, Moment of inertia, Polar moment of inertia ; Friction ; Principle of virtual work.

**Unit 2 : Engineering mechanics- Dynamics**

Kinematics of Particles, Kinetics of Particles , Kinematics of Rigid Bodies , Kinetics of Rigid Bodies , Work-Energy Method , Impulse and Momentum ,Mechanical Vibrations .

**Unit 3: Engineering Materials and their Properties**

Introduction, Classification of Engineering Materials, Selection of Materials for Engineering Purposes. Physical and Mechanical Properties of Metals, Ferrous Metals, Non-ferrous Metals, Non-metallic Materials, Testing of metals, hardness, tensile strength, engineering stress-strain curve.

**Unit 4: Mechanics of Materials - Simple Stress and Strain**

Concept of stress and strain, types of stresses and strains, Thermal stresses, stress strain diagram for ductile and brittle material; material strengths, proof stress, Factor of safety, analysis of axially loaded members. Stresses on oblique plane, Principal planes and planes of maximum shear, Principal stresses and maximum shear stresses, Mohr's circle for two-dimensional state of stress.

**Unit 5: Mechanics of Materials - Bending & Torsion**

Shear forces & bending moments of determinate beams due to concentrated loads, uniformly distributed loads, uniformly varying loads & couples, relation between SF & BM diagrams for cantilevers, simply supported and compound beams. Theory of Simple Bending, Flexure formula, bending stress distribution. Shear stress distribution, shear stress distribution diagram for common cross sections, Maximum and average shear stresses. Torsion in Circular Shafts Stresses, strains and deformations in solid and hollow shafts, derivation of torsion equation, statically indeterminate shaft.

**Unit 6: Mechanics of Materials - Slope and Deflections of Beams, Axially Loaded Columns, Strain Energy and Impact**

Relation between bending moment and slope, slope and deflection of determinate beams, Double integration method (Macaulay method). Derivation of formulae for slopes and deflections for standard cases. Concept of buckling of columns, Derivation of Euler's formula for buckling load for column with hinged ends. Concept of equivalent length for various end conditions. Limitations of Euler's formula. Rankine buckling load. Concept of strain energy, derivation and use of expressions for deformation of axially loaded members under gradual, sudden, and impact loads, strain energy due to self-load.

**List of Home Assignments:****(I) Design (II) Case Study (III) Survey (IV) Blog**

1. Mechanics of different games in amusement park like – Roller-coaster, Bungee Trampoline, Theme Park ride, Spinning Wheels etc.
2. Mechanics applied to games like Carrom, Billiard etc.
3. Mechanics in other sports like Cricket, Basketball, Volleyball etc.
4. Application of Projectile motion like gunfire, bombing, basketball, volleyball, cricket.
5. SFD & BMD for different types of loadings of beams.
6. Variation of shear stress across different cross section of beams.
7. SFD & BMD for Airplane wing .
8. Velocity, acceleration, KE for Motorcycle with rider.
9. Buckling analysis of short, medium & long columns.
10. Determination of MI for different cross section of beams.
11. Eccentrically loaded bolted joint stress analysis.

12. Bicycle, Motorcycle brake analysis.
13. Analysis of shaft subjected to combined bending & torsional moment.
14. Punching operation force analysis.
15. Comparison of torsional strength of solid & hollow shaft.
16. Strain energy due to gradual, sudden, and impact loads.

**Text Books: (As per IEEE format)**

1. Mechanics of Materials, Second Edition, by Andrew Pytel & Jaan Kiusalaas  
Publisher, Global Engineering
2. Mechanics of Materials, Ninth Edition, by James M Gere & Barry J Goodno, Publisher,  
Global Engineering
3. Engineering Mechanics: Statics & Dynamics, by R C Hibbler Prentice Hall publication

**Reference Books: (As per IEEE format)**

1. Vector mechanics for engineers – Statics & Dynamics, 12<sup>th</sup> edition, by Beer & Johnston  
,Mc Graw Hill Publication.
2. Mechanics of Materials, vol I & II, by E J Hearn, Butterworth Heinemann, Oxford.
3. Engineering Mechanics, Fifth edition by S. Timoshenko, D.H. Young, J.V. Rao, Sukumar  
Pati, Tata McGraw Hill publication

**Course Outcomes:**

Students will be able to –

1. Apply the concepts of mechanics to practical engineering problems.
2. Apply concepts of dynamics to practical engineering problems.
3. Differentiate and determine mechanical properties using destructive and non-destructive testing of materials & select appropriate materials for various applications.
4. Evaluate stresses under various loading conditions.
5. Draw shear force and bending moment diagrams under various loading conditions and determine bending stress, torsional shear stress & combined stresses.
6. Determine slope and deflection for the given beam and analyze long and short columns subjected to axial loads for buckling.



## CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	1	0	0	1	1	0	1	1	1	0
CO2	2	2	1	1	1	1	0	0	1	1	0	1	1	1	0
CO3	1	1	1	1	1	1	2	0	1	1	0	1	1	1	0
CO4	3	3	1	1	1	1	0	0	1	1	0	1	1	1	0
CO5	2	2	1	1	1	1	0	0	1	1	0	1	1	1	0
CO6	2	2	1	1	1	1	0	0	1	1	0	1	1	1	0

### Course Outcomes attainment level

Students will be able to –

1. Apply the concepts of mechanics to practical engineering problems. (4)
2. Apply concepts of dynamics to practical engineering problems. (5)
3. Differentiate and determine mechanical properties using destructive and non-destructive testing of materials & select appropriate materials for various applications. (3)
4. Evaluate stresses under various loading conditions. (4)
5. Draw shear force and bending moment diagrams under various loading conditions and determine bending stress, torsional shear stress & combined stresses. (4)
6. Determine slope and deflection for the given beam and analyze long and short columns subjected to axial loads for buckling. (5)

### Future Courses Mapping:

*Machine Design, Mechanical System Design*

### Job Mapping:

*R & D, Design & Development*

## Syllabus Template

**ME2292: ENGINEERING DESIGN AND INNOVATION – III****Credits: 06****Teaching Scheme****Lab: 12 Hours/Week****Course Relevance:**

EDI is course with focus on projects and development of hands on skills. Project specific theory to be taught for this course. Focused on social relevance domains such as Agriculture, Green Technology, Smart city, Health Care, Assistance to weaker section, Renewable energy, Transportation, Ergonomics, Safety etc. (not limited to only these domains)

SECTION-1
<b>Topics and Contents</b> <b>Project Management:</b> Overview and Expectations, the Design Process, <b>Define a Problem:</b> Identify a Valid Problem, Justify the Problem <b>Design a Solution:</b> Select a Solution Path, Develop a Design Proposal
SECTION-1I
<b>Topics and Contents</b> <b>Design and Prototype a Solution:</b> Plan for the Prototype, Build the Prototype <b>Test, Evaluate, and Refine the Solution:</b> Plan the Test, Test the Prototype <b>Communicate the Process and Results:</b> Documentation and Presentation

**Suggest an assessment Scheme:**

*Suggest an Assessment scheme that is best suited for the course. Ensure 360 degree assessment and check if it covers all aspects of Blooms Taxonomy.*

1.MSE

2.ESE

**Text Books: (As per IEEE format)**

1. Biswajit Mallick, Innovative Engineering Projects, Entertainment Science And Technology Publication, Bhubaneswar, India

2. Dilip N. Pawar, Dattary K. Nikam, Fundamentals of Project Planning and Engineering, Penram International Publishing (India) Pvt. Ltd.; First edition (12 July 2017).

**Reference Books: (As per IEEE format)**

1. Fernandes, Joao M, Machado, Ricardo J., Requirements in Engineering Projects, Springer International Publishing

2. Carol McBride, Francisco L. Gonzales, Engineer This: 10 Amazing Projects for Young Mechanical Engineers, PRUFROCK Press, 2018

**Course Outcomes:**

The student will be able to –

- 1) Apply critical and creative thinking in the design of engineering projects (5)
- 2) Plan and manage your time effectively as a team (4)
- 3) Apply knowledge of the 'real world' situations that a professional engineer can encounter (4)
- 4) Use fundamental knowledge and skills in engineering and apply it effectively on a project (5)
- 5) Design and develop a functional product prototype while working in a team (5)

6) Present and demonstrate your product to peers, academics, general and industry community (3)

### CO PO Map

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
PO1	2	3	2	2	2	2	2	2	3	3	3	3	2	2	2
PO2	2	3	3	2	2	2	2	3	3	3	3	3	2	2	2
PO3	3	3	3	2	2	2	2	2	3	3	3	3	2	2	2
PO4	2	3	2	2	2	2	2	2	3	3	3	3	2	2	2
PO5	2	3	2	2	2	2	2	2	3	3	3	3	2	2	2
PO6	2	3	2	2	2	2	2	2	3	3	3	3	2	2	2

### CO attainment levels

Number	Level
	5
	4
	4
	5
	5
	3

### Future Courses Mapping:

### Job Mapping:

# **SY MECHANICAL MODULE-IV**

**SY MECH. MODULE-IV AY: 2023-24**

Su b. No .	Sub. Code	Subject Name	Teaching Scheme(Hrs. /Week)			Examination scheme						Tot al	Cr ed its
			Th .	L a b	Tut	CA			MSE	ESA			
						H A	LAB/ CP	PPT/ GD		ESE	CVV		
S1	ME 2201	FLUID ENGINEERING	2	2	1	20	20	20		20	20	100	4
S2	ME 2202	MACHINE DESIGN	2	2	1	20	20	20		20	20	100	4
S3	ME 2203	THERMODYNAMI CS	2	2	1	20	20	20		20	20	100	4
S4	ME 2204	ANALYSIS AND SIMULATION OF MACHINES AND MECHANISMS	2	2	1	20	20	20		20	20	100	4
S5	ME 2207	MACHINE DRAWING	2	-	-	20	-	-	20	40	20	100	2
S6	ME 2292**	ENGINEERING DESIGN AND INNOVATION -IV		12					30	70		100	6
S7	ME 2296**	DESIGN THINKING	-		1					100		10 0	1
Total			8	20	5								25

\* Irrespective of module in sem.- 1 \*\* Irrespective of module in sem.- 2

## Syllabus Template

**ME2201: Fluid Engineering****Course Objectives:**

1. To familiarize with properties of fluids and applications of fluid mechanics
2. To understand concepts of fluid measurement, types of flows and dimensional analysis
3. To formulate and analyse problems related to calculations of forces in fluid structure interactions

**Credits: 04****Teaching Scheme Theory: 02 Hours/Week****Tut: 01 Hours/Week****Lab: 02 Hours/Week****Course Relevance:**

1. The subject Fluid Mechanics has a wide scope and is of prime importance in several fields of engineering and science. Present course emphasizes the fundamental underlying fluid mechanical principles and application of those to solve real life problems

SECTION-I
<b>Topics and Contents</b>  <b>Basics with fluid statics:-</b> Fluid properties and fluid statics, manometry, buoyancy, forces on submerged bodies, stability of floating bodies;  <b>Fluid Kinematics:-</b> Control-volume analysis of mass, velocity of fluid particle, acceleration of fluid particle types of fluid flow; differential equations of continuity, velocity potential and stream function flow net.  <b>Fluid Dynamics:-</b> Bernoulli's equation, limitations of Bernoulli's equation, Application of Bernoulli's theorem such as venturimeter, orifice meter, pitot tube and V-notch etc.
SECTION-II

**Topics and Contents**

**Dimensional analysis** :-Buckingham's theorem, Model analysis, similarity laws and dimensionless numbers.

**Flow through pipes:-** Losses in pipes, bends and fittings, Flow around submerged bodies, drag and lift

**Boundary layer theory:-**Introduction to boundary layer theory and its analysis, Elementary turbulent flow

**List of Tutorials:**

List of Tutorials:- 1) Problems on Fluid properties. 2) Problems on manometry. 3) Problems on buoyancy. 4) Problems on mass, momentum and energy. 5) Problems on Bernoulli's equation 6) Problems on the boundary layer. 7) Problems on flow through pipes. 8) Problems on head losses in pipes, Problems on bends and fittings.

**List of Practical's: (Any Six)**

1. Measurement of viscosity using Red Wood viscometer
2. Study and demonstration of pressure measurement using manometers
3. Bernoulli equation in nozzle/diffusers: Loss calculation
4. Calibration of Venturimeter / V-Notch
5. Determination of the metacentric height of a floating body and its stability
6. Demonstration of Pitot tube for velocity measurement
7. Flow pattern in a Hale-Shaw cell
8. Reynolds Experiment
9. Determination of Minor Losses – contraction, expansion and bend
10. Force acting on a plate/hemisphere due to a jet

**List of Projects:**

1. Simulation of Flow over airfoil 2. Design of a piping network 3. Simulation of Flow over cylinder 4. Design of Centrifugal Pump. 5. Study of hydrokinetic Turbine. 6. Flow Analysis of Rocket nozzle using Ansys 7. CFD Analysis of Fluid Flow across Propeller Fan using ANSYS 8. Fluid mechanics of Internal combustion engine 9. Speed Bump: Application of Non-Newtonian fluid. 10. Study of Laminar Flow through pipe by simulation.



**List of Course Seminar Topics:**

1. Nano fluids. 2. Bio fluids Principles. 3. Wall Turbulence. 4. Advanced fluid transport machinery 5. Supercritical Fluids. 6. Application of fluid Mechanics 7. Flow Stability. 8. Recent Trends in Fluid Mechanics. 9. Characteristics of flow over airfoils 10. Analysis of Blower 11. Velocity Measurement Techniques 12. Flow Meters 13. Drag calculation(from experimental data) for bluff bodies 14. Hydro turbine analysis 15. Force Measurement techniques 16. Vortex panel method for airfoils

**List of Course Group Discussion Topics:**

1. Bio fluid mechanics 2. Complex and Non Newtonian fluid 3. Multiphase flows 4. Drag reduction and propulsion efficiency 5. Compressible flows 6. CFD 7. Turbulence 8. Boundary Layer. 9. Incompressible Fluids 10. Flow Transition in Hypersonic Boundary Layer. 11. Flow over Aircraft Wing 12. Transition to turbulence 13. Numerical Methods for solving flow equations 14. Meshing methodology for flow solvers 15. Turbulence Modeling 16. Compressible Flow solvers 17. Finite Volume Approach 18. Gas turbine analysis 19. Biological flows 20. Cavitation in pumps and turbines

**List of Home Assignments:****Design –**

1) Design and Numerical Analysis of Flow through Pipe. 2) Design of Pelton Turbine. 3) Design of Rotameter. 4) Design of Centrifugal Pump and Validation by Analysis in ANSYS.

**Blog –**

1) Laminar, Turbulent and Vortex Flow 2) Boundary layer 3) Drag and lift force 4) Flow through pipe 5) Biological flow,

**Case study –**

1. Analysis of flow through an orifice plate(CFD Simulation) 2) Numerical Simulation and Experimental Study of Flow Field around a Bullet 3) Non-Newtonian Fluids 4) Hydrodynamics of Submarine 5) Study and analysis of Water Hammer effect in pipeline. 6) Case study of a Simple Carburettor.

**Survey**

1) Types of Hydraulic turbines 2) Hydraulic system and its components

**Suggest an assessment Scheme:**

*Suggest an Assessment scheme that is best suited for the course. Ensure 360 degree assessment and check if it covers all aspects of Blooms Taxonomy.*

1. CVV
2. HA
3. Lab/ Course project
4. GD/PPT
5. ESE

**Text Books: (As per IEEE format)**

Text Books: (As per IEEE format)

1. Som and Biswas, Fluid Mechanics and Fluid Machines, Tata Mcgraw Hill
2. Frank M White, Fluid Mechanics, 6th Ed., Tata Mcgraw Hill New Delhi
3. Yunus A. Çengel, Fluid Mechanics, Tata Mcgraw-Hill Education
4. D. S. Kumar, Fluid Mechanics And Fluid Power Engineering, S. K. Kataria & Sons
5. R. K. Bansal, Fluid Mechanics, Laxmi Publication (P) Ltd. New Delhi
6. R. K. Rajput, Fluid Mechanics and Hydraulic Machines, S. Chand & Company Ltd.

**Reference Books: (As per IEEE format)**

1. “Reference Books: (As per IEEE format) 1. P. Kundu, I. Cohen, D. Dowling, Fluid Mechanics, Elsevier India
2. P. J. Pritchard, J. C. Leylegian, Introduction to Fluid Mechanics, John Wiley & Sons

**Moocs Links and additional reading material:** [www.nptelvideos.in](http://www.nptelvideos.in)

**Course Outcomes:**

The student will be able to –

1. Develop an intuitive understanding for Fluid properties and fluid statics.
2. Obtain the solution of the problems dealing with ship stability, buoyancy etc.
3. Apply and analyze fluid systems using the integral form of the continuity, momentum
4. Apply Bernoulli's Equation for various fluid systems and flow measuring devices.
5. Demonstrate the Dimensional analysis and working of fluid flow measurement devices.
6. Analyze and explain physical significance of flow through the pipes.

**CO PO Map**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
O1	2	3	2	2	2	1	1	1	1	1	1	1	1	2	1
O2	2	3	3	2	2	1	1	1	1	1	1	1	1	2	1

CO3	3	3	3	2	2	1	1	1	1	1	1	1	1	2	1
CO4	2	3	2	2	2	1	1	1	1	1	1	1	1	2	1
CO5	2	3	2	2	2	1	1	1	1	1	1	1	1	2	1
CO6	2	3	2	2	2	1	1	1	1	1	1	1	1	2	1

### CO attainment levels

Number	Level
	3
	4
	5
	5
	5
	4

### Future Courses Mapping:

Mention other courses that can be taken after completion of this course 1 .Fluid machinery and fluid power engineering 2. Turbo machinery 3. Heat Transfer

**Job Mapping:** 1. Pump Industry 2. Power Plants

## Syllabus Template

**ME2202 : MACHINE DESIGN**

**Course Prerequisites:** Engineering Mechanics, Material Science, Strength of Materials.

**Course objectives:**

Students will be able to-

1. Apply knowledge of mechanics of materials to understand component behaviour under various loading conditions.
2. Reduce the behaviour of complex machines into appropriate subsystems/elements and then analyze the behaviour of those elements.
3. Understand the concept of Principal stresses and theories of failure.
4. Apply different design considerations to common machine elements for failure prevention and sustainability.
5. Deduce Power transmission system for a particular application.
6. Use manufacturers catalog for selection of standard components.

**Credits: 04**

**Teaching Scheme: Theory: 2 Hours/Week**

**Tut: 1 Hours/Week**

**Lab: 2 Hours/Week**

**Course Relevance:**

Machine design is the creation of plans for a machine to perform the desired functions. The machine may be entirely new in concept performing a new type of work, or it may more economically perform the work that can be done by an existing machine. It may be an improvement or enlargement of an existing machine for better economy and capability.

**SECTION—I****Unit 1: Simple stresses & strain**

Simple stresses & strain, Stress-Strain Relationship, Introduction to thermal stresses, Shear stress & shear strain, Stresses on Oblique plane, Principal stresses & strains, Stresses due to Bending Moment, Stresses due to Eccentric axial loading, Stresses due to Torsional Moment.

**Unit 2: Theories of failure for Static Loading & Dynamic loading**

Theories of Elastic Failure, Modes of failure, Factor of safety.

Design for fluctuating stresses – Endurance limit – Estimation of Endurance strength – Goodman's line – Soderberg's line – Modified Goodman's line. Stress concentration & Stress Concentration factor

**Unit 3: Design of Simple Mechanical Elements**

Design of Simple Mechanical Elements like Design of levers, wall brackets, frames, Shafts & keys, Spring, Power screws, Spur & Helical Gears.

**SECTION—II**

**Unit 4: Manufacturing Considerations in Design**

Design considerations of Casting, Forging & Machined parts, Design & selection of Belt. Geometrical Dimensioning & Tolerancing. Introduction to Design for Environment (DFE) & Life Cycle Assessment (LCA)

**Unit 5: Belt, Rope, Chain & Bearings**

Belt & rope drives, Chain Drives, Rolling contact bearings and Sliding contact bearings.

**Unit 6: Design of Mechanical Assemblies**

Design of Mechanical Assemblies like Design of Couplings, Threaded & Welded Joint's, Cotter Joint & Design of Knuckle Joint.

**List of Tutorials:**

Problems on design of

- 1.Lever
- 2.Wall bracket
- 3.Frame
- 4.Shaft
- 5.Coupling
- 6.Spring
- 7.Bolted joint
- 8.Welded joint
- 9.Gear
- 10.Bearings
- 11.Belt
12. Chain

**List of Practical's: (Any Six)**

Write a program for Parametric Design & Simulation and Optimization.

1. Spur Gear.
2. Helical Gear.
3. Helical Compression Spring.
4. Power Screw.
5. Protected Flange Coupling.
6. Flexible Shaft Coupling.
7. V-Belt & selection
8. Ball Bearing & selection from catalog

9. Life of bearing
10. Chain drive & selection from catalog
11. Journal Bearing Test: Experimental measurement of the pressure distribution and frictional torque in the journal bearing for different applied load and speed.
12. Dry abrasion test
13. Four-Ball Test: To investigate the Wear preventive ability (WP) / Extreme pressure capacity (EP) and Friction behaviour of lubricants operating under non-conformal (point contact) contact condition.
14. Pin-on-Disc Test: To investigate the behaviour of interacting surfaces in terms of Friction and Wear measurement, under dry condition
15. Any other similar # Program may be written in C++/MATLAB/Python/EXCEL.....

**List of Project areas:**

Design, Modelling & Drafting of

1. Gearbox of Motorcycle.
2. Screw jack
3. C-clamp
4. Fly Press
5. Protected Flange Coupling
6. Flexible Shaft Coupling
7. Cotter Joint
8. Knuckle Joint
9. Crankshaft
10. Lead Screw of lathe
11. Differential gearbox
12. Single plate clutch
13. Disk Brake , Any other similar # use any CAD software for Modelling & Drafting.

**List of Course Seminar Topics:**

1. Selection of factor of safety
2. Theories of failures & their significance
3. Design considerations of Casting. Forging & Machined parts.
4. Modes of failures
5. Hole basis & Shaft basis system, Types of fits & their selection
6. Dimensional & Geometrical tolerances
7. Bearing Mounting.
8. Design of Sliding contact bearings.
9. DFMA
10. DFE
11. LCA

### **List of Course Group Discussion Topics:**

1. Types of fits & their selection for a particular application.
2. Modes of Failures
3. DFMA
4. Design of shaft on the basis of Torsional rigidity.
5. Factors to be considered in selection of factor of safety
6. Factors to be considered in designing Gearbox.
7. Factors to be considered in selection of Power transmission for a particular application.
8. Factors to be considered in selection of manufacturing method for mechanical element.
9. Factors to be considered in selection of type of bearing for a particular application.
10. Design for sustainability.

### **List of Home Assignments:**

#### **Design**

1. Design of shaft on the basis of torsional rigidity.
2. Design of bolts for pillar crane base.
3. Design of V-belt for portable air compressor
4. Design of chain drive for Motorcycle
5. Design of Spring for IC engine valves.

#### **Case Study**

1. Design of shaft on the basis of torsional rigidity
2. Design of bolts for pillar crane base
3. Design of V-belt for portable air compressor
4. Design of chain drive for Motorcycle
5. Design of Spring for IC engine valves.

#### **Survey**

1. Different types of failures in Gears & heat treatment
2. Different types of Springs used in Mechanical Applications
3. Different types of Threads used in Mechanical Applications
4. Different types of Belt Drives used in Mechanical Applications
5. Different types of Bearings used in Mechanical Applications
6. Different types of failures in Gears & heat treatment
7. Different types of Springs used in Mechanical Applications
8. Different types of Threads used in Mechanical Applications
9. Different types of Belt Drives used in Mechanical Applications
10. Different types of Bearings used in Mechanical Applications

**Suggest an assessment Scheme:**

Suggest an Assessment scheme that is best suited for the course. Ensure 360 degree assessment and check if it covers all aspects of Blooms Taxonomy.

1. CVV
2. HA
3. Lab/ Course project
4. GD/PPT
5. ESE

**Text Books: (As per IEEE format)**

1. Bhandari V. B. "Design of Machine Elements". 5th Edition. Tata McGraw Hill Publication Private Ltd. New Delhi
2. Khurmi R. S. and Gupta J. K. "A text book of Machine Design". Eurasia Publishing house Pvt. Ltd, New Delhi
3. David G Ullman, "The Mechanical Design Process", McGraw Hill Pub. Co. Ltd., Delhi.
4. George E Dieter, Linda C Schmidt, "Engineering Design", McGraw Hill Pub. Co. Ltd., Delhi.

**Reference Books: (As per IEEE format)**

1. Spotts M. F. and Shoup T. E. "Design of Machine Elements", Pearson Education Pvt. Ltd., Delhi.
2. Shigley J. E. and Mischke C. R, "Mechanical Engineering Design", 6th international Edition, McGraw Hill Pub. Co. Ltd., Delhi.
3. William Orthwein. "Machine Component Design", Jaico Publication. Mumbai.
4. "Design Data", P.S.G. College of Technology, Coimbatore

Mooc's Links and additional reading material: [www.nptelvideos.in](http://www.nptelvideos.in)

**Course Outcomes:** Students will be able to

1. Evaluate stresses under various loading conditions.
2. Analyze stresses in various machine components like Shaft, Coupling, Power Screws, Spring, Knuckle & Cotter Joint, Threaded and Welded joints.
3. Apply failure theories in evaluating strength of machine elements subjected to static and variable loads.
4. Decide Power transmission system for a particular application & Select the material and derive the design specifications for Spur & Helical gears.
5. Select the standard components like Belts, Chains and Bearings from the manufacturers catalog.
6. Decide Tolerances & manufacturing method for different Mechanical Components.



## CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PS O3
C O 1	2	3	2	2	3	1	1	1	2	2	1	1	2	2	1
C O 2	2	3	3	2	3	1	1	1	2	2	1	1	2	2	1
C O 3	2	2	3	1	1	1	1	1	2	2	1	1	1	1	1
C O 4	2	2	2	2	2	1	1	1	2	2	1	1	2	2	1
C O 5	2	2	2	2	2	1	1	1	2	2	1	1	2	2	1
C O 6	1	1	1	1	3	1	2	2	2	2	1	1	2	2	1

### Course Outcomes attainment level

1. Evaluate stresses under various loading conditions. (3)
2. Analyze stresses in various machine components like Shaft, Coupling, Power Screws, Spring, Knuckle & Cotter Joint, Threaded and Welded joints.(5)
3. Apply failure theories in evaluating strength of machine elements subjected to static and variable loads. (4)
4. Decide Power transmission system for a particular application &Select the material and derive the design specifications for Spur and Helical gears. (5)
5. Select the standard components like Belts, Chains and Bearings from the manufacturers catalog. (3)
6. Decide Tolerances & manufacturing method for different Mechanical Components. (4)

### Future Courses Mapping:

*Mechanical System Design*

### Job Mapping:

*R & D, Design & Development*

## Syllabus Template

**ME2203: THERMODYNAMICS**

**Course Prerequisites:** Zeal to learn the subject 1. Mathematics 2. Physics

**Course Objectives:**

1. To learn the significance of thermodynamics, basic terms and definitions of Thermodynamics.
2. To learn thermodynamic interactions, and balance of energy between system and its surroundings
3. To learn laws of thermodynamics and understand the difference between high grade and low grade energies, limitations on energy conversion.
4. To learn applications of thermodynamics laws to various thermal systems.
5. To learn the concept of steam formation and its utility in engineering applications.
6. To understand the use of Steam Tables, Mollier Chart and analyse simple steam systems.

**Credits: 04**

**Teaching Scheme**

**Theory: 02 Hours/Week**

**Tut: 01 Hours/Week**

**Lab: 02 Hours/Week**

**Course Relevance:** Mechanical Engineering broadly has four sub-streams, i.e. Thermal and Fluids, Mechanisms and Design engineering, Materials and Manufacturing, Computational Techniques. Engineering Thermodynamics is the first course on Thermal Science and Engineering. It studies various energy interactions notably heat and work transfer. It is based on certain laws of nature which are never seen to be violated. Although Thermodynamics lies at the core of thermal and fluids engineering, it also helps in understanding many concepts and courses from other sub-streams.

SECTION-1
<b>UNIT I: Introduction (4 Hrs)</b>
Basic Terms and Definitions; Thermodynamic System, Surroundings, Boundary, Property, State, Process, Cycle, Macro and Microscopic approach
<b>UNIT II: First Law of Thermodynamics (5Hrs)</b>

First law of thermodynamics, Joule's experiment, Concept of Thermal energy, Flow energy and Enthalpy, Limitations of First Law of Thermodynamics, Application of first law to flow and non-flow processes and cycles
<b>UNIT III: Zeroth Law of Thermodynamics (5Hrs)</b>
Zeroth Law of Thermodynamics, Limitations of Zeroth Law of Thermodynamics, Limitations of First Law of Thermodynamics, Temperature and Temperature scale, Thermometry
<b>SECTION-II</b>
<b>UNIT IV: Second Law of Thermodynamics (5Hrs)</b>
Concept of Reversibility, Reversible and Irreversible Processes, Kelvin-Planck and Clausius statement of Second Law of Thermodynamics, Equivalence between Kelvin-Planck and Clausius statement, Perpetual Motion Machine II, Carnot theorem, Concept of Entropy. Carnot Cycle for Heat engine, Refrigerator and Heat Pump, Applications of second law to flow and non-flow processes and cycles.
<b>UNIT V: Ideal Gas and Gas Processes (5Hrs)</b>
Ideal Gas definition, Gas Laws, Gas Properties, Equation of State, Study and analysis of Gas Processes; Isobaric, Isochoric, Isothermal, Isentropic, Polytropic
<b>UNIT VI: Introduction to Steam Properties (4Hrs)</b>
Formation of steam, Phase changes, Steam Properties, Dryness fraction, Use of Steam Tables and Mollier diagram, Steam calorimeters
<b>List of Tutorials: (Any Three)</b>
<ol style="list-style-type: none"> <li>1. Problems on application of First Law of Thermodynamics to flow processes and cycles</li> <li>2. Problems on application of First Law to non-flow processes and cycles</li> <li>3. Problems on Thermometry</li> <li>4. Problems on application of Second Law to flow processes and cycles</li> <li>5. Problems on application of Second Law of Thermo. to non-flow processes and cycles</li> <li>6. Problems on Gas Properties and Processes</li> <li>7. Problems on Steam Properties</li> <li>8. Problems on Dryness Fraction</li> </ol>
<b>List of Practical's: (Any Six)</b>
<ol style="list-style-type: none"> <li>1. Determination of calorific value using gas calorimeter</li> <li>2. Determination of calorific value using Bomb calorimeter</li> <li>3. Trial on Flue gas analysis using gas analyzer</li> <li>4. Trial for performance determination of Refrigerator</li> <li>5. Trial for performance determination of Heat pump</li> </ol>

6. Demonstration and study of boiler mountings and accessories
7. Determination of dryness fraction of steam using throttling calorimeter
8. Determination of dryness fraction of steam using throttling and separating calorimeter
9. Trial on boiler to determine boiler efficiency, equivalent evaporation
10. Trial for energy balance of any one thermal system

**List of Projects:**

1. Energy balance in closed systems.
2. Energy balance in open systems.
3. Performance of Work transfer devices
4. Performance of Heat transfer devices
5. Performance of neither Heat transfer nor Work transfer devices
6. Performance of system involving both Work transfer and Heat transfer devices.
7. Demonstration of the First Law of Thermodynamics
8. Demonstration of the Second Law of Thermodynamics
9. Calibration of a Temperature measuring device
10. Construction of Temperature Scale

**List of Course Seminar Topics:**

1. History of Thermodynamics
2. Significance of Thermodynamics in Engineering
3. Applications of Thermodynamics in Engineering
4. Contributors to today's Thermodynamics'
5. First Law of Thermodynamics
6. Zeroth Law of Thermodynamics
7. Second Law of Thermodynamics
8. Thermometry
9. Temperature Scales
10. Thermometers
11. Boyle's Law
12. Ideal Gas Definition and Ideal Gas Laws
13. Steam Formation
14. Steam Properties
15. Boiler Mountings and accessories

**List of Course Group Discussion Topics:**

1. Historical background of Thermodynamics
2. Contributors and their contribution to Thermodynamics
3. Applications of Laws of Thermodynamics
4. Significance of Laws of Thermodynamics
5. Relevance of Laws of Thermodynamics
6. Thermometry
7. Thermometers and principle of working
8. Temperature Scales
9. Role of Mountings in Boilers
10. Role of accessories in Boilers

**List of Home Assignments:*****Design -***

- 1) Design and Analysis of a Thermal System Demonstrating First Law of Thermodynamics.
- 2) Design and Analysis of a Thermal System Demonstrating 2nd Law of Thermodynamics.
- 3) Design of a new temperature scale.
- 4) Design of a boiler for performance.
- 5) Analysis of a vapor power cycle.

***Blog -***

- 1) Significance of Thermodynamics in Engineering
- 2) First Law of Thermodynamics
- 3) Second Law of Thermodynamics
- 4) Zeroth Law of Thermodynamics
- 5) Boilers

***Case study -***

- 1) Isothermal process and its typical applications
- 2) Existence of corresponding Isotherms in a given pair of systems
- 3) Isentropic process and its typical applications
- 4) Adiabatic process and its typical applications
- 5) Entropy generation in a system

***Survey-***

- 1) Types of Temperature Measuring Devices
- 2) Temperature Scales and their applications
- 3) Boiler Mountings and Accessories
- 4) Vapor power cycles and their applications
- 5) Types of Processes and their significance.

**Suggest an assessment Scheme:**

*Suggest an Assessment scheme that is best suited for the course. Ensure 360 degree assessment and check if it covers all aspects of Blooms Taxonomy.*

CA: 1. HA 2. LAB/CP 3. PPT/GD ESA: 1. ESE 2. CVV
<b>Text Books: (As per IEEE format)</b>
1. Nag.P.K., "Engineering Thermodynamics", 4th Edition, Tata McGraw-Hill, New Delhi, 2008 2 Kothandaraman and Domkundwar ;Thermodynamics and Heat Engines 3 Ballaney P. L; -Thermal Engineering; Khanna Publishers 4 Natarajan E., "Engineering Thermodynamics: Fundamentals and Applications", Anuragam Publications, 2012
<b>Reference Books: (As per IEEE format)</b>
1. Cengel. Y. and MBoles, "Thermodynamics – An Engineering Approach", 7th Edition, Tata McGraw Hill, 2010. 2. Rathakrishnan. E., "Fundamentals of Engineering Thermodynamics", 2nd Edition, Prentice- Hall of India Pvt. Ltd, 2006 3. Van Wylen and Sonntag, "Classical Thermodynamics", Wiley Eastern, 1987 4. RaynerJoel ; Engineering Thermodynamics; ELBS Longman
<b>Moocs Links and additional reading material:</b> <a href="http://www.nptelvideos.in">www.nptelvideos.in</a>
<b>Course Outcomes:</b> After completing this course students will be able; 1. To demonstrate energy balance in systems involving thermodynamic interactions 2. To evaluate changes in thermodynamic properties of substances 3. To apply the knowledge of temperature scale and Thermometry 4. To apply laws of thermodynamics to processes and cycle 5. To evaluate performance of refrigerator, heat pump etc 6. To explain steam properties and evaluate changes

**CO PO Map**

CO/ PO	PO: 1	PO: 2	PO: 3	PO: 4	PO: 5	PO: 6	PO: 7	PO: 8	PO: 9	PO: 10	PO: 11	PO: 12	P S O : 1	P S O : 2	P S O : 3
CO:1	3	3	3	2	1	2	3	1	1	3	2	3	2	3	1
CO:2	3	3	3	2	1	2	3	1	1	3	2	3	1	3	1
CO:3	3	3	2	2	1	1	2	1	1	3	2	3	2	3	2
CO:4	3	3	2	2	1	2	3	1	1	3	2	3	1	3	2
CO:5	3	3	2	2	1	1	3	1	1	3	2	3	2	3	2
CO:6	3	3	1	2	1	1	3	1	1	3	2	3	1	3	1

**CO attainment levels**

CO Number	Level
1. To demonstrate energy balance in systems involving thermodynamic interactions	1
2. To evaluate changes in thermodynamic properties of substances	2
3. To apply the knowledge of temperature scale and Thermometry	3
4. To apply laws of thermodynamics to processes and cycle	3
5. To evaluate performance of refrigerator, heat pump etc	4
6. To explain steam properties and evaluate changes	4

**Future Courses Mapping:**

*Mention other courses that can be taken after completion of this course*

Heat Transfer, Thermal Engineering, Heat Exchange Devices, Power Plant Engineering, Refrigeration, Air Conditioning, Internal Combustion Engineering

**Job Mapping:**

What are the Job opportunities that one can get after learning this course

Thermal Design, Research and Development Labs, System Modeling and Thermal Analysis etc.



## Syllabus Template

**ME2204: ANALYSIS AND SIMULATION OF MACHINES  
AND MECHANISMS****Prerequisites:** Engineering Physics and Mathematics**Course Objectives:**

To understand

1. Kinematic structure and model of machines and mechanisms
2. Position, velocity, and acceleration analysis
3. Synthesis of mechanisms for various design tasks
4. Computer based analysis of machines and mechanisms
5. Process of design, simulation and develop the mechanisms for real life applications

**Credits: 4****Teaching Scheme Theory: 2 Hours/Week****Tut: 1 Hours/Week****Lab: 2 Hours/Week****Course Relevance:**

Course is intended to cover the field of engineering theory, analysis, design and practice with modern tools. This engineering theory is generally described as mechanisms or as kinematics and dynamics of machines. Course is designed primarily for students of mechanical engineering, the content can also be of considerable value to practicing engineers throughout their professional careers.

**Topics and Contents****Elements of Machines and Mechanisms**

Basics of machines and mechanisms, planer and spatial mechanisms, kinematic models, links and pairs. Kinematics and dynamics, inversions and Grashof's criterion

**Mechanism Configurations**

Mobility and range of movement. Kutzbach and Grubler's criterion, four link planar mechanisms, compound and complex mechanisms, mechanism synthesis, constructional features and their applications

**Kinematic Analysis of Mechanisms**

Displacement, velocity and acceleration analysis of planar mechanisms. Motion study and simulation of mechanisms, rubbing velocity, mechanical advantage

**Static and Dynamic Analysis of Mechanisms**

Static and dynamic forces in four link planar mechanisms, simulation of forces in slider crank

and four bar mechanisms and their applications such compressor, engine, crank and rocker etc. Forces, torque, energy and power calculations

### **Cam and Follower Mechanisms**

Types of cam follower mechanisms, follower motion study, and cam profile design. Analysis of and simulation of cam follower mechanisms. Selection of cam followers in various applications such process automation, valve operating mechanisms and robotics.

### **Kinematics of Involute Gear Tooth Profile**

Kinematics of involute gears, properties of involute profile, cycloidal profile, contact ratio, interference, undercutting, profile modification

To elaborate the above topics (section I & II) mechanisms may be considered from applications such as manufacturing machines, steering system, pumps, valves and valve operating systems, multi-cylinder engines, compressors, robotic devices, actuators, suspension systems and material handling systems etc.

### **List of Tutorials:**

Practice session on kinematic models, synthesis, analysis and simulation of mechanisms

### **List of Practical's: (Any Six)**

1. Motion simulation of equivalent mechanisms and their mobility
2. Velocity analysis of planer mechanisms
3. Acceleration analysis of planer mechanisms
4. Computer based kinematic analysis of planer mechanism
5. Static and dynamic force analysis and simulation
6. Synthesis and analysis of mechanisms
7. Computer based kinematic analysis of cam follower motions.
8. Design and simulation of cam profiles
9. Involute gear tooth profile generation and modeling
10. Determine the radius of gyration and mass moment of inertia of mechanical bodies

### **List of Projects:**

1. Rotary engine
2. Pantograph
3. Multi cylinder reciprocating engine
4. Hydraulic actuators

5. Simulation of spring mass in mechanical Suspension
6. Elliptical trammel
7. Reciprocating compressor
8. Compound gear box for general purpose
9. Peaucelliers mechanism
10. Industrial automation cam (profile design)
11. Reciprocating plunger (Pump)
12. Valve mechanism for i.c engine (cam follower)
13. Backhoe (earth moving machine-JCB)
14. Ackerman steering mechanism
15. Epi-cyclic gear trains for automotive
16. Universal joint (Hooke's joint)
17. Quick return mechanisms for manufacturing machines

**List of Course Seminar Topics:**

1. Cam follower mechanisms and applications
2. Different types of gear box
3. Epicyclic gear train and applications
4. Determination of mass moment of inertia of mechanical bodies
5. Mechanical vibrations
6. Steering mechanisms
7. Straight line mechanisms
8. Inversions of slider crank and four bar mechanisms & their applications
9. Kennedy's theorem based velocity analysis (icr)
10. Klein's construction
11. Machines and mechanisms
12. Planar and spatial mechanisms
13. Acceleration analysis & Coriolis theory
14. Kinematics of spur gear and interference
15. Degrees of freedom and basic criteria's
16. Mechanism of reciprocating engine and compressor

**List of Course Group Discussion Topics:**

1. Cam follower mechanisms and applications
2. Different types of gear box
3. Epicyclic gear train and applications
4. Determination of mass moment of inertia of mechanical bodies
5. Mechanical vibrations
6. Steering mechanisms
7. Straight line mechanisms
8. Inversions of slider crank and four bar mechanisms & their applications
9. Kennedy's theorem based velocity analysis (icr)
10. Klein's construction
11. Machines and mechanisms
12. Planar and spatial mechanisms
13. Acceleration analysis & Coriolis theory

14. Kinematics of spur gear and interference
15. Degrees of freedom and basic criteria's
16. Mechanism of reciprocating engine and compressor

**List of Home Assignments:**

**Design:**

1. Synthesis for function generation
2. Synthesis for path generation
3. Synthesis for motion generation
4. Synthesis for body guidance
5. Design of steering mechanisms

**Case Study:**

1. Cams in automation
2. Sun and planetary gears in automotive
3. Straight line mechanisms and applications
4. Inventions of straight line mechanisms
5. Synthesis for coupler curve

**Blog**

1. Differential gear box
2. Scotch yoke mechanism
3. Quick return mechanisms
4. Mechanisms with higher pairs
5. Frudenstin's mechanism design approach

**Surveys**

1. Inventions of Coriolis theory
2. Rotary engines
3. Oscillating cylinder mechanisms and applications
4. Straight line mechanisms
5. Cam curves and design approach

**Suggest an Assessment scheme that is best suited for the course. Ensure 360 degree assessment and check if it covers all aspects of Blooms Taxonomy.**

**Assessment scheme**

Theory exams, lab work, course projects, assignments, technical presentations and compressive Viva voce

**Text Books: (As per IEEE format)**

1. Theory of Machines and Mechanisms (Third edition), John Uicker Jr., Gordon R. Pennock and J. E. Shigley, Oxford University Press.
2. Theory of Machines, S. S. Rattan, Tata McGraw-Hill Publication
3. Theory of Machines and Mechanisms, Amitabh Ghosh and A. K. Mallik, Affiliated East-West Press Pvt Ltd.

**Reference Books: (As per IEEE format)**

1. Theory of Machines, Thomas Bevan, CBS Publications.
2. Machines and Mechanisms Applied Kinematic Analysis, David H. Myszka, Pearson Education, Asia.
3. Design of Machinery, R. L. Norton, McGraw-Hill.

**Moocs Links and additional reading material:** [www.nptelvideos.in](http://www.nptelvideos.in)

Course Outcomes:

The student will be able to –

1. Understand fundamentals of mechanisms and machines
2. Do position, velocity, and acceleration analysis of planar mechanisms
3. Synthesize the mechanisms for various design tasks
4. Take kinematic analysis of geared systems for a particular application
5. Design the kinematic profile of a cam to achieve a desired follower motion
6. Design, simulate and develop the mechanisms in realistic application

**CO-PO Mapping**

CO	PO1	2	3	4	5	6	7	8	9	10	11	12	PSO1	2	3
1	3	0	0	1	1	1	0	0	0	0	0	2	1	3	1
2	3	2	1	2	3	1	1	1	1	1	0	2	2	2	2
3	3	3	2	2	3	2	1	1	1	1	0	2	2	3	1
4	2	2	2	2	1	1	2	1	1	1	0	0	2	2	2
5	2	2	2	2	1	1	2	1	1	1	0	0	2	2	2
6	3	3	3	3	3	1	1	2	2	2	2	1	2	3	2

**CO attainment levels**

1. Understand fundamentals of mechanisms and machines (3)
2. Do position, velocity, and acceleration analysis of planar mechanisms (5)
3. Synthesize the mechanisms for various design tasks (3)
4. Take kinematic analysis of geared systems for a particular application (4)
5. Design the kinematic profile of a cam to achieve a desired follower motion (4)
6. Design, simulate and develop the mechanisms in realistic application (5)

**Future Courses Mapping:**

Mechanical system design, Dynamics of machinery, Computer aided design, Analysis and synthesis of mechanisms

**Job Mapping:** Product design, R&D, System Modelling and Analyst etc.

## Syllabus Template

**ME2207: Machine Drawing****Credits: 2****Teaching Scheme:****Theory: 2 Hours / Week****Section I****Orthographic Projections**

Types of projection, first angle and third angle projection, Projection of solids, Applications of Orthographic projections, Selection of views, One, Two and Three view drawings, Interpretation of views, Development of missing views, Types of Auxiliary views

**Sectional Views of Solids**

Sections of solids, Sectional Views, Full Half and Auxiliary sections,

**Development and Intersection**

Development of Surfaces Intersection of surfaces Intersection of solids & its developments,

**Isometric Projection**

Conversion of Orthographic views to isometric and vice versa

**Section II****GD & T Conventions**

IS Conventional representations, Dimensioning, Standard Abbreviations, Representation of Limits, Fits, Tolerances on drawings, Threaded Fasteners, Welded Joints, Riveted Joints, Piping Symbols, and Machining Symbols.

**Assembly Drawing Part and Production Drawings**

Assembly and Part Drawings: Engine parts, Machine Tool Parts and Accessories, Valves and Boiler Mounting, Miscellaneous parts

Production Drawings: Detail or part drawing

**Computer Aided Drafting**

Types of Modeling, Creation of 3D solid model in CAD software, drafting work bench, generating drawing views. Hatch pattern and section views, Adding Annotations, generating bill of materials, generating balloons, Creating assembly, part and production drawing using CAD software.

**List of Assignments:** (Minimum two hand drafting sheets and other CADD SW based Assignments)

1. Symbols and Conventions
2. Isometric Projection
3. Orthographic Projection
4. Machine Part Drawing
5. Piston cylinder assembly, IC engine components, Joints and coupling drawings with Geometrical Dimensioning and Tolerance (GD&T) and Machining Symbols.
6. Assembly dismantling & measurement of dimensions of components

7. Given the Detailed drawing prepare Assembly Drawing
8. Given the Assembly Drawing prepare Detailed drawing
9. Any other similar

**Text Books**

1. N.D.Bhatt, V M Panchal, "Engineering Drawing", Charotar Publishing House Pvt.Ltd.
2. N.D.Bhatt, V M Panchal, "Machine Drawing", Charotar Publishing House Pvt.Ltd.
3. K. L. Narayana, P. Kannaiah, K. Venkata Reddy, "Machine Drawing" 3rd edition, New Age International (P) Ltd.
4. Sham Tickoo "CATIA V 5 for Engineers and Designers", DreamTech Press.

**Reference Books**

1. IS Code " Engineering Drawing Practice for schools and colleges : SP 46: 1988
2. "Design Data Book" PSG College of Technology, Coimbatore.
3. "Westermann Tables for metal trade" Wiley Publication
4. Warren Luzzader, "Fundamentals of Engineering Drawing", Prentice Hall of India, New Delhi.

**Course Outcomes:****The student will be able to —**

1. Create, read/interpret assemblies and 2D drafting of various machine components and assemblies,
2. Provide dimensions, tolerances and other annotations on the drawings of the components by 3D modelling software like Solidworks /CATIA.
3. Develop new and utilize existing symbol libraries of standard components
4. Understand and apply limits, fits, tolerances and surface finish on the existing and new drawings, as per standards.
5. Measure dimensions of components and make production drawings for the same.
6. Read and understand the production drawings of mechanical components and assemblies
7. Visualize geometrical solids in 3D space through exercise in orthographic projections interpret orthographic, isometric and perspective views of objects



## Syllabus Template

**ME2292: ENGINEERING DESIGN AND INNOVATION – IV****Credits: 06****Teaching Scheme****Lab: 12 Hours/Week****Course Relevance:**

EDI is course with focus on projects and development of hands on skills. Project specific theory to be taught for this course. Focused on social relevance domains such as Agriculture, Green Technology, Smart city, Health Care, Assistance to weaker section, Renewable energy, Transportation, Ergonomics, Safety etc. (not limited to only these domains)

SECTION-I
<b>Topics and Contents</b> <b>Project Management:</b> Overview and Expectations, the Design Process, <b>Define a Problem:</b> Identify a Valid Problem, Justify the Problem <b>Design a Solution:</b> Select a Solution Path, Develop a Design Proposal
SECTION-II
<b>Topics and Contents</b> <b>Design and Prototype a Solution:</b> Plan for the Prototype, Build the Prototype <b>Test, Evaluate, and Refine the Solution:</b> Plan the Test, Test the Prototype <b>Communicate the Process and Results:</b> Documentation and Presentation

**Suggest an assessment Scheme:**

**Suggest an Assessment scheme that is best suited for the course. Ensure 360 degree assessment and check if it covers all aspects of Blooms Taxonomy.**

- 1.MSE
- 2.ESE

**Text Books: (As per IEEE format)**

1. Biswajit Mallick, Innovative Engineering Projects, Entertainment Science And Technology Publication, Bhubaneswar, India
2. Dilip N. Pawar, Dattary K. Nikam, Fundamentals of Project Planning and Engineering, Penram International Publishing (India) Pvt. Ltd.; First edition (12 July 2017).

**Reference Books: (As per IEEE format)**

1. Fernandes, Joao M, Machado, Ricardo J., Requirements in Engineering Projects, Springer International Publishing
2. Carol McBride, Francisco L. Gonzales, Engineer This: 10 Amazing Projects for Young Mechanical Engineers, PRUFROCK Press, 2018

**Course Outcomes:**

The student will be able to –

- 1) Apply critical and creative thinking in the design of engineering projects(5)
- 2) Plan and manage your time effectively as a team(4)
- 3) Apply knowledge of the ‘ real world ’ situations that a professional engineer can

encounter(4)

4) Use fundamental knowledge and skills in engineering and apply it effectively on a project(5)

5) Design and develop a functional product prototype while working in a team(5)

6) Present and demonstrate your product to peers, academics, general and industry community(3)

### CO PO Map

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
O1	2	3	2	2	2	2	2	2	3	3	3	3	2	2	2
O2	2	3	3	2	2	2	2	3	3	3	3	3	2	2	2
O3	3	3	3	2	2	2	2	2	3	3	3	3	2	2	2
O4	2	3	2	2	2	2	2	2	3	3	3	3	2	2	2
O5	2	3	2	2	2	2	2	2	3	3	3	3	2	2	2
O6	2	3	2	2	2	2	2	2	3	3	3	3	2	2	2

### CO attainment levels

Number	Level
	5
	4
	4
	5
	5
	3

**Future Courses Mapping:**

**Job Mapping:**

# **TY MECHANICAL MODULE-V**

**TY MECH. MODULE-V AY: 2022-23**

Su b. No.	Sub. Code	Subject Name	Teaching Scheme(Hrs/We ek)			Examination scheme							Tot al	Credi ts
			Th.	Lab	Tut	CA				MS E	ESA			
						H A	LAB/ CP	PPT/G D			ES E	CV V		
S1	ME325 3	HYDRAULIC MACHINES AND FLUID POWER	2	2	1	2 0	20	20			20	20	100	4
S2	ME326 2	DYNAMICS OF MACHINES	2	2	1	2 0	20	20			20	20	100	4
S3	ME326 3	HYBRID AND ELECTRIC VEHICLES	2	2	1	2 0	20	20			20	20	100	4
S4	ME325 4	MECHATRON ICS	2	2	1	2 0	20	20			20	20	100	4
S5	ME329 3*	ENGINEERIN G DESIGN AND INNOVATION - V	-	12	-					30		70	100	6
S6	ME 3295*	DESIGN THINKING –I	-		1						10 0		100	1
Total			8	20	5									23

## Syllabus Template

**ME3253: HYDRAULIC MACHINES AND FLUID POWER****Course Prerequisite:** Fluids Engineering/Fluid Mechanics**Course Objectives:**

- 1) Understand the application of impulse momentum principle
- 2) Understand the working of hydraulic turbines
- 3) Understand the working of hydraulic pump
- 4) Understand the application of Pascal Law
- 5) Understand the hydraulic systems
- 6) Design and analyze the fluid power systems

**Credits: 04****Teaching Scheme****Theory: 02** Hours/Week**Tut: 1** Hours/Week**Lab: 2** Hours/Week**Course Relevance:**

1. This course offers various design aspects of hydraulic machines.
2. This course forms the basis for designing the industrial fluid power systems.
3. Students will be able to apply the course knowledge in computational fluid dynamics.

**SECTION-1****Unit 1 Impulse Turbine**

Impulse Turbines, Pelton turbine, Work done and Efficiencies of Pelton Turbines, Velocity Triangles and their analysis, Governing, Main and Operating Characteristics, Governing Mechanisms, Unit Quantities. (CO1)

**Unit 2 Reaction Turbine**

Reaction Turbines, Francis turbine, Work done and Efficiencies of Reaction Turbines, Velocity Triangles and their analysis, Kaplan Turbine, Governing, Main and Operating Characteristics, Governing Mechanisms, Draft Tube. (CO2)

**Unit 3 Centrifugal Pump**

Centrifugal Pump, Classification, construction, working, various heads, velocity triangle, losses and efficiencies, specific speed, net positive suction head (NPSH), Main and

Operating Characteristics, Pumps in series and parallel, Priming. (CO3)

## SECTION-II

### Topics and Contents

#### Unit 4 Introduction to Fluid Power

Source of Power and Fluid Power Control, Fluid Power Systems, advantages, Applications, Principle of working, Reservoir assembly, Filters, Accumulators. (CO4)

#### Unit 5 Hydraulic Pumps and Control Valves

Construction of Gear Pumps, Vane Pumps, Necessity of Fluid control, Pressure Control Valves, Flow Control Valves, and Direction Control Valves, Symbols for hydraulic systems and pneumatic systems. (CO5)

#### Unit 6 Hydraulic Actuators and Hydraulic Circuits

Industrial Circuits and Systems, Actuators types, Types of Cylinders, Simple Circuits (Regeneration, Speed Control, Sequencing, Synchronizing, fail safe, unloading, actuator locking circuit). (CO6)

### List of Tutorials:

1. Numericals on design of Pelton turbine
2. Numericals on design of Francis turbine
3. Numericals on design of Kaplan turbine
4. Numericals on design of centrifugal pump
5. Numericals on gear pump
6. Numericals on vane pump
7. Numericals on hydraulic actuators
8. Numericals on hydraulic accumulator

### List of Practical's: (Any Six)

1. Trial on Pelton Turbine
2. Trial on Francis Turbine
4. Trial on Centrifugal Pump
5. Trial on Gear Pump
6. Trial on Vane Pump
7. Demonstration of working of Pressure/Direction/ Flow control valves
8. Demonstration of Compressed air generation and distribution systems
9. Demonstration of shuttle valve/quick exhaust valve/twin pressure valve/pneumatic clamp.
10. Visit to hydro power plant.



**List of Projects:**

1. Design and analysis of Turgo turbine
2. Design and analysis of Kaplan turbine
3. Design and analysis of Centrifugal pump
4. Design and analysis of hydraulic circuits
5. Design and analysis of Pneumatic circuits
6. Design and analysis of Industrial circuits

**List of Course Seminar Topics:**

1. Multi staging in centrifugal pump
2. Applications of centrifugal pump
3. Types of centrifugal pump impeller
4. Comparison of hydraulic turbines
5. Multi jet Pelton turbine
6. High head reaction turbines (modified)
7. Application of Pascal Law
8. Hydraulic cranes
9. Application of logic gates in pneumatic systems
10. Fault finding in Fluid power systems.

**List of Course Group Discussion Topics:**

1. Surge tank in hydro power station
2. Losses in penstock
3. Losses in hydraulic turbines
4. Pumps in series and parallel
5. Propeller turbine
6. Types of DCVs
7. Types of pumps for Fluid Power systems
8. Troubleshoot of fluid power systems
9. Applications of pneumatic systems
10. Applications of hydraulic systems

**List of Home Assignments:****Design:**

1. Design of Hydro power plant for given gross head
2. Design of pumping system for given application
3. Design of gear pump
4. Design of double acting cylinder
5. Selection criteria of hydraulic pumps for Fluid Power systems

**Case Study:**

1. Case study of any Hydro power plant
2. Case study of any pumping system of any application
3. Case study of hydraulic system used for any application
4. Case study of pneumatic system used for any application
5. Case study of micro head hydraulic turbines

**Blog**

1. Future hydraulic turbines
2. Latest trends in centrifugal pump
3. Latest trends in hydraulic pumps
4. Latest trends in hydraulic systems
5. Latest trends in pneumatic systems

**Surveys**

1. Survey of Francis turbines for different heads
2. Survey of Kaplan turbines for different heads
3. Survey of different centrifugal pumps
4. Survey of different hydraulic systems.
5. Survey of different pneumatic systems

**Suggest an assessment Scheme:**

Suggest an Assessment scheme that is best suited for the course. Ensure 360 degree assessment and check if it covers all aspects of Blooms Taxonomy.

1. GD/PPT
2. HA
3. Lab/Course Project
4. CVV
5. ESE

**Text Books: (As per IEEE format)**

1. R.K.Rajput, "Hydraulic Machines", S.Chand Publications, New Delhi
2. Esposito A., "Fluid Power with application", Prentice Hall

**Reference Books:** (As per IEEE format)

1. Modi and Seth, "Hydraulics, Fluid Mechanics and Machinery", Standard Book House, NewDelhi
2. Vasandani V. P., "Theory of Hydraulic Machinery", Khanna Publishers, Delhi
3. Vickers Manual on Industrial Hydraulics
4. Lal J., "Hydraulic Machines", Metropolitan Book Co., Delhi.
5. Karassic, "Hand Book of Pumps", Tata McGraw Hill Ltd. Delhi
6. Majumdar, "Oil Hydraulics-Principle and Maintenance", Tata McGraw Hill
7. Pipenger J. J., "Industrial Hydraulics", McGraw Hill

**Moocs Links and additional reading material:** [www.nptelvideos.in](http://www.nptelvideos.in)

**Course Outcomes:**

The students will be able to –

1. Understand the principle, operation and design of impulse turbine. (CO Attainment level 3)
2. Understand the principle, operation and design of reaction turbines.(5)
3. Understand the principle, operation and design of centrifugal pump.(4)
4. Understand the functions of fluid power components.(3)
5. Understand the functions of hydraulic pumps and control valves.(4)
6. Analyze industrial fluid power systems and circuits(5)

**CO PO Map**

CO	PO 1	2	3	4	5	6	7	8	9	10	11	12	PS O1	2
1	3	2	3	3	2	3	3	1	1	1	1	1	1	3
2	3	2	3	3	2	3	3	1	1	1	1	1	1	3
3	3	2	3	3	2	3	3	1	1	1	1	1	1	3
4	3	2	3	3	2	3	3	1	1	1	1	1	1	3
5	3	2	3	3	2	3	3	1	1	1	1	1	1	3
6	3	2	3	3	2	3	3	1	1	1	1	1	1	3

**CO attainment levels**

CO Number	Level
1	3
2	5
3	4
4	3
5	4
6	5

**Future Courses Mapping:**

Mention other courses that can be taken after completion of this course.

Students can undertake the courses such as CFD, electro hydraulic and electro pneumatics after learning this subject.

**Job Mapping:**

What are the Job opportunities that one can get after learning this course.

After learning this subject, students can work in fluid power companies and also work in certain government departments such as irrigation and hydropower.

## Syllabus Template

**ME3262: DYNAMICS OF MACHINES****Course Objectives:**

1. Study of mechanical power transmission system using positive drive elements.
2. Study of mechanical Kinetics.
3. Study of mechanical inertial systems.
4. Study of Free Vibration Systems.
5. Study of Forced Vibration Systems.

**Credits: 05****Teaching Scheme Theory: 02 Hours/Week****Tut: 01 Hours/Week****Lab: 02 Hours/Week**

**Course Relevance:** Mechanical Transmission systems, Kinetic and Inertial Systems, Mechanical Vibration Systems.

**SECTION-1****Gear Trains:**

Types of gear trains, Velocity ratio, Tooth load, torque transmitted. Holding torque, Tabular method of problem solving, Analytical, Algebraic and Graphical methods of Gear Train Problem Solving.

Gearboxes, Typical industrial gearboxes like constant mesh, synchromesh, differential gearbox Graphical, Positively infinite variable speed drives.

**Flywheels**

Flywheels : Turning moment Diagrams for a four stroke Cycle single and Multi cylinder Internal combustion engine, Fluctuation of energy, Coefficient of fluctuation of energy, Flywheels for engines and Punching machines

**Gyroscope:**

Principles of gyroscopic action, precession, gyroscopic couple, effect of gyroscopic couple on ships, aero plane and vehicles etc.

**SECTION-II****Topics and Contents****Balancing:**

Balancing of rotating masses in one and several planes, balancing of reciprocating masses in single and multi-cylinder engines. Primary and secondary balancing analysis. Concept of direct and reverse cranks.

**Mechanical vibrations –free vibrations:**

Vibration of Mechanical Systems; Types of Vibration; Degrees of Freedom; Types of Restoration and Dissipation Mechanisms; Types of Excitation. Free Undamped Vibration of Single Degree of Freedom Systems; Determination of Natural Frequency; Equivalent Inertia and Stiffness; Energy Method; Phase Plane Representation. Free Vibration with viscous Damping; Critical Damping and Aperiodic Motion; Logarithmic Decrement; Systems with Coulomb Damping.

**Mechanical vibrations –forced vibrations:**

Forced Vibration with Harmonic Excitation; Undamped Systems and resonance; Viscously Damped Systems; Frequency Response Characteristics and Phase Lag; Systems with Base Excitation; Transmissibility and Vibration Isolation; Whirling of Shafts and Critical Speed.

**List of Tutorials:** (Any Three)

- 1) Methods of problem solving and analysis of Gear Trains.
- 2) Typical applications of Gear Trains.
- 3) Methods of problem solving and analysis of Fly wheels.
- 4) Typical applications of Fly wheels.
- 5) Methods of problem solving and analysis of Gyroscopic Couple.
- 6) Typical applications of Gyroscopes.
- 7) Methods of problem solving and analysis of Balancing of Rotors.
- 8) Typical applications of Balancing of Rotors.
- 9) Methods of problem solving and analysis of Mechanical Vibrations.
- 10) Typical applications of Mechanical Vibrations.

**List of Practicals:** (Any Six)

The term work shall consist of following Experiments and students are expected to submit a journal containing these experiments and sheets.

1. To study the transmitted and holding torque of an epicyclic gear trains.
2. To study various types of industrial gear boxes such as; Differential, Constant mesh, Synchromesh and PIV gear box.
3. To study the performance of a given flywheel for I.C. Engine and Punching Machine application.
4. Study of Gyroscopic effect
5. Damped torsional vibrations
6. Forced vibration system

7. Static and dynamic balancing
8. Transverse vibrations of beam
9. Two rotor system

**List of Projects:**

1. Design and development of a PIV Speed Drive.
2. Design and development of an automatic gear box.
3. Design and development of Fly Wheel for 4 stroke Multi cylinder IC Engine / Fluctuating Loads.
4. Vibration measurements / analysis of different systems
5. Dynamic analysis of rotating system

**List of Course Seminar Topics:**

1. Industrial applications of simple Gear Box
2. Industrial applications of Compound Gear Box
3. Industrial applications of Automobile Gear Box
4. Fly wheels for fluctuating Input torque
5. Fly wheels for fluctuating Output torque
6. Gyro Instruments
7. Gyro effect on 2 wheelers, 4 wheelers, Boats, Aircrafts and Spacecrafts
8. Balancing of rotating masses
9. Vibration measurements
10. Vibration Absorbers

**List of Course Group Discussion Topics:**

1. Applications of Gear Trains
2. Applications of Fly wheels
3. Applications of Gyroscopes
4. Applications of Balancing of Rotors
5. Applications of Mechanical Vibrations

**List of Home Assignments:****Design:**

1. Gear Trains
2. Fly Wheels
3. Gyroscopic Applications
4. Balancing of Rotors
5. Mechanical Vibrations

**Case Study:**

1. Automatic Gear Trains for Automobiles
2. Fly Wheels for 4 stroke engines Steam engines and Punching Presses
3. Gyroscope Instruments
4. Balancing of multi-cylinder Engines
5. Vibration Instrumentation

**Blog**

1. PIV Gear Trains
2. Fly wheel Types
3. Gyroscopic Stabilization
4. High speed Rotor Balancing
5. Vibration Isolators

**Surveys**

1. Industrial Gear Trains
2. Fly wheel Manufacturing
3. Gyroscopic Instrumentation
4. Rotor Balancing
5. Vibration Instrumentation

**Text Books: (As per IEEE format)**

1. Ballaney P.L., "Theory of Machines", Khanna Publications.
2. S. S. Rattan, "Theory of Machines", Tata McGraw-Hill Publication.
3. R. S. Khurmi, "Theory of Machines", Khanna Publication.

**Reference Books: (As per IEEE format)**

1. Hannah and Stephans, "Mechanics of Machines", Edward Arnold Publications.
2. Beven T, "Theory of Machines", Longman Publications.
3. Shigley J.E. and Uiker J.J., "Theory of Machines and Mechanisms", International Edition, MacGraw Hill Inc.
4. JagdishLal, "Theory of Machines", Metropolitan BookCo.Pvt. Ltd. N. Delhi.

**Moocs Links and additional reading material:** [www.nptelvideos.in](http://www.nptelvideos.in)

You Tube Videos, How stuff works

**Course Outcomes:**

On successful completion of the course, the student will be able to;

1. Design & analysis of gear train system for a particular application.
2. Analyze various forces and torques acting on Mechanical components like Flywheels.
3. Understand the gyroscopic couple and its effect on ships, aero planes and vehicles.
4. Design & analyze the dynamic balancing of machines.
5. Develop the mathematical model of a single degree vibratory system and perform free vibration analysis.
6. Develop the mathematical model of a single degree vibratory system and perform force vibration analysis.

CO/ PO	PO :1	PO :2	PO :3	PO :4	PO :5	PO: 6	PO :7	PO: 8	PO :9	PO: 10	PO: 11	PO: 12	PSO :01	PSO :02	PSO: 03
CO: 1	2	3	2	2	1	1	1	1	1	1	1	1	2	2	1
CO: 2	2	2	1	1	2	1	0	1	0	0	2	2	1	0	1
CO: 3	3	3	2	2	2	1	1	0	1	1	1	1	0	2	2



3															
CO: 4	2	2	2	2	2	1	2	0	1	1	1	1	0	1	1
CO: 5	3	3	2	2	1	1	2	2	1	2	2	1	0	0	1
CO: 6	3	3	2	2	1	1	2	2	2	2	2	2	1	1	0

## Syllabus Template

**ME3263: HYBRID AND ELECTRIC VEHICLES****Course Objectives:**

1. To do mathematical analysis of engine cycles for air standard, fuel-air and real conditions.
2. To gain knowledge of Engine systems and modern trends
3. To demonstrate and analyse electric vehicle and hybrid electric vehicle configurations.
4. To do experimentation for Engine performance and its mathematical analysis.
5. To gain knowledge about electric propulsion systems and energy storage systems of the Electric and Hybrid Electric Vehicles
6. Design of Hybrid and Electric Vehicles

**Credits: 04****Teaching Scheme Theory: 02 Hours/Week****Tut: 01 Hours/Week****Lab: 02 Hours/Week****Course Relevance:**

1. The course exposes the students to the technology of Hybrid and Electric Vehicles.
2. Students learn the mathematical analysis of I.C. Engine cycles and engine performance parameters.
3. With the knowledge gained by this course, students become familiar with the knowledge about electric propulsion systems and energy storage systems of the Electric and Hybrid Electric Vehicles configurations and drive trains.

**SECTION- I****Unit 1:Hybrid Electric Vehicles Engine Fundamentals :(6)**

Engine components, Basic engine nomenclature, Engine classification, working of four stroke and two stroke engines.

I.C.Engine Cycles: Air standard cycles, Fuel air cycles and Actual cycles of the Engine  
Air standard cycles. - Assumptions, Otto, Diesel and Dual cycles, Fuel-air cycles - Importance, Effect of variable specific heat and dissociation, Actual cycles

**Unit 2: Introduction to Engine Systems: (4)**

Fuel Supply Systems for S. I. Engines, Fuel Supply Systems for C. I. Engines, Lubrication system, Cooling systems, Ignition systems, Exhaust systems

**Unit 3: Vehicle dynamics, EV and HEV power train analysis (4)**

Conventional Vehicles fundamentals, Vehicle dynamics, Configurations of Electric

Vehicles, Performance of Electric Vehicles, Traction Motor Characteristics and comparison with engines performance characteristics, Tractive Effort and Transmission Requirement, Vehicle Performance, Tractive Effort in Normal Driving and Energy consumption.

## SECTION- II

### Unit 4: Performance of I. C. Engine (6)

Determination of fuel consumption, air consumption, air-fuel ratio, Determination of brake power, indicated power, friction power. Determination of thermal efficiency, mechanical efficiency, volumetric efficiency, Determination of mean effective pressure, Energy Balance, Performance Characteristics

Supercharging: Objectives of supercharging, Supercharging of S.I. Engines and C.I. Engines and its limitations, effects of supercharging on performance of engine. Turbo charging- Methods, Limitations.

### Unit 5: Hybrid Electric Vehicles (4)

Concept of Hybrid Electric Drive Trains, Architectures of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel Hybrid Electric Drive Trains, Torque-Coupling Parallel Hybrid Electric Drive Trains, Speed-Coupling Parallel Hybrid Electric Drive Trains, Torque-Coupling and Speed-Coupling Parallel Hybrid Electric Drive Trains.

### Unit 6: Motors, batteries, and battery packs (4)

Motors used for EVs and HEVS. Batteries, Battery Pack and Battery Thermal Management

### List of Tutorials: (Any Three)

- 1) Numerical based on-air standard cycles
- 2) Numerical based on fuel- air and actual cycles
- 3) Numerical based on engine performance
- 4) Numerical based on turbo charging performance
- 5) Drive cycles and its analysis
- 6) Calculations regarding Acceleration, Max speed and range performance of Electric or HEV
- 7) Calculations based on sizing of the motor, battery of Electric vehicles
- 8) Numerical based on motor performance
- 9) MPFI systems
- 10) Turbo charging

**List of Practical's: (Any Six)**

1. Study and Demonstration of conventional diesel fuel injection system and common rail diesel injection system.
2. Study and Demonstration of Distributor type injection system.
3. Study and demonstration of Carburettors and MPFI systems.
4. Trial on motor for torque and power performance.
5. Trial on diesel engine to determine variable load performance and energy balance.
6. Variable speed trial on petrol/diesel engine.
7. Trial on multi-cylinder petrol engine – Morse Test.
8. Trial on variable compression ratio engine.
9. Trial on diesel/petrol engine to plot Pressure-Crank angle diagram.
10. Trial on exhaust gas analyser and smoke meter for emission analysis at variable load.
11. Study and Demonstration of the Electric Car/ Electric two-wheeler/Electric Bus

**List of Course Projects areas:**

1. Gasoline Engine simulation, optimization, and realization
2. Diesel Engine simulation, optimization, and realization
3. CNG Engine simulation, optimization, and realization
4. Engine aftertreatment systems
5. Alternative fuels for Engines
6. Brushless DC Motor simulation using Simulink or Ansys Maxwell
7. Induction Motor simulation using Simulink or Ansys Maxwell
8. SRM Motor simulation using Simulink or Ansys Maxwell
9. PMSM Motor simulation using Simulink or Ansys Maxwell
10. Engine testing performance and comparison
11. Motor testing performance and its comparison
12. Battery testing
13. BMS and BTMS
14. Prototype building of electric two-wheeler, three-wheeler, and four-wheeler

**List of Course Seminar Topics/ GD Topics:**

1. Electric two-wheeler regulations ARAI standard test procedure AES 1233 (Part 3)
2. Opportunity areas in the two-wheeler E Mobility such as Motor design, Battery design and IOT integration
3. Future batteries such as Sodium ion, Graphene, and super capacitors etc.
4. Torque coupling and speed coupling basics, types, latest trends, manufacturing, manufacturers, and design etc.
5. Lithium-ion batteries basics, types, latest trends, manufacturing, manufacturers, and design etc.
6. Engine cooling systems design
7. MPFI systems basics, types, latest trends, manufacturing, manufacturers, and design
8. Configuration and control and performance of DC motors and Induction motors
9. Configuration and control and performance of Permanent magnet motor and SRM
10. Battery Performance Characteristics
11. Energy storage using Super Capacitor and its analysis
12. Electric chargers and its design for electric and hybrid vehicles

13. Electric vehicle Vs Conventional vehicles
14. Series Hybrid vehicles Vs Parallel hybrid vehicles
15. Motor performance/manufacturing Vs. Engine performance/manufacturing
16. Gasoline Engine emission regulations Vs Diesel Engine emission regulations
17. Hybrid and electric vehicle energy management strategies.
18. Regenerative braking and Mechanical braking
19. Hydrogen fuel cell and SOFC
20. Environmental impact of I.C. Engine
21. Engine after treatment systems (Petrol and diesel engines)
22. AC motors Vs DC motors used in HEV
23. Local electricity generation, utilization distribution for electric vehicles to reduce the net pollution
24. ECU for Gasoline, diesel, electric and hybrid vehicles

**List of Home Assignments:****Design:**

- 1.Design of series hybrid vehicle
- 2.Design of Electric vehicle
- 3.Design of Electric two wheeler
- 4.Torque and speed coupling design
- 5.Engine design

**Case Study:**

- 1.Case study of Atherelectric two wheeler or Okinava Electric two wheeler or Bajaj Chetak
- 2.Case study of Electric three wheeler
- 3.Case study of Lithium ion battery raw material and its availability
- 4.Case study of Mahindra E2O or any other electric four wheeler
- 5.Toyota Prius hybrid car

**Blog**

- 1.Electric vehicle fleet
- 2.Charging stations
- 3.Two wheeler industry potential for electrification
- 4.Effect of E mobility on manufacturing industries
- 5.Opportunities in the field of E mobility

**Surveys**

- 1.Survey to know orientation of people towards Electric or conventional vehicle
- 2.Survey based on Power train Preference for next vehicle purchase (Gasoline, Diesel, Hybrid, Electric, other)
- 3.Survey based on new purchase of two wheeler ( Gasoline, CNG, Electric)
- 4.Survey report based on CNG filling stations in India (current status and future scope)
- 5.Survey report based on battery manufacturing in India (current status and future scope)

**Suggest an assessment Scheme:**

Suggest an Assessment scheme that is best suited for the course. Ensure 360 degree assessment and check if it covers all aspects of Blooms Taxonomy.

1. Course Seminar/GD
2. HA
3. Course project
4. CVV
5. ESE

**Text Books: (As per IEEE format)**

1. V. Ganesan, "Internal Combustion Engines", Tata McGraw-Hill Publishing Company Ltd.
2. M. L. Mathur and R. P. Sharma, "A Course in Internal Combustion Engines", Dhanpat Rai and Co. Pvt. Ltd.
3. Rajput R. K. "International combustion Engines", Laxmi publications Pvt. Ltd.
4. "Electric and Hybrid Vehicles Design Fundamentals" (2<sup>nd</sup> Edition), by Iqbal Husain

**Reference Books: (As per IEEE format)**

1. Srinivasan, "Automotive Engines", Tata McGraw-Hill Publishing Company Ltd.
2. "Modern Electric, Hybrid Electric and Fuel Cell Vehicles Fundamentals, Theory and Design" By Mehrdad Ehsani, Yimin Gao and Ali Emadi
3. "Hybrid Electrical Vehicle Principles and Application with Practical Perspectives" by Chris MI, M. Abul and David Wenzhong Gao
4. "Propulsion System for Hybrid Vehicle" 2nd Edition" by John M. Miller

**Moocs Links and additional reading material:** [www.nptelvideos.in](http://www.nptelvideos.in)**Course Outcomes:**

The student will be able to –

1. Do analysis of engine cycles for air standard, fuel-air and real conditions.
2. Demonstrate and compare engine systems and modern trends in the engines.
3. Demonstrate and analyze vehicle dynamics of Hybrid And Electric vehicles
4. Do analysis of engine performance parameters.
5. Demonstrate and analyze hybrid electric vehicle configurations
6. Demonstrate knowledge about electric propulsion systems and energy storage systems of the Electric and Hybrid Electric Vehicles

**CO PO Map**

CO	PO 1	2	3	4	5	6	7	8	9	10	11	12	PS O1	2
1	3	1	0	0	0	0	0	0	0	0	0	1	0	2
2	1	0	0	0	0	0	0	0	1	1	0	1	0	3
3	1	0	0	0	0	0	1	0	1	1	0	1	0	3
4	3	0	3	3	1	0	0	0	1	1	0	1	0	3
5	2	0	2	0	0	0	0	0	1	1	1	1	0	3
6	2	0	2	1	2	0	0	0	1	1	1	1	0	3

**CO attainment levels**

CO Number	Level
1	4
2	3
3	3
4	5
5	4
6	4

**Future Courses Mapping:**

Mention other courses that can be taken after completion of this course

I C Engine Modelling and simulations

Automotive fuels and Emissions

**Job Mapping:**

Work in Automobile Industry as an engineer. This knowledge will be useful to study the technology of hybrid and electric vehicles which is the very basic need of the present automobile industry. Job opportunities in the companies like Caterpillar, KOEL, Cummins and Automobile OEMS and Subsidiaries

C	PO1	2	3	4	5	6	7	8	9	10	11	12	PSO	2	3
---	-----	---	---	---	---	---	---	---	---	----	----	----	-----	---	---

O													1			
1	3 Cycle analysi s	1 Eng ine cycl e analysi s	0	0	0	0	0	0	0	0	0	0	1 Self lear nin g	0	2 Engine basics	0
2	1	0	0	0	0	0	0	0	0	1 C P a n d H A	1 GD and Seminar	0	1 Self lear nin g	1 (Engi ne syste ms cut section drawings)	3 (Engin e system s and labs)	0
3	1	0	0	0	0	0	1 EV leads Enviro nment al sustain ability	0	0	1 C P a n d H A	1 GD and Seminar	0	1 Self lear nin g	0	3 (HEV system s)	0
4	3 EV and HEV Mathe matical Analys is	0	3 Engi ne pollu tion Red uction	3 Experim entation for critical results	1	0	0	0	0	1 C P a n d H A	1 GD and Seminar	0	1 Self lear nin g	0	3 ( Engine perfor mance analysi s)	0
5	2 HEV Project analysi s	0	2 Desi gn of HEV	0	0	0	0	0	0	1 C P a n d H A	1 GD and Seminar	1 Co urs e project s	1 Self lear nin g	0	3 ( HEV perfor mance analysi s)	1 B M S a n d B T M S
6	2 EV and HEV system s analysi s	0	2 Desi gn of EV	1 Lithium ion Battery chemist ry and develop ment	2 HE V cou rse project	0	0	0	0	1 C P a n d H A	1 GD and Seminar	1 Co urs e project s	1 Self lear nin g	0	3 ( Motor and Batter y perfor mance	1 M o t o r



					usin g mo der n tool s			A						analysi s)	a n d  B a t t e r y
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## Syllabus Template

**ME3254: Mechatronics****Prerequisites:**

Basic mechanical engineering, Engineering mechanics, Engineering Mathematics, Basic electronics, Basic electrical engineering, Boolean algebra, various number systems

**Course Objectives:**

1. To understand mechatronic system, control system types, measurement system, actuators and control system
2. To model basic engineering systems for implementing control.
3. To analyze system models and system responses for various engineering systems.
4. To understand analogue to digital and digital to analogue conversion principles and data acquisition system.
5. To implement control using various embedded systems for given applications.
6. To demonstrate ladder programming of PLCs for various industry applications.

**Credits: 04****Teaching Scheme Theory: 02 Hours/Week****Tut: 01 Hours/Week****Lab: 02 Hours/Week****Course Relevance:**

Industry 4.0 requires industries to implement IoT, smart communication, cloud storage, connectivity between various systems and implementation of control systems. Mechatronics helps students to grasp these important areas of developing engineering fields and thus be relevant in these advanced concepts

SECTION-1
<b>Uni-I</b> <b>Introduction to Mechatronics</b> Mechatronic system, measurement systems, control systems – open loop, closed loop, feedback and feed forward control systems and its applications, static and Dynamic characteristics, classification of sensors, Actuators, selection of sensors and actuators. <b>Unit-II</b> <b>System Models and Responses</b> Mathematical models, introduction to mechanical, electrical, fluid and thermal systems, Dynamic responses of systems – various types of inputs, first and second order systems and its examples, system transfer functions <b>Unit-III</b> <b>Closed loop controllers</b> On-Off, proportional, proportional + integral, proportional + derivative, proportional integral + derivative control actions.

**SECTION-II****Unit-IV****Micro Mechatronic Systems and Data Acquisition**

Micro sensors, Micro actuators, Micro-fabrication techniques, LIGA process, Lithography, etching, Micro-joining etc, Analogue to digital conversion - Sample and hold circuit, Sampling frequency, Sampling theorem.

**Unit-V****Micro-controllers and IoT**

Microcontroller, embedded systems Arduino controller, practical examples, control using Raspberry pi and its features, introduction to IOT softwares and protocols,.

**Unit-VI****Programmable Logic Controllers**

Relay logic, basic structure, input/output processing, timers, internal relays and counters, shift registers, ladder diagram and programming, introduction to SCADA systems

**List of Tutorials:**

1. Problems on Block Diagram Reduction Techniques/Signal Flow Graphs
2. Problems on Root Locus/Bode plots
3. Determination of System response & Transfer function.
4. Problems on Mathematical Modeling for Mechanical, Electrical, Thermal & Fluid systems.
5. Case study on Mechatronics examples.

**List of Practical's: (Any Six)**

1. Formulation of Feedback control system using MATLAB Simulink.
2. Formulation of Feed forward control system using MATLAB Simulink.
3. Interfacing of any Sensor with Data Acquisition System.
4. Design and implementation of a system using IoT.
5. Simulation of Response of second order system to various types of inputs.
6. Programming an Arduino for a smart lighting system.
7. Simulation of Response of first order system to various types of inputs.
8. PID Control Implementation on DC Motor Speed Control System
9. Ladder Diagram development for different types of Logic Gates using suitable Software.
10. Implementation and verification of Mathematical model of a mechanical system using MATLAB Simulink.
11. Smart systems using microcontroller boards
12. Demonstration of cloud data storage and communication techniques

**List of Projects:**

1. Intelligent illumination control system (using Arduino / Raspberry Pi)
2. Modelling of automotive suspension system in Simulink
3. Smart security system for intruder detection (using Arduino / Raspberry Pi)
4. Smart camera module for motion detection and security (using Arduino / Raspberry Pi)
5. Smart obstacle detection system for automobiles (using Arduino / Raspberry Pi)
6. Mobile App controlled home automation using microcontroller board (using Arduino / Raspberry Pi)
7. Bluetooth controlled smart water management system for apartments (using Arduino / Raspberry Pi)
8. Automated control system for cooling devices in household and public locations (using Arduino / Raspberry Pi)
9. Intelligent car parking system (using Arduino / Raspberry Pi)
10. Intelligent motor speed control system using Mobile App (Arduino).

**List of Course Seminar Topics:**

1. Recent trends in sensor technology
2. Sensor properties improvement
3. Mechatronic design - concept, need, applications, clarifications
4. Role of system models in modifications and improvement
5. Control systems in industry
6. Mechatronics and industry 4.0
7. Micro-mechatronic systems - concept, scope, applications
8. Mechatronics and Robotics
9. Actuators in Mechatronic systems
10. Cloud storage and communication techniques for IoT systems.

**List of Course Group Discussion Topics:**

1. Mechatronic design Vs traditional design
2. Challenges of mechatronic systems and prospective solutions
3. IOT & Mechatronics
4. Mechatronics and Health care (Medical Science, Food Industry)
5. Various controllers
6. Mechatronics for smart cities
7. SCADA Systems - scope and limitations
8. Next level mechatronic systems
9. Mechatronics & Robotics
10. Conventional Vs 'Solid state' speed control of dc motors
11. Micromechatronics Applications
12. Mechatronics and Agriculture
13. AI & Mechatronics
14. ML & Mechatronics

**List of Home Assignments:****Design:**

1. Selection of proper actuator for a mechatronic system
2. Design of PID controller for an apartment water tank management
3. Design of drive system for apartment water pump
4. Design of drive for an electric vehicle
5. Design of an automobile suspension system

**Case Study:**

1. Static and dynamic characteristics of a market transducer and its relevance
2. Autonomous vehicle - a mechatronic system case study
3. Case study on drive for material handling system in industry
4. Drive characteristics improvement for industry application
5. IoT system for quality control application in industry

**Blog**

1. A mechatronic system - Role, need and clarifications
2. Control system - need and types
3. Benefits of IoT to industry and manufacturing
4. Role and scope of sensors
5. Modeling and response of systems – scope and applications

**Surveys**

1. Comparative analysis of 4 market sensors based on their static and dynamic characteristics.
2. Identify all the sensors available in the market (with their specifications) and study sensors used for an autonomous vehicle
3. Industry implemented SCADA systems and improvement achievements
4. Implemented mechatronic systems in vigilance applications by Government
5. Data Acquisition systems for research application

**Suggest an assessment Scheme:**

Suggest an Assessment scheme that is best suited for the course. Ensure 360 degree assessment and check if it covers all aspects of Bloom's Taxonomy.

1. HA
2. Lab
3. Course project
4. GD/PPT
5. ESE
6. CVV

**Text Books: (As per IEEE format)**

1. Bolton W., “Mechatronics–Electronics Control Systems in Mechanical and Electrical Engineering”, Pearson – Education (Singapore) Pvt. Ltd.
2. Histan B. H., Alciatore D. G “Introduction to Mechatronics and Measurement Systems”.
3. K.P. Ramchandran, G.K. Vijayaraghavan, M.S. Balasundaram, Mechatronics: Integrated Mechanical Electronic Systems, Wiley Publication, 2008

**Reference Books:** *(As per IEEE format)*

1. Rangan C. S., Sarma G. R. and Mani V. S., “Instrumentation – Devices and Systems”, Tata McGraw Hill, New Delhi.
2. Johnson C. D. “Process Control Instrumentation Technology”, Prentice Hall of India Pvt Ltd., New Delhi.
3. Rajput R. K, “A Textbook of Mechatronics” S. Chand and Co. Ltd.
4. Bishop (Editor), Mechatronics – An Introduction, CRC Press, 2006.

**Moocs Links and additional reading material:**

<https://nptel.ac.in/courses/112/103/112103174/>

**Course Outcomes:**

The student will be able to –

1. Select appropriate measurement system, actuators and control system for a mechatronic system, based on static and dynamic characteristics.
2. Model basic engineering systems and use it for implementing control.
3. Apply knowledge of mathematics, science and engineering to model and solve various engineering systems.
4. Carry out analogue to digital and digital to analogue conversion of given signal and system.
5. Implement control using various embedded systems for given application.
6. Carry out ladder programming for given application of PLC in engineering industry.

**CO PO Map**

C	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	P	PS	P
O	1	2	3	4	5	6	7	8	9	10	11	12	S	O2	S
													O		O
													1		3

1	2	2	2	1	1	1	1	1	2	2	1	1	3	3	2
2	1	2	1	2	2	1	1	1	2	2	1	1	3	2	2
3	3	2	1	2	1	1	1	1	2	2	1	1	3	2	3
4	2	2	1	2	1	1	1	1	2	2	1	1	2	2	2
5	1	1	1	1	3	1	1	1	2	2	1	1	2	2	3
6	1	1	1	1	3	1	1	1	2	2	1	1	2	3	3

### Justification of Mapping

#### CO attainment levels

CO Number	Level
1	3
2	4
3	4
4	5
5	3
6	4

### Future Courses Mapping:

Industrial Automation, Embedded Systems, Control Systems, Signal Processing

### Job Mapping:

Course helps students in niche areas to implement IoT systems in industry, work in an interdisciplinary environment, help select sensors and actuators for various engineering systems and identify requirements for industrial automation.

## Syllabus Template

**ME3293: ENGINEERING DESIGN AND INNOVATION – V****Credits: 06****Teaching Scheme****Lab: 12 Hours/Week****Course Relevance:**

EDI is a course with focus on projects and development of hands-on skills. Project specific theory to be taught for this course. Focused on social relevance domains such as Agriculture, Green Technology, Smart city, Health Care, Assistance to weaker section, Renewable energy, Transportation, Ergonomics, Safety etc. (not limited to only these domains)

SECTION-1
<b>Topics and Contents</b> <b>Project Management:</b> Overview and Expectations, the Design Process, <b>Define a Problem:</b> Identify a Valid Problem, Justify the Problem <b>Design a Solution:</b> Select a Solution Path, Develop a Design Proposal
SECTION-1I
<b>Topics and Contents</b> <b>Design and Prototype a Solution:</b> Plan for the Prototype, Build the Prototype <b>Test, Evaluate, and Refine the Solution:</b> Plan the Test, Test the Prototype <b>Communicate the Process and Results:</b> Documentation and Presentation
<b>Suggest an assessment Scheme:</b> Suggest an Assessment scheme that is best suited for the course. Ensure 360 degree assessment and check if it covers all aspects of Bloom's Taxonomy. 1.MSE 2.ESE
<b>Text Books: (As per IEEE format)</b>



1. Biswajit Mallick, Innovative Engineering Projects, Entertainment Science And Technology Publication, Bhubaneswar, India
2. Dilip N. Pawar, Dattary K. Nikam, Fundamentals of Project Planning and Engineering, Penram International Publishing (India) Pvt. Ltd.; First edition (12 July 2017).

**Reference Books: (As per IEEE format)**

3. Fernandes, Joao M, Machado, Ricardo J., Requirements in Engineering Projects, Springer International Publishing
4. Carol McBride, Francisco L. Gonzales, Engineer This: 10 Amazing Projects for Young Mechanical Engineers, PRUFROCK Press, 2018

**Course Outcomes:**

The student will be able to –

- 1) Apply critical and creative thinking in the design of engineering projects (5)
- 2) Plan and manage your time effectively as a team (4)
- 3) Apply knowledge of the ‘ real world ’ situations that a professional engineer can encounter (4)
- 4) Use fundamental knowledge and skills in engineering and apply it effectively on a project (5)
- 5) Design and develop a functional product prototype while working in a team (5)
- 6) Present and demonstrate your product to peers, academics, general and industry community (3)

**CO PO Map**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PSO3
CO1	2	3	2	2	2	2	2	2	3	3	3	3	2	2	2

<b>C02</b>	2	3	3	2	2	2	2	3	3	3	3	3	2	2	2	
<b>C03</b>	3	3	3	2	2	2	2	2	3	3	3	3	2	2	2	
<b>C04</b>	2	3	2	2	2	2	2	2	3	3	3	3	2	2	2	
<b>C05</b>	2	3	2	2	2	2	2	2	3	3	3	3	2	2	2	
<b>C06</b>	2	3	2	2	2	2	2	2	3	3	3	3	2	2	2	

**CO attainment levels**

<b>CO Number</b>	<b>Level</b>
	<b>5</b>
	<b>4</b>
	<b>4</b>
	<b>5</b>
	<b>5</b>
	<b>3</b>

**Future Courses Mapping:****Job Mapping:**

# **TY MECHANICAL MODULE-VI**

**TY MECH. MODULE-VI AY: 2022-23**

Su b. No.	Sub. Code	Subject Name	Teaching Scheme(Hrs/We ek)			Examination scheme								Tot al	Cre dits
			Th.	Lab	Tut	CA				MS E	ESA				
						H A	CP/LA B	PPT/G D			ES E	CV V			
S1	ME3266	APPLIED THERMAL ENGINEERI NG	2	2	1	2 0	20	20			20		20	100	4
S2	ME3301	MATERIALS AND PROCESS ENGINEERI NG	2	2	1	2 0	20	20			20		20	100	4
S3	ME3302	HEAT TRANSFER	2	2	1	2 0	20	20			20		20	100	4
S4	ME3276	MECHANIC AL SYSTEM DESIGN	2	2	1	2 0	20	20			20		20	100	4
S5	ME3294 **	ENGINEERI NG DESIGN AND INNOVATIO N - VI	-	12	-					30	70			100	4
S6	ME3296 **	DESIGN THINKING- II	-	-	1						10 0			100	1
Total			8	20	5										23

## Syllabus Template

**ME3266: APPLIED THERMAL ENGINEERING****Course Prerequisites:** Thermodynamics**Course Objectives:**

1. Understand Working and Application of Reciprocating Compressors
2. Understand the Working and Application of Rotary Compressors
3. Understand the Working of Steam Turbines
4. Understand the Working Cycle of Gas Turbines and Its Performance
5. Understand the Working and Application of VCR Cycle
6. Understand the Working of Air Conditioning Systems

**Credits: 4****Teaching Scheme Theory: 2 Hours/Week****Tut: 1 Hours/Week****Lab: 2Hours/Week****Course Relevance:**

1. Understand Reciprocating Compressors and Rotary Compressors
2. Understand Steam Turbines and Gas Turbines
3. Students can learn various applications of VCR Cycle

**SECTION-I****Unit 1- Reciprocating Air Compressor**

Reciprocating Air Compressor - Single and Multistage, computation of work done, isothermal efficiency, effect of clearance volume, volumetric efficiency, Free air delivery, Theoretical and actual indicator diagram,

**Unit 2- Rotary Compressor**

Rotary Compressor – Introduction, Classification, Displacement Compressors, Steady Flow Compressors, Comparison between Reciprocating and Centrifugal Compressors, Comparison between reciprocating and rotary Compressors, Advantages and Disadvantages

**Unit 3- Steam Turbines**

Steam Turbines: Classifications, construction details, compounding, velocity diagrams, governing, losses in steam turbines

## SECTION-II

### Unit 4- Gas Turbines

Gas Turbines- Introduction, Classification, Brayton Cycle, Thermal Efficiency, Work ratio, maximum and optimum pressure ratio, Actual cycle effect of operating variables on thermal efficiency, inter-cooling, reheating and regeneration cycle.

### Unit 5- Refrigeration

Refrigeration - Applications, Refrigerants, Refrigerator and Heat Pump Vapour compression systems, Effect of Operating Conditions on Vapour Compression Cycle, Vapour absorption systems.

### Unit 6- Air Conditioning

Air Conditioning- Psychrometry, Psychrometric Chart, Air Conditioning Processes, Human Comfort, Air Conditioning Systems, Water Coolers, Ice Plant, Air Coolers.

### List of Tutorials: (Any Three)

1. Numericals on Reciprocating Compressor
2. Numericals on Rotary Compressors
3. Numericals on Steam Turbines
4. Numericals on Brayton Cycle with Reheating, Regeneration and Intercooling
5. Numericals on VCR Cycle
6. Numericals on Psychrometric Chart and Air Conditioning

### List of Practical's: (Any Six)

1. Trial on Reciprocating Air Compressor
2. Study of Axial Flow Compressors
3. Trial on Centrifugal Air Blower
4. Trial on Steam Turbine
5. Study of Gas Turbine
6. Trial on Ice Plant Test Rig
7. Trial on Vapour Compression System
8. Trial on Vapour Absorption System
9. Trial on Air Conditioning Test Rig: Cooling and Dehumidification Process.
10. Estimation of Cooling Load of Simple Air Conditioning System (case study)

### List of Projects:

1. Thermal Analysis of Reciprocating Compressors

2. Thermal Analysis of Rotary Compressors
3. Thermal Analysis of Steam Turbines
4. Thermal Analysis of Gas Turbines
5. Analysis of VCR Cycle with practical approach
6. Analysis of Various market available Refrigerants and its applications
7. Analysis of Human Comfort Zones using Psychrometry
8. Analysis of Air-conditioned Room with Psychrometry and Heat Load Calculation
9. Air Conditioning Processes
10. Central Air Conditioning System

**List of Course Seminar Topics:**

1. Advances in the Thermodynamics-Case study
2. Applications of Reciprocating Compressors and Recent Advancements
3. Applications of Rotary Compressors and Recent Advancements
4. Thermal analysis of Refrigeration cycle
5. Thermal Analysis of Solar Refrigeration cycle
6. Thermal analysis of Vapour Power cycle
7. Analysis of any thermal mechanical devices
8. Steam turbine and Its design Understanding
9. Gas Turbines and Its Design Understanding
10. Air Conditioning Systems

**List of Course Group Discussion Topics:**

1. Reciprocating air compressor and applications
2. Rotary compressors and applications
3. Steam turbines applications
4. Gas turbines and applications
5. List of Various Refrigerants with its molecular formulas

6. Components of VCR Cycle and its applications
7. Various Psychrometric Processes and its nature on chart
8. Components of Air Conditioning Systems
9. Human Comfort
10. Water Coolers and Air Coolers

List of Home Assignments:

**Design:**

1. Design of any thermal system with entropy analysis
2. Design of Reciprocating Compressor
3. Design of Rotary Compressor
4. Design of steam turbines
5. Design of Gas Turbines

**Case Study:**

1. Case study of Reciprocating compressor and its application
2. Case study of Rotary compressor and its application
3. Case study of Gas Turbine used and its application
4. Case study of Steam Turbines used and its application
5. Case study of Refrigeration cycle used in any thermal system

**Blog:**

1. Future Compressors
2. Latest trends in Reciprocating compressors
3. Latest trends in Rotary Compressors
4. Latest trends in Gas Turbines
5. Latest trends in Air conditioning systems

**Surveys:**

1. Survey of Reciprocating compressors and its specifications
2. Survey of Rotary compressors and its specifications
3. Survey of Steam turbine in power plant and its specifications
4. Survey of Refrigeration and Air conditioning units used in multiplex, Vehicles
5. Survey of Gas turbine power plant and its specification

**Suggest an assessment Scheme:**

Suggest an Assessment scheme that is best suited for the course. Ensure 360 degree assessment and check if it covers all aspects of Blooms Taxonomy.

1. Course Seminar/GD
2. HA
3. Lab/Course project



4. CVV
5. ESE

**Text Books: (As per IEEE format)**

1. Mahesh M. Rathore, Thermal Engineering, Tata McGraw Hill
2. R.K. Rajput, Thermal Engineering, Laxmi Publications
3. P. K. Nag; Engineering Thermodynamics; Tata McGraw Hill
4. Arora C. P., Refrigeration and Air Conditioning, Tata McGraw Hill

**Reference Books: (As per IEEE format)**

1. Yunus Cengel and Michael Boles; Thermodynamics - An Engineering Approach; Tata McGraw Hill
2. Dossat Ray J; Principles of refrigeration, S.I. version, Willey Eastern Ltd, 2000
3. Rayner Joel; Engineering Thermodynamics; ELBS Longman
4. Ballaney P. L; -Thermal Engineering; Khanna Publishers

**Moocs Links and additional reading material:** [www.nptelvideos.in](http://www.nptelvideos.in)

**Course Outcomes:**

After completion of this course, student will able to;

1. Understand performance parameters of Reciprocating Air Compressors
2. Understand performance characteristics of Rotary Compressors.
3. Analyse the performance of Steam Turbines.
4. Analyse the performance of Gas Turbines
5. Illustrate the fundamental principles and applications of Refrigeration Systems
6. Illustrate the fundamental principles and applications of Air Conditioning Systems

**CO PO Map:**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO <sub>1</sub>	3	3	2	3	2	2	2	1	2	2	1	2	1	3	2
CO <sub>2</sub>	3	3	2	3	2	2	2	1	2	2	1	2	1	3	2
CO <sub>3</sub>	3	3	2	3	2	2	2	1	2	2	1	2	1	3	2
CO <sub>4</sub>	3	3	2	3	2	2	2	1	2	2	1	2	1	3	2
CO <sub>5</sub>	3	3	3	3	2	2	2	1	2	2	1	2	1	3	2
CO <sub>6</sub>	3	3	3	3	2	2	2	1	2	2	1	2	1	3	2

**CO attainment levels:**

CO Number	Level
1	4
2	4
3	5
4	4
5	3
6	3

**Future Courses****Mapping:**

Mention other courses that can be taken after completion of this course

Students can undertake the courses such as Advance Thermodynamics during their Master's Program.

**Job Mapping:**

After learning this subject, students can work in Thermal Domain companies such as Thermax, Forbes Marshall and also work in some Thermal Power Plants.

## Syllabus Template

**ME 3301 Material and Process Engineering****Credits:4****Teaching Scheme Theory: 2 Hours/Week****Tut: 1 Hours/Week****Lab:2 Hours/Week****Pre-requisites:**

Basic Mechanical Engineering, Engineering Graphics, Higher Secondary Science courses, Engineering Physics, Engineering Chemistry.

**Course Objectives:**

1. To study patterns, core boxes and different methods of casting, forming and welding processes.
2. To study various metal removal processes and machine tools.
2. Know about fundamentals of metal cutting process, tool wear and tool life.
3. To impart fundamental knowledge of material science and importance of heat treatment on structure and properties of materials.
4. Understand the basic concepts, operation of computer numerical control (CNC) machines.
5. Develop necessary skills for measurement, calibration and testing of instruments.

**Course Outcomes: On completion of the course, learner will be able to:**

**CO1.** Understand types of patterns and core boxes, and importance of casting, forming and welding as a manufacturing process.

**CO2.** Understand basic working principle, configuration, specification, classification of machine tools, mechanics of metal cutting and tool life.

**CO3.** Explain applications and advantages of CNC machines and understand the codes (G-code and M Code) used in CNC machines for programming.

**CO4.** Differentiate and determine mechanical properties using destructive and non-destructive testing of materials.

**CO5.** Measure angle precisely using precision angular measuring instruments like sine bar, angle dekkor and autocollimator.

**CO6.** Measure the threads, gear tooth profiles and surface roughness using appropriate instruments.

**SECTION-1**

**Unit I-Casting, welding and forming processes:** Patterns, types of pattern, moulding sand, core making, melting practices and furnaces, principle and working of permanent mould casting, Investment casting, centrifugal casting, continuous casting, gravity die casting, pressure die casting and casting defects.

**Forming Processes:** Rolling process, Forging, open and closed die forging, Extrusion: Types, wire and tube drawing.

**Welding Process:** Gas welding, Electric arc welding and Resistances welding.

**Unit II- Machine Tools & Processes:** Lathe , lathe cutting tools, speed, feed and depth of cut, geometry of single point cutting tools, mechanics of chip formation, Merchant's Circle of forces analysis, tool life, tool materials. Shaper, planer, slotting machines, milling, drilling machines and related operations.

**Unit III-** Introduction to Numerical Control: Introduction, classification of NC/CNC systems, components of CNC system, CNC Part programming: Introduction, methods of programming: Manual and Computer Assisted Part programming, manual part program of a given component on CNC Lathe using G and M codes. Machining centers-Vertical machining centers (VMCs), horizontal machining centers (HMCs)

## **SECTION-II**

**Unit IV-** Engineering Materials and their Properties: Introduction, Classification of Engineering Materials, Selection of Materials for Engineering Purposes. Physical and Mechanical Properties of Metals, Ferrous Metals, Non-ferrous Metals, Non-metallic Materials, Testing of metals, hardness, tensile strength, ductility measurements, engineering stress-strain curve, Introduction to NDT techniques.

**Unit V: Heat Treatment:** Heat treatment of steels, annealing processes, normalizing, hardening, tempering, quenching and hardenability, surface hardening processes-nitriding, carbonitriding, flame hardening, induction hardening.

**Engineering Metrology:** Precision, accuracy, calibration, linear measurement, angular Measurement- sine bar, angle gauges, angle dekkor, and autocollimator. Methods of measuring surface finish, Tomlinson surface meter.

**Unit VI: Gear and Screw Thread Metrology:** External screw thread terminology, Floating carriage micrometer, measurement of run out, pitch and tooth thickness, Parkinson gear tester, Profile Projector, advancements in metrology: Coordinate measuring machine.

**Any six experiments of the following:**

1. Linear measurements by precision measuring instruments
2. Angular measurements by sine bar
3. Dial Gauge calibration
4. Design of limit gauge
5. Surface roughness measurement of a given sample using a surface tester.
6. Surface roughness measurement using surface roughness tester.
7. Use of interferometer for study of various surfaces
8. Determination of geometry & dimensions of given object (screw thread, spring and saw tooth) using profile projector.

9. Measurement of spur gear parameters using Gear tooth vernier caliper.
10. Measurement of screw thread parameters using floating carriage micrometer
11. Machine tool metrology- Alignment tests on Lathe Machine
12. Study of Toolmakers Microscope
13. Experiment on chip formation, measurement of shear angle using chip thickness ratio criteria.
14. Poldi's Hardness Tester
15. Study the influence of cutting parameters on surface roughness in turning.
16. Industrial visit to Calibration lab /Quality control lab / Gear manufacturing unit / Automotive Industry / Engineering Industry.
17. Brinell hardness test on different materials.
18. Vickers hardness test on different materials.
19. To perform various operations such as plain turning, step turning, taper turning, drilling, chamfering and thread cutting operation on Lathe machine.
20. Gear cutting by Indexing mechanism on a milling machine.

**List of Tutorials: (Any Three)**

1. Calculations for gear ratios for thread cutting and setting angle for taper turning.
2. Gear cutting on milling- Indexing and related calculations.
3. Process sheet of machining component.
4. Design & working drawing of SPCT.
5. Verification of metal cutting theories.
6. Problems on chip formation, measurement of shear angle, chip thickness ratio criteria etc.
7. Problems on Taylorian tool life equation.
8. Measurement of cutting forces in turning using lathe tool dynamometer.
9. Tool life study on a single point turning tool.
10. Study of types of chips and tool wear.

**List of Projects:**

1. Mechanics of Chip Formation
2. Preparation of Cutting Tool Models
3. Design of Drilling Jigs
4. Design of Milling Fixtures

5. Machinability study of difficult-to-cut materials
6. Machining performance under different machining environments
7. Challenges in machining of composites
8. Variation in cutting forces during machining of composites using tool dynamometer
9. Design and Manufacturing of Cutting Tools.
10. Alignment test on various machine tools.
11. Measurement of forces on lathe, milling machines.
12. Simulation Model for solex pneumatic comparator.
13. Simulation Model for electrical comparator (visual gauging head)
14. Programming for CMM.
15. Study the effect of tempering on the hardness of steel.
16. In process gauging system

**List of Course Seminar Topics:**

1. Different types of coating on cutting tools
2. Performance enhancement of natural oils as cutting fluids in detrimental cutting conditions
3. Study of hazards related to cutting fluids and remedies
4. Thermal monitoring in cutting zone
5. Modular fixtures: Concept, roles and applications
6. Nano-Cutting Fluid for Enhancement of Metal Cutting Performance.
7. Machining challenges faced in processing of metal matrix composition
8. Methods of Tool Wear Measurement in machining of Super alloys
9. Application of soft computing in optimization of machining process parameter
10. Use of nanotechnology in material science

**List of Course Group Discussion Topics:**

1. Cryogenic Machining
2. Comparison between Vertical machining center and Horizontal machining center
3. Modular v/s conventional fixtures.
4. Back gear mechanism in lathe
5. Classification of jig and fixtures
6. Conventional & Advanced finishing processes for Gear manufacturing
7. Conventional versus Additive Manufacturing of Jigs and Fixtures
9. Economics and selection of tooling
10. Engineering materials and their properties

**List of Home Assignments:**

**Design:**

1. Design of SPCT
2. Design of Drill jig 3D model
3. Design of Gauges
4. Designing methods for measuring tapers
5. Designing methods for measuring angles
6. Designing methods for testing of parts
7. Designing methods for testing of process parameters

**Case Study:**

1. Multi-spindle drill machine
2. Design of Part locating Pin
3. Machine tools and noise pollution
4. Selection of cutting tool
5. Recent trends in manufacturing.
6. 5S
7. Kaizen

**Blog:**

1. Tool failure criteria in case of SPCT, Milling cutter, Broaches, Drill
2. Nano composites in Machining Tool
3. Various types of cutting tools
4. Artificial intelligence for accurate metal cutting
5. Machine learning in manufacturing engineering
6. New materials for manufacturing industry
7. Materials for industry 4.0

**Surveys:**

1. Function and requirements of spindle unit
2. Recycling of Cutting Tool inserts
3. JIT
4. Quality Audit

5. Determination of process capability
6. Fault finding in given batch of specimen
7. ISO 14000

**Moocs Links and additional reading material / Online Education resources:**

1. [nptel.ac.in/courses/112106179](http://nptel.ac.in/courses/112106179)
2. [www.nptelvideos.in/2012/12/mechanical-measurements-and-metrology.html](http://www.nptelvideos.in/2012/12/mechanical-measurements-and-metrology.html)
3. <https://nptel.ac.in/courses/112/107/112107242/>
4. freevideolectures.com > Mechanical > IIT Madras
5. <https://nptel.ac.in/courses/112/106/112106139/>

**Text Books:**

1. A Textbook of Production Technology, P. C. Sharma, S.Chand Publications
2. A Textbook of Manufacturing Technology, R. K. Rajput, Laxmi Publications (p) LTD
3. A Textbook of Manufacturing Technology, Metal Cutting and Machine Tools, P. N. Rao, Vol. 2, 2nd edition, Tata McGraw Hill Publishing Co. Ltd, New Delhi, 2002
4. Elements of Workshop Technology, Vol-II, S. K. Hajra Chaudhary, Media Promoters & Publications Pvt Ltd.
5. Bewoor A. K. and Kulkarni V. A., Metrology and Measurements, McGraw hill Publication.
6. Jain R.K., Engineering Metrology, Khanna Publication.
7. Dr. V. D. Kodgire & S. V. Kodgire, “Material Science & Metallurgy For Engineers”, Everest Publication.
8. William D. Callister, “Materials Science and Engineering an Introduction”, Jr, John Wiley & Sons, Inc.
9. Smith W. F., Principles of Material Science and Engineering, McGraw Hill Book Co.

**References Books:**

1. Theory of Metal Cutting, M. C. Shaw, 1st Edition, Oxford and I.B.H. publishing, 1994
2. Jigs & Fixtures, P.H. Joshi, Third edition, McGraw Hill, 2017
3. Production Technology Manufacturing Systems VOL-I & II, R. K. Jain, Khanna Publishers
4. Production Technology –HMT, Tata McGraw Hill publication
5. A. K. Bhargava, C.P. Sharma, “Mechanical Behaviour & Testing of Materials”, P H I Learning Private Ltd.
6. Raghvan V., “Material Science & Engineering”, Prentice Hall of India, New Delhi. 2003
7. Avner, S.H., “Introduction to Physical Metallurgy”, Tata McGraw-Hill, 1997.
8. Galyer J.F & Shotbolt C.R., Metrology for engineers



**CO-PO Mapping:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	2	2	1	1	1	1	2	1	1	1	3	2
CO 2	3	3	3	2	2	1	1	1	1	2	1	1	1	3	2
CO 3	3	3	3	2	2	1	1	1	1	2	1	1	1	3	2
CO 4	3	3	3	2	2	1	1	1	1	2	1	1	1	3	2
CO 5	3	3	3	2	2	1	1	1	1	2	1	1	1	3	2
CO 6	2	2	3	2	2	1	1	1	1	2	1	1	1	3	2

**CO attainment levels:**

CO Number	Level
1	4
2	5
3	4
4	4
5	4
6	4

**Suggest an assessment Scheme:**

Suggest an Assessment scheme that is best suited for the course. Ensure 360 degree assessment and check if it covers all aspects of Blooms Taxonomy.

1. Course Seminar/GD
2. HA
3. Lab/Course project
4. CVV
5. ESE

**Future Courses Mapping:**

1. Software applications in manufacturing.
2. Additive manufacturing
- 3 Process engineering
4. Die and mould design
5. 3D/4D Printing and Nanotechnology
6. Metal Forming Technologies & Tool Design, Engineering Design and Innovations, Advanced Manufacturing Processes

**Job Mapping:**

Power Industry

Research and development Industry

Automobile Industry

Defence Industry

Marine Industry

Consumer goods Industry

Metal and mining Industry

Heat Treatment shop, Research and Development, Material Procurement, Product Design. Foundry Industry, Quality Assurance.

Excellence in this course make students employable for various positions in a manufacturing company as a Production Supervisor, Quality inspector, manufacturing engineer, design engineer and R&D engineer.

## Syllabus Template

**ME 3302 Heat Transfer****Course Objectives:**

- 1) Understand the modes of heat transfer
- 2) Concepts of steady and unsteady cases in heat transfer
- 3) Extended surfaces
- 4) Free and Forced Convection
- 5) Analysis and Design of Heat Exchangers
- 6) Modelling Radiative heat transfer

**Credits: 4****Teaching Scheme Theory: 2 Hours/Week****Tut: 1 Hour/Week****Lab: 2 Hours/Week****Course Relevance:**

1. This course provides the basis for thermal and fluids engineering of any system.
2. A conceptual clarity in this course is essential for:
  - I. Design of thermal equipment.
  - II. Plant/Process Engineering
  - III. Computational Fluid Dynamics (CFD) is a very important field in thermal and fluids engineering.

**Unit 1: Introduction**

Applications of heat transfer in engineering field. Modes of heat transfer. Thermal conductivity, its significance, its variation in solids, liquids and gases. Formulation for temperature distribution and heat transfer rate for one dimensional steady state heat conduction in a plane wall, cylinder and sphere with and without heat generation.

**Unit 2: Conduction**

General heat conduction equation in Cartesian coordinate system and its applications to simple thermal systems. General heat conduction equation in cylindrical and spherical coordinates. Electrical analogy and its use in analyzing composite systems. Overall heat transfer coefficient. Critical radius of insulation.

**Unit 3: Fins and Transient Conduction**

Extended surfaces (fins): Meaning, Significance and Classification. Fin analysis with different boundary conditions. Performance evaluation of fins. Temperature measurement error with thermo-well. Introduction to unsteady state heat conduction and Lumped analysis.

**Unit 4: Forced and Free Convection**

Mechanism of convection, Introduction to hydrodynamic and thermal boundary layer. Laminar and turbulent flow over and inside a surface.

Dimensional analysis of free and forced convection. Physical significance of the dimensionless Numbers; Nu, Re, Pr, Gr, Pe, Ri, St, Ra.

Forced convection: Empirical correlation's for heat transfer in laminar and turbulent flow over a flat plate and in a circular pipe. Concept of hydraulic diameter.

Natural convection: Physical mechanism, Empirical correlations for free convection heat transfer over horizontal plate, vertical plate and cylinder.

**Unit 5: Radiation**

Heat exchange by radiation between two finite black surfaces. Radiation shape factor. Irradiation, radiosity, electrical network method of solving problems. Heat exchange between non-black bodies and Heat exchange between two infinitely parallel planes, cylinders and spheres. Radiation shields.

**Unit 6: Heat Exchangers**

Heat Exchangers: Meaning, Significance, Classification. Performance evaluation methods (LMTD and Effectiveness-NTU).

**List of Tutorials: Extra numerical on the following topics**

1. One dimensional conduction and convection problems
2. Electrical Analogy
3. Extended Surfaces: Fins
4. Unsteady Lumped mass systems
5. Convective heat transfer in pipes, over flat plate
6. Natural Convection with vertical and horizontal surfaces
7. Heat Exchangers: Analysis
8. Radiation in black and grey enclosures

**List of Practicals: (Any Six)**

1. Determination of Thermal Conductivity
2. Composite Wall
3. Emissivity determination
4. Stefan-Boltzmann constant
5. Free Convection
6. Pipe-in-Pipe heat exchanger

**List of Course Seminar Topics:**

1. Heat Transfer Enhancement Mechanisms
2. Enhancement with Nanofluids
3. Mechanisms or cooling of electronic components
4. Phase change materials for cooling
5. Heat Pipes

**6. Numerical modelling of phase change****List of Course Project Topics:**

1. Analysis of heat pipe
2. Analysis of steam iron
3. Electronic cooling system
4. Modelling of phase change
5. Modelling of Solar Dryer
6. Modelling of vortex generators(or other enhancement mechanisms)
7. Numerical Algorithms for heat transfer problems

**List of PPT Topics:**

1. Battery Thermal Management
2. Solar Collectors
3. Compact heat exchangers
4. Heat Transfer enhancement techniques
5. Phase Change Materials for cooling
6. Condensation/Boiling: Issues in modelling
7. Turbulence Modelling

**List of Home Assignments:****Design:**

1. Fins
2. Counter-Flow Heat Exchangers
3. Cross Flow Heat Exchangers
4. Condenser/Evaporator

**Case Study:**

1. Cooling of Equipments like MRI Scanners
2. Engine Cooling
3. Ablation Tiles in re-entry spacecrafts
4. Radiative systems

**Blog**

1. Electronics cooling
2. Compact heat exchangers
3. Thermal energy in spacecrafts
4. Effective heating of interiors(in cold countries)

**Surveys**

1. Data Centre cooling
2. Heat Exchanger Design methods

3. Algorithms for numerical solution
4. Issues in Turbulence modelling

**Suggest an assessment Scheme:**

Suggest an Assessment scheme that is best suited for the course. Ensure 360 degree assessment and check if it covers all aspects of Blooms Taxonomy.

**Text Books: (As per IEEE format)**

1. "Fundamentals of Engineering Heat and Mass Transfer", Sachdeva R. C., Wiley Eastern Limited, 3rd Edition 1988.
2. "A text book on Heat Transfer" Sukhatme S. P., Orient Longmans Ltd., New Delhi, 3<sup>rd</sup> Edition, 1989.
3. "Heat Transfer- A Basic Approach", Ozisik M. N., McGraw Hill, I edition, 1985.

**Reference Books: (As per IEEE format)**

1. "Fundamentals of Heat Transfer", Frank P. Incropera and David P. De Witt, Wiley, Eastern Limited
2. "Heat Transfer", J. P. Holman, McGraw Hill, 9th edition, 2004.
3. "Engineering Heat Transfer", Gupta and Prakash, Nemchand and Brothers.

**Moocs Links and additional reading material:** [www.nptelvideos.in](http://www.nptelvideos.in)

**Course Outcomes:**

1. Students will be able to mathematically formulate and analyse heat transfer system by Conduction mode.(2)
2. Students will be able to apply the conduction heat transfer knowledge for composite systems with heat generation.(2)
3. Students will be able to apply the knowledge of unsteady state heat transfer and concept of fins to analyze the thermal systems.(3)
4. Students will be able to apply the knowledge of fluid flow and convection heat transfer to analyze the thermal system(2)
5. Students will be able to perform thermal design of various heat exchangers.(3)
6. Students will be able to analyze radiative heat transfer system.(4)

**CO PO Map**

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
1	3	3	2	2	2	1	1	2	2	2	1	2	1	3	2
2	3	3	2	2	2	1	1	2	2	2	1	2	1	3	2
3	3	3	2	2	2	1	1	2	2	2	1	2	1	3	2
4	3	3	2	2	2	1	1	2	2	2	1	2	1	3	2
5	3	3	2	2	2	1	1	2	2	2	1	2	1	3	2
6	3	3	2	2	2	1	1	2	2	2	1	2	1	3	2

**Justification:**

Weak mapping, Moderately and Strong mapping

CO1 to CO 6 are strongly mapped with PO1 and PO2 as in respective CO's use of mathematics for analysis is applicable.

CO1 to CO 6 are moderately mapped with PO3 to PO5 as in respective CO's design concepts w.r.t. heat transfer for product development, process development is considered. Modern tool may be used for optimisation of the same.

CO1 to CO 6 are weakly mapped with PO6 and PO7 as in respective CO's societal, health, safety, legal and cultural issues are addressed along with the environmental and societal aspects.

CO1 to CO 6 are moderately mapped with PO8 to PO10 as in respective CO's communication, team work and the ethical behaviour of the student has addressed. Various course projects and the seminar presentations develop the said skills of the students.

CO1 to CO 6 are weakly mapped with PO11 as respective CO is related to project management and finance.

CO1 to CO 6 are moderately mapped with PO12 as respective CO is related to lifelong learning of the student.

PSO 1 mapped weakly with all CO's as it is related to component design and the manufacturing

PSO 2 mapped strongly with all CO's as it is related to system and process design w.r.t. different modes of heat transfer.

PSO 3 mapped moderately with all CO's as it is related to multi disciplinary approach and usage of software tools.

**CO attainment levels**

1. Students will be able to mathematically formulate and analyze heat transfer system by Conduction mode.(2)
2. Students will be able to apply the conduction heat transfer knowledge for composite systems with heat generation.(2)
3. Students will be able to apply the knowledge of unsteady state heat transfer and concept of fins to analyze the thermal systems.(3)

4. Students will be able to apply the knowledge of fluid flow and convection heat transfer to analyze the thermal system.(2)
5. Students will be able to analyze radiative heat transfer system.(4)
6. Students will be able to perform thermal design of various heat exchangers.(3)



## Syllabus Template

**ME3276: MECHANICAL SYSTEM DESIGN**

**Course Prerequisites:** Introductory courses in Machine Design and Manufacturing Processes

**Course Objectives:**

1. To understand intricacies of design as a process.
2. To understand the importance of standards and codes in design and its effective use.
3. To use statistics and optimization techniques to arrive at better design
4. To understand the influence of manufacturing and overall product life cycle on the design of mechanical system
5. To integrate machine elements so as to form a complete mechanical system such as worm gear box, Pressure Vessels, conveyor system for material handling and IC Engine.

**Credits: 04****Teaching Scheme Theory: 2 Hours/Week****Tut: 1 Hours/Week****Lab:2 Hours/Week****Course Relevance:**

Design can be considered as a complete plan for realization of product or system, hence, it is an essential subject in mechanical engineering.

**SECTION-I****Unit 1- Design of Bevel and Worm Gears**

**Bevel Gears:** Terminology, Force Analysis, Beam and Wear strength

**Worm Gears:** Worm and worm gear terminology and geometrical relationship, Types of worm and worm gears, Standard dimensions, Force analysis of worm gear drives, Friction in Worm gears and its efficiency, Worm and worm-wheel material, Strength and wear ratings of worm gears as per IS-7443-1974, Thermal consideration in worm gear drive

**Unit 2- Design of Cylinders and Pressure vessels**

Thick and thin cylinders, Thin cylindrical and spherical vessels, Lamé's equation, Clavarino's and Birnie's equation, Design of hydraulic and pneumatic cylinders, Autofrettage and Compound cylinders Unfired pressure vessels, Classification of pressure vessels as per I.S. 2825–1965, categories and types of welded joints, weld joint

efficiency, Corrosion, erosion and protection vessels, materials of construction. Nozzles and Openings in pressure vessels, Reinforcement of openings in shell and end closures.

### **Unit 3- Design of Material Handling System**

Material handling system concept, basic principles, objectives of material handling system, unit load and containerization. Flat belt and troughed belt conveyors, capacity of conveyor, rubber covered and fabric ply belts, belt tensions, types of conveyor pulleys, types of belt idlers, types of tension take-up systems, power requirement of horizontal and inclined belt conveyors.

## **SECTION-II**

### **Unit 4- Statistical Consideration in Design**

Frequency distribution, Histogram and frequency polygon, Normal distribution, Units of measurement of central tendency and dispersion, Standard variable, population combinations, Design and natural tolerances, Design for assembly Statistical analysis of tolerances, Mechanical reliability and factor of safety

### **Unit 5- Design of I.C. Engine Components**

Introduction to selection of material for I. C. engine components, Design of cylinder and cylinder head, construction of cylinder liners, design of piston and piston-pins, piston rings, design of connecting rod, design of crank-shaft and crank-pin.

### **Unit 6- Product Design Process and Guidelines**

Engineering Design Process, Considerations of a Good Design, Product Development Process, Morphology of design, DFX Principles in general and as applied in Ergonomics and Aesthetics, Legal factors, engineering ethics and social issues related to design of products.

### **List of Tutorials: (Any Three)**

#### **Numerical problems on design of**

1. Worm Gear
2. Pressure Vessels
3. Belt Conveyors
4. Statistical Considerations in Design
5. IC Engine Component
6. Bevel Gear

**List of Practical's: (Any Six):** Depending upon the type of mechanical system undertaken for project work, students have to design related and requisite machine elements from the following list as practical activity.

1. Design of shafts and keys
2. Selection of suitable bearings from the manufacturer's catalogue
3. Selection of flat belt from the manufacturer's catalogue
4. Selection of V-belt from the manufacturer's catalogue
5. Selection of roller chain from the manufacturer's catalogue
6. Design of Spur, Helical, Bevel gears as per design requirement
7. Design of worm gear and worm wheel
8. Design of housing/casing
9. Design of Fins
10. Design of cylinders and pressure vessels
11. Design of threaded joint and power screws
12. Design of springs
13. Design of engine cylinder and cylinder head, construction of cylinder liners
14. Design of piston and piston-pins, piston rings
15. Design of connecting rod
16. Design of crank-shaft and crank-pin
17. Design of big and small End Bearings, Caps and bolts
18. Design of Engine Valves, and Valve Springs
19. Design of Rocker Arm
20. Design of Cam and Camshaft
21. Design of Push Rod.
22. Design of belt conveyor
23. Design of pulley
24. Design of Flywheel
25. Selection of Electric drive for a given mechanical system

**List of Projects:**

Students have to select and complete any one design project from the following list.

1. Design of Worm gear box
2. Design of Pressure vessel
3. Design of I. C. Engine
4. Design of Material Handling System
5. Design of Reciprocating Compressor

- 6.Design of Machine Tool Gear Box
- 7.Design of Concrete Mixer 8. Design of Sugar Cane Crusher
- 8.Any other Similar

Students should focus on designing all required individual elements and its meaningful integration with other elements to build a fully functional mechanical system. While undergoing the design activity students have to pay special attention to use of applicable National and International standards, application of Design for Manufacturing and Assembly principles, considerations of Ergonomics and Aesthetics, Repair, Maintenance, and troubleshooting considerations.

The deliverables shall include assembly drawing with bill of materials, production drawings for individual components duly complete with manufacturing tolerances, surface finish symbols, geometric tolerances etc. A design report supplemented with necessary calculations, process sheets, cost estimation, operating instructions and troubleshooting for the system should be submitted along with drawings.

**List of Course Seminar Topics:**

1. Design for Welding
2. Design for Sheet Metal Working
3. Design for Safety
4. Design for Maintainability
5. Principles for Good Design
6. Simulation in Design
7. Submarine as a pressure vessel
8. Airplane as a pressure vessel
9. Conveyor Belt Material and its Belt Construction
10. Statistics and Reliability in Design
11. Societal Issues in Design

**List of Course Group Discussion Topics:**

1. Use of National and International standards in Design
2. Principles for Good Design
3. Psychological and Physiological considerations in Design
4. Ethics and Engineering Design
5. Man-Machine interaction
6. Selection criteria for Material Handling System
7. Simulation in Design
8. Worm Gears vis-a-vis other gears
9. Automated Guided Vehicles (AGVs)
10. Robots for Material Handling

**List of Home Assignments:****Design:**

1. Design of pressure vessel as per standards for a given process
2. Testing Procedure of Pressure Vessels as per standards

3. Design of Cylinder Fins for Two Wheeler IC Engine
4. Design of engine valve spring
5. Design of IC engine push rod

**Case Study:**

1. Morphology of design
2. Statistical considerations in Design
3. Energy saving motors
4. Lightweight materials
5. Use of Composites

**Blog;**

1. Application of AI in Design
2. Virtual Testing of Design
3. Nanomaterials in Design
4. Recent Developments in Engineering Materials
5. Recent Developments in IC Engine Design

**Surveys:**

1. Replacement of conventional material by Composite material
2. Good and Bad designs of real life products with justifications
3. Comparison of Repair, Maintenance, and troubleshooting considerations in any two equivalent mechanical systems
4. Survey for environment friendly products around you (minimum 5)
5. Use of Smart Materials in Product Design

**Suggest an assessment Scheme:**

Suggest an Assessment scheme that is best suited for the course. Ensure 360 degree assessment and check if it covers all aspects of Bloom's Taxonomy.

1. Course Seminar/GD
2. HA
3. Lab/Course project
4. CVV
5. ESE

**Text Books: (As per IEEE format)**

1. Bhandari V. B., “Design of Machine Elements” 3rd Edition, 2010, Tata McGraw Hill Education (India) Pvt. Ltd., New Delhi
2. Patil S. P., “Mechanical System Design”, 2nd Edition, 2005, Jaico Publishing House, Mumbai
3. George E. Dieter and Linda C. Schmidt, Engineering Design, 4th Ed., McGraw Hill Higher Education, 2000

**Reference Books: (As per IEEE format)**

1. Johnson R.C., “Optimum Design of Mechanical Elements” John Wiley & Sons Inc., London.
2. Ray T. K., “Mechanical Handling of Materials”, 2005, Asian Book Pvt. Ltd., Delhi
3. Rudenko N., “Material Handling Equipment”, PEACE Publishers, Moscow.
4. G. Pahl, W. Beitz, J. Feldhusen and K.-H. Grote “Engineering Design-A Systematic Approach”, Third Edition, Springer-Verlog 2007
5. “Design Data”, P.S.G. College of Technology, Coimbatore.
6. Ullman D.G., “The Mechanical Design Process”, McGraw Hill International Editions
7. John F Harvey, “Theory and Design of Pressure vessels”, CBS publishers & distributors, Delhi
8. William C. Orthwine, “Machine Components Design I and II”, Jaico Publishing House, Mumbai.
9. Joshi M. V., Mahajani V. V., “Process Equipment Design”, MacMillan India, Ltd., Delhi
10. IS-2825-1969 Code for unfired pressure vessels.

**MOOCs Links and additional reading material: [www.nptelvideos.in](http://www.nptelvideos.in)**

1. NPTEL video course on “Design of Machine Elements  
<http://www.nptelvideos.in/2012/12/design-of-machine-elements.html>
2. MIT Opencourseware “Design and Manufacturing-I:  
<https://ocw.mit.edu/courses/mechanical-engineering/2-007-design-and-manufacturing-i-spring-2009/index.htm>
3. MIT Opencourseware “Design and Manufacturing-II:  
<https://ocw.mit.edu/courses/mechanical-engineering/2-008-design-and-manufacturing-ii-spring-2004/index.htm>

**Course Outcomes:**

The student will be able to –

- 1) Design as per IS code the Mechanical components like Worm gears, Unfired Pressure vessels, and Machine Tool Gearboxes.
- 2) Design mechanical systems like pressure vessels.
- 3) Design material handling system like belt conveyor
- 4) Use statistical considerations in design of mechanical elements
- 5) Design Mechanical systems like IC Engine and its components.
- 6) Apply DFX principles in designing engineering component or product

**CO PO Map**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO <sub>1</sub>	3	3	2	3	2	2	2	1	2	2	1	2	1	3	2
CO <sub>2</sub>	3	3	2	3	2	2	2	1	2	2	1	2	1	3	2
CO <sub>3</sub>	3	3	2	3	2	2	2	1	2	2	1	2	1	3	2
CO <sub>4</sub>	3	3	2	3	2	2	2	1	2	2	1	2	1	3	2
CO <sub>5</sub>	3	3	3	3	2	2	2	1	2	2	1	2	1	3	2
CO <sub>6</sub>	3	3	3	3	2	2	2	1	2	2	1	2	1	3	2

**CO Attainment level:**

CO Number	Level
1	4
2	4
3	5
4	4
5	3
6	3

**Future Courses Mapping:** Mention other courses that can be taken after completion of this course

Students can undertake Advanced Design courses during their Master's Program, or Join Post-Graduate Product Design courses in NID or IDC of IITs.

**Job Mapping:**

After learning this subject, students can work in the design department of product and process centric companies.



## Syllabus Template

**ME3293: ENGINEERING DESIGN AND INNOVATION – VI****Credits: 06****Teaching Scheme****Lab: 12 Hours/Week****Course Relevance:**

EDI is a course with focus on projects and development of hands-on skills. Project specific theory to be taught for this course. Focused on social relevance domains such as Agriculture, Green Technology, Smart city, Health Care, Assistance to weaker section, Renewable energy, Transportation, Ergonomics, Safety etc. (not limited to only these domains)

SECTION-1
<b>Topics and Contents</b> <b>Project Management:</b> Overview and Expectations, the Design Process, <b>Define a Problem:</b> Identify a Valid Problem, Justify the Problem <b>Design a Solution:</b> Select a Solution Path, Develop a Design Proposal
SECTION-1I
<b>Topics and Contents</b> <b>Design and Prototype a Solution:</b> Plan for the Prototype, Build the Prototype <b>Test, Evaluate, and Refine the Solution:</b> Plan the Test, Test the Prototype <b>Communicate the Process and Results:</b> Documentation and Presentation
<b>Suggest an assessment Scheme:</b> <i>Suggest an Assessment scheme that is best suited for the course. Ensure 360 degree assessment and check if it covers all aspects of Bloom's Taxonomy.</i> 1.MSE 2.ESE
<b>Text Books: (As per IEEE format)</b>

1. Biswajit Mallick, Innovative Engineering Projects, Entertainment Science And Technology Publication, Bhubaneswar, India
2. Dilip N. Pawar, Dattary K. Nikam, Fundamentals of Project Planning and Engineering, Penram International Publishing (India) Pvt. Ltd.; First edition (12 July 2017).

**Reference Books: (As per IEEE format)**

3. Fernandes, Joao M, Machado, Ricardo J., Requirements in Engineering Projects, Springer International Publishing
4. Carol McBride, Francisco L. Gonzales, Engineer This: 10 Amazing Projects for Young Mechanical Engineers, PRUFROCK Press, 2018

**Course Outcomes:**

The student will be able to –

- 1) Apply critical and creative thinking in the design of engineering projects (5)
- 2) Plan and manage your time effectively as a team (4)
- 3) Apply knowledge of the 'real world' situations that a professional engineer can encounter (4)
- 4) Use fundamental knowledge and skills in engineering and apply it effectively on a project (5)
- 5) Design and develop a functional product prototype while working in a team (5)
- 6) Present and demonstrate your product to peers, academics, general and industry community (3)

**CO PO Map**

	P O 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO 8	PO 9	PO1 0	PO 11	PO 12	PS O1	PS O 2	PSO3
1	2	3	2	2	2	2	2	2	3	3	3	3	2	2	2
2	2	3	3	2	2	2	2	3	3	3	3	3	2	2	2

<b>C03</b>	3	3	3	2	2	2	2	2	3	3	3	3	2	2	2	
<b>C04</b>	2	3	2	2	2	2	2	2	3	3	3	3	2	2	2	
<b>C05</b>	2	3	2	2	2	2	2	2	3	3	3	3	2	2	2	
<b>C06</b>	2	3	2	2	2	2	2	2	3	3	3	3	2	2	2	

**CO attainment levels**

<b>CO Number</b>	<b>Level</b>
	<b>5</b>
	<b>4</b>
	<b>4</b>
	<b>5</b>
	<b>5</b>
	<b>3</b>

**Future Courses Mapping:****Job Mapping:**

# **B.TECH. MECHANICAL MODULE-VII**

**B.Tech. MECH. MODULE-VII AY: 2022-23**

Su b. No.	Sub. Code	Subje ct Name	Teaching Scheme(Hrs/We ek)			Examination scheme							Tot al	Credi ts	
			Th.	Lab	Tut	CA				MS E	ESA				
						H A	LA B	PPT/G D			ES E	CV V			
S1	-	Open Electiv e-I	2			10				30	30		30	100	2
S2	-	Open Electiv e-I	2			10				30	30		30	100	2
S3	-	Open Electiv e-I	2			10				30	30		30	100	2
S4	ME4255/ 56	Major Project		20						30	70			100	10
Total			6	20											16

## Syllabus Template

**ME 4251CAD/CAM/CAE****Credits: 02****Teaching Scheme****Lab: 12 Hours/Week**

**Course Prerequisites:** 1.Mathematics Engineering Mechanics; Mathematics course related to: Ordinary Differential Equation, Matrices,

**Course Outcomes:**

The student will be able to –

1. Use the underlying algorithms, mathematical concepts, supporting computer graphics. These include but are not limited to: Composite2D & 3D homogeneous matrices for translation, rotation, and scaling transformations.
2. Use and demonstrate fundamental knowledge of CAD/CAM.
3. Understand the basic theory behind the finite element method.
4. Use the finite element method for the solution of practical engineering problems.
5. Create the G-code program (with a standard computer post processor) of a work-piece on a standard numerically controlled machine tool with CNC
6. Understand Rapid prototyping Technique

**Section I****Computer Graphics**

Introduction to Basic Transformations - Translation, Rotation, Scaling, Reflection, Homogenous Coordinate system , Concatenated Transformation, Mapping of Geometric Models, Inverse Transformations.

**Geometric Modelling****Curves**

Introduction to Parametric representation of curves and its advantages. Analytic Curves- Line, Circle, Parabolas, Hyperbolas, Ellipses, Conics. Synthetic Curves- Hermite Cubic Spline, Bezier Curve,

**Surfaces**

Introduction to Parametric representation of Surfaces. Analytic Surfaces-Plane, Ruled, Tabulated, Revolved surfaces. Synthetic Surfaces- Bezier Surface,

**Solids**

Introduction, Geometry and Topology, Solid Representation, Boundary Representation, Euler's equation, Constructive Solid Geometry, Boolean operation for CSG, Hybrid Modelling, Feature Based Modelling,

### **Computer Aided Manufacturing**

Introduction, Integrating CAD, NC and CAM, Preparing CAD data for NC, The Basic components of NC System, Machine Axes and Coordinate system, Positioning System, NC Motion Control System, Point-to-Point and Continuous Path Machining, The NC Procedure, Machine Zero, Job Zero, Manual part Programming (G and M code),

## **Section II**

### **Finite Element Analysis**

Types of 1D element. Displacement function, Global and local coordinate systems, Order of element, primary and secondary variables, shape functions and its properties. Formulation of elemental stiffness matrix and load vector for spring, bar, beam, truss and Plane frame. Transformation matrix for truss and plane frame, Assembly of global stiffness matrix and load vector, Properties of stiffness matrix, half bandwidth, Boundary conditions elimination method and penalty approach, Symmetric boundary conditions, Stress calculations.

### **Two Dimensional Finite Element Analysis**

Types of 2D elements, Formulation of elemental stiffness matrix and load vector for Plane stress/strain such as Linear Strain Rectangle (LSR), Constant Strain Triangles (CST), primary and secondary variables, properties of shape functions. Assembly of global stiffness matrix and load vector, Boundary conditions, solving for primary variables (displacement)

### **Rapid Prototyping**

Introduction to Rapid Prototyping, classification of RP Processes, Working principle, models & specification process, application, advantages & disadvantages

### **Home Assignment:**

List of Home Assignments:

#### **Design:**

1. Design and Analysis a beam for a given application
2. Design and analysis of Shaft
4. Design and analysis of connecting rod

#### **Case Study:**

1. Effect Mesh size
2. Effect of material on Model
3. Effect of variation of thermal conductivity in a nonlinear conduction problem
5. Good and Bad FEA model

#### **Blog:**

1. Principles and Tips for Improving Engineering Analysis
2. Automotive Applications of FEA
3. Finite element for nonlinear problems

4. Recent areas of Application for FEA

5. Recent areas of application for CFD

**Surveys:**

1. Novel application of FEA

2. Novel application of CFD

**Text Books:**

1. Ibrahim Zeid, "Mastering CAD/CAM", Tata McGraw Hill
2. Groover M. P., "Automation, production systems and computer integrated manufacturing" Prentice Hall of India.
3. Chandrupatla T. R. and Belegunda A. D., "Introduction to finite elements in engineering", Prentice Hall of India
4. P.N. Rao -CAD/CAM, Principles & Applications-Tata McGraw Hill

**Reference Books:**

1. Ibrahim Zeid, "CAD/CAM - theory and practice", Tata McGraw Hill.
2. Segerling L. J., "Applied finite elements analysis", John Wiley and Sons.
3. Gebhardt A., "Rapid Prototyping", Hanser Publisher.
4. David F. Rogers, J. Alan Adams, Mathematical Elements for Computer Graphics, Tata McGraw-Hill Publishing Company Ltd., New Delhi-8.

**CO-Po Mapping**

	PO 1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P1 0	PO 11	PO 12	PS O1	PS O2	PS O3
C01	2	1	1	1	0	0	0	0	0	0	0	0	3	1	0
CO2	0	0	1	0	0	1	0	0	0	0	0	0	3	2	0
CO3	0	1	0	0	0	0	0	2	0	0	0	0	3	3	2
C04	0	0	2	3	0	0	0	2	0	0	0	0	3	3	2
C05	0	0	2	3	0	0	0	1	0	0	0	0	3	2	0
C06	0	0	1	3	0	0	0	0	0	0	0	0	3	3	1



Syllabus Template

**ME 4280 Computational Fluid Dynamics**

**Prerequisites:** Knowledge of Fluid Mechanics, Heat Transfer and Numerical Methods

**Course Objectives:**

1. To teach the basics of numerical methods to solve flow/thermal energy equations
2. To understand and learn Finite volume method
3. To learn modelling of industrial flow problems
4. To understand choosing the most appropriate boundary conditions
5. To know the basics of turbulence modelling
6. To know the basics of Compressible flow and its formulations

**Credits: 02**

**Teaching Scheme: Theory: 2 Hours/Week**

**Course Relevance:**

1. The course exposes the students to algorithms used in flow solvers.
2. Students learn how to model and simulate industrial flow problems
3. With the knowledge gained by this course, students can model, simulate as well as design components like blower, turbine, heat exchanger etc.

**Section I**

**Unit 1**

Review of fluid mechanics & heat transfer, Principles of Conservation: Continuity Equation, Navier Stokes Equation, Energy Equation and General Structure of Conservation Equations (Reynolds transport theorem)

**Unit 2**

Classification of Partial Differential Equations and Physical Behaviour, Approximate Solutions of Differential Equations: Error Minimization Principles, Variational Principles and Weighted Residual Approach, Finite Volume Method: Some Conceptual Basics and Illustrations through 1-D & 2D Steady and unsteady State Diffusion Problems

**Unit 3**

Boundary Conditions, Stability Analysis: Consistency, Stability and Convergence; Meshing technique, Unstructured & structured Grid Formulation, Grid independent and time

independent study

## Section II

### Unit 4

Discretization of Navier Stokes Equations: Stream Function- Vorticity approach and Primitive variable approach; Differencing scheme: central, upwind, higher order differencing, explicit and Implicit scheme; Solution Algorithms for Pressure -Velocity coupling: (SIMPLE, SIMPLEC, PISO Algorithm)

### Unit 5

Turbulence Modeling: Introduction, Statistical representation of turbulent flows: General Properties of turbulent quantities, Closure problem: Necessity of turbulence modeling, Reynolds average Navier stokes (RANS) equation, Different types of turbulence model, near wall behavior

### Unit 6

Compressible Flow: solution of compressible N-S equation, finite volume formulations, geometric flexibility

### List of Tutorials: (Write any 3)

1. Discretization of compressible N-S equation
2. Energy conservation equation for steady/unsteady state & compressible/incompressible flow
3. Analytical solution for Unsteady Heat Conduction in 1-d
4. Analytical solution for Unsteady heat Conduction in 2 d
5. Analytical solution for Unsteady heat Conduction in 3 d
6. Write a code of laminar flow through a pipe (Python, FORTRAN, MATLAB)
7. Write a code of parabolic inlet velocity profile (Python, FORTRAN, MATLAB)
8. Analytical solution of drag force, for a laminar flow over a flat plate
9. Analytical solution of constant heat flux on wall boundary
10. Analytical solution for Blasius Equation

### List of Practical's: (Any Six)

1. Laminar/turbulent flow through a pipe/channel
2. Flow through a pipe bend
3. Flow through a 2D square lid driven cavity
4. Flow through a Converging-Diverging Nozzle
5. External flow analysis: Flat plate/Circular Cylinder/Aerofoil
6. Natural Convection with a Vertical Plate
7. Flow through a pipe with constant temperature/heat flux wall condition

8. Conduction through a slabs/walls/bricks
9. Flow through a tube-in-tube heat exchanger
10. Effect of Diffuser angle on aerodynamic characteristics

FF No. : 654

Syllabus Template

**PR4203::DIE & MOLD DESIGN**

**Course Prerequisites:** Manufacturing Technology, Forming Technologies & Tool Technology

**Course Objectives:**

1. To learn sheet metal working operations and equipments
2. To design Simple blanking and progressive die design
3. To learn design of deep drawing dies and Bending dies
4. To learn design of pattern, core box and gating system of sand cast and diecast components
5. To understand principle of injection mould design for plastic components

**Credits:2**

**Teaching Scheme Theory: 2** Hours/Week

**Course Relevance:** This course explores the design of dies for sheet metal shearing and forming operations. It also focus on design of casting manufacturing tools such patterns, corebox, gating system, die casting dies, injection molding dies for plastic components. This will enhance skills and methods of Die, Molds and Tools design for engineering applications. Scope of course is in core engineering design as well as consulting and service industries for new product design and developments from sheet metal, forged and injection molded plastic components.

**SECTION-1**

**1) Introduction to Press Working :** Press working terminology, Basic operations, types of presses- mechanical, hydraulic, pneumatic and their mechanisms, elements of die sets, types of die sets, types of dies - simple, compound, progressive, combination and inverted dies, types of punches Methods of reduction of shear force, types of strip layouts, types of strippers, types of pilots, types of stoppers.

**2) Design of Blanking & Progressive dies:** Shearing force, press capacity, clearances, die & punch size types of strippers, types of pilots, types of stoppers, selection of dowel pins & allen screws., center of pressure of progressive die. Problems on progressive and blanking die design

**3) Design of Deep Drawing & Bending Dies:** Formability of sheet metals, Forming Limit diagram, Anisotropy of sheet metals, Deep drawing mechanism, Design of deep drawing die: blank size, no of draws, drawing punch and die size, drawing force, press capacity and ironing, Types of Bending dies, developed length calculation, bending force, spring back & methods used to overcome it, press brake.

**SECTION-11****4) Forging Die Design :**

**(A) Closed die Forging :** Single impression and Multi impression dies. Stock size calculation, Machined component part print to Forged component part design. Forging process plan. Edging impression design, Blocking, Fullering and Finishing impression die design. Forging Die material, Die manufacturing and heat treatment of dies.

**(B) Upset Forging Die Design:** Rules of Upset forging, Stock size estimation. Process sequence. Die and punch sets for upsetting. Equipment and applications of Upset forged.

**5) Polymer materials & Processing:** Classification of polymer materials, property and applications.

**Processing polymers:** Injection Moulding, Compression Moulding, Blow Moulding, Rotational Moulding, Thermoforming, Calendaring and Extrusion processes.

**6) Injection Mould Design :** Injection moulding: Types of machines and equipment, Selection of plastic material for various parts, Design of mould elements: Cavity & Core Two plate injection mould system, three plate injection mould system, parting lines, split molds, molds for threaded components. Feed system: Designs of various types of runners, gates, balancing of runners, positioning of gates, mould filling patterns etc. Ejection system: Pin ejection, stripper plates, valve ejection, blade ejection, air ejection, etc. Cooling & heating

arrangements: Design of cooling channels, layouts etc,runner less molds.

**List of Home Assignments:**

**Design:**

1. Blanking die design of simple blank
2. Deep drawing die design for cup shape forming
3. Bending die design of bend component
- 4.Closed Forging Die design
- 5.Upset Forging Die design

**Design Case Study of Industry base components:**

1. Die design for Cup shape components.
2. Die design for connecting rod
- 3 Die design for axle flange
- 4.Die design for Bottle Cap
5. Die design for sheet metal components

**Text Books: (As per IEEE format)**

1. Donaldson, Lecain and Goold, Tool Design, Tata McGraw Hill, ISBN 0 07 099274
2. J R Paquin, Die design Fundamentals, Industrial Press Inc., ISBN 0 8311 1172 0.
3. P. N. Rao, Manufacturing Technology- Foundry, Forming & Welding, Tata McGraw Hill
4. R. G. W. Pye, Injection Mould Design (Design manual for plastic industry), EWP

**Reference Books: (As per IEEE format)**

1. P. H. Joshi, Press Tools Design & Construction, Wheeler Pub
2. P. C. Sharma, Production Engineering, S. Chand
3. Dr. Surender Kumar, Production Engg. Design (Tool Design), Satya Prakashan
4. R. G. W. Pye, Injection Mould Design (Design manual for plastic industry), EWP
5. A. S. Athalye, Plastics Materials handbook, Multitech Pub. Co., ISBN 81 7671 007
6. Denton and Glanvil Injection mould design fundamentals, Industrial Press, Inc.

**Moocs Links and additional reading material:** [www.nptelvideos.in](http://www.nptelvideos.in)

**Course Outcomes:**

Student will be able to

1. Select and design appropriate die set and equipment for shearing operations of sheet metal.
2. Understand principles of deep drawing operations.
3. Design bending die design and selection of press capacity
4. Scope of polymeric materials and applications
5. Understand the principles of polymer processing techniques
6. Design elements of injection molding dies and understand the working of injection machines.

**CO PO Map**

PO	1	2	3	4	5	6	7	8	9	10	11	12	PS1	PS2	PS3
CO1	2	3	3									1	2	1	1
CO2	3	2	3									1	2	1	1
CO3	2	3	3									1	2	1	1
CO4	3	2	2									1	2	1	1
CO5	3	3	3									1	2	1	1
CO6	2	2	3									1	2	1	1

**CO attainment levels**

CO1	CO2	CO3	CO4	CO5	CO6
3	4	4	5	3	3

**Future Courses Mapping:**

For Higher studies in Tool and Die Design, Plastic Engineering, MTech Manufacturing Engineering, MTech Design

**Job Mapping:**

Die designer in Sheet metal industry, Forging Industry, Plastic component manufacturing as well as casting manufacturers. Die shop, Toolroom, Job as Engineering design department. Procurement of sheet metal components, plastic components, forged components and castings



## Syllabus Template

**ME4253:Vibration Analysis****Course Prerequisites:**

Engineering Mechanics; Theory of Machines, Mathematics course related to: Ordinary Differential Equation, Matrices, Transforms: Fourier and Laplace

**Course objectives:**

Students will be able to-

1. To understand the fundamentals of Vibration Theory
2. To be able to mathematically model real-world mechanical vibration problems
3. To use computer software programs to investigate and understand vibration problems.

**Credits: 02****Teaching Scheme: Theory: 2 Hours/Week****Course Relevance:**

Vibration is a common phenomenon occurring in a mechanical system. For example, vibration of a rotor due to unbalanced mass, vibration of a vehicle engine at varying speed. The study of a dedicated course is required to understand the fundamental concepts of mechanical vibrations for engineers and designers.

**SECTION—I**

Introduction: Concept of linear and non-linear systems, various mathematical models of vibration system, damping models, free vibration analysis.

Forced vibration analysis (under harmonic excitation) of single degree freedom system, force and displacement transmissibility, Numerical simulations.

Multi degree freedom systems: Introduction, Formulation of equations of motion, elastic and inertial couplings, Free vibration analysis (un-damped and damped): natural frequencies and mode shapes, orthogonality of mode shapes, principal coordinates, modal analysis, Numerical simulations.

**SECTION—II**

Multi degree freedom systems: Forced vibration analysis (under harmonic excitation) , Numerical simulation.

Rotor system dynamics, Principles of vibration Control.

Vibration Measurements: Measurement of displacement, velocity, acceleration, frequency and damping. Vibration testing equipment's: signal generation, measurement and analysis, conditioning monitoring of pumps, gear box, e.t.c..

**List of Home Assignments:****Design:**

1. 1-DOF system free vibration
2. 1-DOF system forced vibration
3. 2-DOF system free vibration
4. 2-DOF system forced vibration
5. Vibration instruments –design considerations

**Case Study:**

1. Vibration conditioning monitoring of centrifugal pumps
2. Vibration conditioning monitoring of gear box
3. Vibration analysis of washing machine
4. Vibration absorbers-application like high tension cables
5. Fault diagnosis using vibration measurements

**Blog**

1. Various damping models
2. Linearization of non-linear system- Demonstration using Simple pendulum problem
3. Displacement transmissibility of shock absorbers subjected to shock loading
4. Vibration isolators
5. Forced vibration analysis under periodic (non-harmonic) excitation

**Surveys**

1. Vibration measuring instruments
2. Acceptable Levels of Vibration-different standards
3. Source of vibration in steam turbines
4. Sources of vibration in a car
5. vibration isolation systems

**Text Books: (As per IEEE format)**

1. L. Meirovitch, Fundamental of Vibrations, Mc-Graw Hill Inc., 2001
2. Grover G. K., Mechanical Vibrations ,Nem Chand and Bros (2009)
3. , S. S. Rao, Mechanical Vibrations, Pearson Education Inc. (4th Ed.), 2007.
4. Ghosh and Malik, Theory of Mechanism and Machines , East West Pvt. Ltd

**Reference Books: (As per IEEE format)**

1. Thomas Bevan, Theory of Machines, CBS Publications.
2. B. Balachandran, E. B. Magrab, 2009, Vibrations, Cengage learning: Second edition
3. D. J. Inman, Engineering Vibration, 4th Edition, Prentice-Hall, 2013

4. S. Graham Kelly, Fundamentals of Mechanical Vibrations, Mc-Graw Hill, 2000. Second edition

**Course Outcomes:** Students will be able to

1. Develop the mathematical model of a single degree freedom vibration system and perform free vibration analysis.
2. Perform force vibration analysis of a single degree freedom system.
3. Develop the mathematical model of a multi degree freedom vibration system and perform free vibration analysis.
4. Perform forced vibration analysis of a multi degree freedom system.
5. Perform and verify computer simulations employing time integration and modal analysis of discrete vibrating systems.
6. Select the instruments for a vibration measurement and analyze the measured data.

### CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C O 1	3	3	3	2	3	2	1	1	1	2	1	1	1	3	1
C O 2	3	3	3	2	3	2	1	1	1	2	1	1	1	3	1
C O 3	3	3	3	2	3	2	1	1	1	2	1	1	1	3	1
C O 4	3	3	3	2	3	2	1	1	1	2	1	1	1	3	1
C O 5	3	3	3	2	3	2	1	1	1	2	1	1	1	3	1
C O 6	2	2	3	3	3	3	1	1	1	2	1	1	1	3	2

### Course Outcomes attainment level

1. Develop the mathematical model of a single degree freedom vibration system and perform free vibration analysis. (3)
2. Perform force vibration analysis of a single degree freedom system. (4)

3. Develop the mathematical model of a multi degree freedom vibration system and perform free vibration analysis. (5)
4. Perform forced vibration analysis of a multi degree freedom system. (5)
5. Perform and verify computer simulations employing time integration and modal analysis of discrete vibrating systems. (5)
6. Select the instruments for a vibration measurement and analyze the measured data. (5)

**Future Courses Mapping:**

Advance courses on vibration

**Job Mapping:**

*R & D, Design & Development*

## Syllabus Template

**ME4254: REFRIGERATION AND AIR CONDITIONING****Course prerequisite-Thermodynamics and Heat Transfer****Course Objectives:**

1. Students should be able to analyze vapour compression refrigeration cycle and find cop of the cycle.
2. Students will be able to compare two vapour compression cycles and select the efficient one.
3. Students will be able to understand various psychometric processes involved in air conditioning systems.
4. Students will be able to find important factors which affect the load on the air conditioner.

**Credits: 2****Teaching Scheme Theory: 2 Hours/Week****Course Relevance:**

Refrigeration is the need of an hour. Refrigeration cycles are used in cold storages, transport of perishable food, blood banks, ice plants, dairies and few process industries. Air conditioning has become a necessity to cope up with the extreme atmospheric conditions. It is necessary for comfort in malls, auditoriums, theaters, hospitals, hotels, buses, railways, aeroplanes as well as in some process industries. VCS and VAS both are widely used in comfort and process air conditioning. Mechanical engineers, having knowledge of refrigeration and air conditioning may get various job opportunities in the above and other related industries.

**SECTION-1****Unit 1 :Vapour Compression Cycle (VCC)**

Introduction of Refrigeration, Ideal vapour compression cycle (VCC), effect of operating parameters on VCC, use of p-h charts, actual vapour compression cycle, method to improve COP of VCC, Introduction to multistage systems. (CO1)

**Unit 2: Refrigerants**

Classification of refrigerants, Desirable properties of refrigerants, Designation of refrigerants, Ozone depletion potential (ODP) Global warming potential (GWP), Montreal protocol, Kyoto protocol, Alternative Refrigerants, Total equivalent warming impact

(TEWI). (CO2)

### **Unit 3: Components of VCC and Vapour Absorption Cycle**

Types of Compressor, Condenser, Evaporator, Expansion Device.

Introduction to vapour absorption system (VAS), COP of simple vapour absorption system, lithium bromide system, Comparison between VCS and VAS. (CO3)

## **SECTION-II**

### **Unit 4: Psychrometry**

Introduction to Psychrometry, Psychrometric properties, Use of Psychrometric chart. (CO4)

### **Unit 5: Psychrometric Processes**

Psychrometric processes, Sensible heat Factor (SHF), Application of psychrometric processes

in Air-conditioning equipment - Apparatus Dew Point (ADP), Bypass factor of coil, Air Washer,

Evaporative cooling. (CO5)

### **Unit 6: Comfort Conditions and Types of AC Systems**

Human comfort, factors influencing comfort, Concept of effective temperature, Air conditioning Systems - Unitary, Zoned and Central; Summer, Winter and Year round. Applications of Air conditioning in Industry and Transport. Introduction to duct system. (CO6)

### **List of Home Assignments:**

#### **Design:**

1. Food preservation system
2. Alternative refrigerants
3. Air refrigeration cycles
4. Cryogenic refrigeration
5. Multi compression multi evaporator VCS

#### **Case Study:**

1. Case study of an auditorium air conditioning plant

2. Case study of a window air conditioner
3. Case study of air conditioning systems of railway coach
4. Case study of winter air conditioning systems
5. Case study of evaporator types

**Blog**

1. ECO friendly Refrigerants
2. Rotary compressors in RAC applications
3. Latest trends in condenser
4. Latest trends in duct design
5. Latest trends in domestic refrigerator

**Surveys**

1. Survey of different compressors used in RAC applications
2. Survey of different types of room air conditioners available in market
3. Survey of different types of expansion devices
4. Survey of food preservation systems
5. Survey and comparison of household split air conditioners

**Suggest an assessment Scheme:**

*Suggest an Assessment scheme that is best suited for the course. Ensure 360 degree assessment and check if it covers all aspects of Blooms Taxonomy.*

1. MSE
2. HA
4. CVV
5. ESE

**Text Books: (As per IEEE format)**

1. Khurmi R.S., Gupta J. K.,—Refrigeration and Air conditioning, S. Chand Publication (Fifth edition).
2. Arora C. P., —Refrigeration and Air conditioning, Tata McGraw Hill Co., New Delhi.
3. Dossat Ray J, —Refrigeration and Air conditioning, Wiley Eastern Limited

**Reference Books: (As per IEEE format)**

1. Arora S. C. and Domkundwar S., —Refrigeration and Air conditioning, Dhanpatrai and Sons, New Delhi.
2. Manohar Prasad, —Refrigeration and Air conditioning, Wiley Eastern Limited.
3. Anantnarayanan —Refrigeration and Air conditioning, Tata McGraw Hills Co., New Delhi.

**Moocs Links and additional reading material:** [www.nptelvideos.in](http://www.nptelvideos.in)

**Course Outcomes:**

The students will be able to –

1. Analyze vapour compression and vapour absorption refrigeration system
2. Select suitable components for vapor compression system application and compatible ecofriendly refrigerant based on international protocols
3. Various methods to improve COP of VCS and VAS
4. Analyze psychrometric processes and use those in air conditioning methods
5. Understand different types of air conditioning systems applied for human comfort and for industrial applications
6. Understanding various factors contributing in the air conditioning load

**CO PO Map**

CO	PO 1	2	3	4	5	6	7	8	9	10	11	12	PS O1	2
1	3	2	3	3	2	3	3	1	1	1	1	1	1	3
2	3	2	3	3	2	3	3	1	1	1	1	1	1	3
3	3	2	3	3	2	3	3	1	1	1	1	1	1	3
4	3	2	3	3	2	3	3	1	1	1	1	1	1	3
5	3	2	3	3	2	3	3	1	1	1	1	1	1	3
6	3	2	3	3	2	3	3	1	1	1	1	1	1	3



<b>CO attainment levels</b>	
<b>CO Number</b>	<b>Level</b>
<b>1</b>	<b>3</b>
<b>2</b>	<b>5</b>
<b>3</b>	<b>4</b>
<b>4</b>	<b>3</b>
<b>5</b>	<b>4</b>
<b>6</b>	<b>5</b>
<b>Future Courses Mapping:</b> Mention other courses that can be taken after completion of this course Advanced refrigeration and air conditioning, Advanced applied thermal engineering	
<b>Job Mapping:</b> What are the Job opportunities that one can get after learning this course Work in cold storages, blood banks, malls, auditoriums, hotels, hospitals, theaters, sugar mills, pulp and paper mills etc as RAC engineer. This knowledge will be useful to study advanced RAC and then design, erection and commissioning of the system can be done.	

## Syllabus Template

**ME4261: Power Plant Engineering****Credits: 02****Teaching Scheme Theory: 02 Hours/Week****Course Prerequisites:**

1. Thermodynamics
2. Applied Thermal Engineering
3. Heat Transfer
4. Fluid Mechanics & Hydraulic Machines

Power Plant Engineering is a vast field of Engineering that mainly focuses on power generation and the principles involved in real-world applications. More specifically this course is focused on application of energy principles and power generation cycles.

**Course Objectives:**

- 1) To study the power generation scenario, the components of thermal power plant, improved Rankin cycle, Cogeneration cycle.
- 2) To understand details of steam condensing plant, analysis of condenser, the environmental impacts of thermal power plant, and methods to reduce various pollution from thermal power plant.
- 3) To study layout, component details of hydroelectric power plant, hydrology and elements, types of nuclear power plant.
- 4) To understand components; layout of diesel power plant, components; different cycles; methods to improve thermal efficiency of gas power plant.
- 5) To study the working principle, construction of power generation from non-conventional sources of energy.
- 6) Providing an overview of Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance.

**Course Outcomes:** On completion of the course, students will be able to –

- 1) **Describe and analyze** different types of sources and mathematical expressions related to thermodynamics and various terms and factors involved with power plant operation.
- 2) **Describe** the power generation scenario, the layout components of thermal power plant and analyze the improved Rankin cycle, Cogeneration cycle.

- 3) **Analyze** the steam condensers, recognize the environmental impacts of thermal power plant and methods to control the same.
- 4) **Recognize** the layout, component details of hydroelectric power plant and nuclear power plant.
- 5) **Realize** the details of diesel power plant, gas power plant and analyze gas turbine power cycle.
- 6) **Emphasize** the fundamentals of non-conventional power plants.

### Section I

**Introduction to Power plant:** Power and energy, sources of energy, review of thermodynamic cycles related to power plants - Rankine cycle, Indian Energy scenario, Conventional & Non-Conventional sources of energy and their availability in India, different types of Power Plants, Power Plants in India, Location of power plant.

**Thermal power plant:** Role of thermal power plant in current power generation scenario, Selection site for thermal power plant, General lay out of a thermal power plant, Fuels used in thermal power plant- Fuel handling layout and its methods, stages in coal handling storage, Fuel burning-Stoker firing, Pulverized fuel burning- Pulverization of coal, Ash handling system- Gravity system, pneumatic or vacuum system. Ash disposal management and its utilization, Feed water treatment- Mechanical, thermal methods.

**Hydroelectric power plant:** Introduction to Hydroelectric power plant, Rainfall, Runoff and its measurement, Hydrograph, flow duration curve, Selection of sites for hydroelectric power plant, General layout of Hydroelectric power plant and its working, Classification of the plant-Run off river plant, storage river plant, pumped storage plant, Advantages and disadvantages of hydroelectric power plant

### Section II

**Diesel and Gas turbine plant:** The layout of diesel power plant, Components and the working of diesel power plant, Advantages and disadvantages of diesel power plant, Gas turbine power plant-Schematic diagram, components and its working, Combined cycle power generation- Combined gas and steam turbine power plant operation (only flow diagram).

**Nuclear power plant:** Introduction, Nuclear power-Radio activity-Radioactive charge-types of reactions, Working of a nuclear power plant, Thermal fission Reactors- PWR, BWR and gas cooled reactors, Advantages and Disadvantages of Nuclear power plant.

**Power from Renewable Energy:** Principle, Construction and working of Wind, Tidal, Solar Photovoltaic (SPV), Solar Thermal, Geothermal and Fuel Cell power systems.

**Power Plant Economics and Environmental impact of Power plant:** Social and economical issues of power plant, greenhouse effect, Acid precipitation-Acid rain, Acid snow, Dry deposition, Acid fog, Air, water, Thermal pollution from power plants, Radiations from nuclear power plant effluents. Energy, Economic and Environmental issues of Power plants.

**List of Tutorials: (Any Three)**

- 1) Analysis of Rankine cycle
- 2) Analysis of Rankine cycle with reheat
- 3) Analysis of Rankine cycle with regeneration
- 4) Analysis of Rankine cycle with reheat and regeneration
- 5) Analysis of nozzle
- 6) Analysis of jet condenser
- 7) Analysis of surface condenser
- 8) Analysis of cooling towers and cooling ponds
- 9) Power plants load
- 10) Power plant economics

**List of Practical's: (Any Six)**

1. Trial on diesel power plant
2. Trial on steam power plant
3. Industrial visit to power plant
4. Trial and demonstration of a boiler feed water treatment
5. Study and demonstration of power plant instrumentation
6. Study and demonstration of High pressure boiler
7. Study and demonstration of FBCB boiler
8. Study and demonstration ESP system

9. Demonstration and trial on Surface Condenser

10. Demonstration and trial on Steam Nozzles

**List of Course Seminar Topics:**

1. Thermal power plant

2. Hydraulic power plant

3. Nuclear power plant

4. Wind power plant

5. Diesel power plant

6. Solar power plant

7. Gas power plant

8. DM Plant and Water Treatment

9. Ash handling and dust collection

11. Cooling towers and cooling ponds Indian Energy Scenario and World Energy resources

12. Clean Coal Technology

13. Combined cycle Gas Turbine for efficient Energy Production

14. Supercharging and Turbocharging for Diesel Power Plant

15. Optimization of Solar Power Plant

16. Safety in Nuclear Power Plants

17. Design of Wind Power Turbines

18. Economics and Environmental issues of Power Plants

**List of Course Group Discussion Topics:**

1. Selection of site of Nuclear Power Plant

2. Selection of site of Hydro Power Plant

3. Environmental impact of Thermal Power Plant

4. Waste Disposal of Nuclear Power Plants

5. Cooling water requirements for power plant and water pollution

6. Load shedding between power stations,

7. Cost analysis

8. Solar energy as a clean energy source

9. Biogas

10. Tidal energy

**List of Home Assignments:**

**Design:**

1. Design of jet condenser
2. Design of surface condenser
3. Design of nozzle of a power plant
4. Wind turbine design for wind power plants
5. Steam turbine design

**Case Study:**

1. Case study of thermal power plant with coal as a fuel
2. Case study of thermal power plant with gas as a fuel
3. Case study of sugar factory cogeneration power plant
4. Case study of a nuclear power plant
5. Case study of DM plant in a sugar factory cogeneration power plant
6. Case study on combined cycle power plant with cogeneration
7. Study and Analysis of Small Hydro Projects
8. Case studies on Interconnection Barriers for Distributed Renewable Power Projects
9. Case Studies on Renewable Energy sources

**Blog:**

1. Power generation scenario in India
2. Power generation scenario of world
3. Solar power generation
4. Pollution due to thermal power plant
5. Coal reserves of India and coal imports

**Surveys:**

1. Survey for power plant types and its capacity in India
2. Survey for Nuclear power plant types and its capacity in World
3. Survey for Wind power plant types and its capacity in World
4. Diesel power plants
5. Gas power plants

**Moocs Links and additional reading material:** [www.nptelvideos.in](http://www.nptelvideos.in)

1. <http://nptel.ac.in/courses/108105058/8>
2. <http://nptel.ac.in/courses/108105058/9>
3. <http://nptel.ac.in/courses/108105058/10>

**Text Books:**

1. Domkundwar & Arora, Power Plant Engineering, Dhanpat Rai & Sons, New Delhi

2. Domkundwar&Domkundwar- Solar Energy and Non-Conventional Sources of Energy, Dhanpat Rai& Sons, New Delhi.
3. R.K.Rajput, Power Plant Engineeringl, Laxmi Publications New Delhi.
4. D.K.Chavan&G.K.Phatak, Power Plant Engineeringl, Standard Book House, New Delhi.

**References Books:**

1. E.I.Wakil, Power Plant Engineeringl, McGraw Hill Publications New Delhi
2. P.K.Nag, Power Plant Engineeringl, McGraw Hill Publications New Delhi.
3. R.Yadav , Steam and Gas Turbinesl ,Central Publishing House, Allahabad.
4. G.D.Rai, Non-Conventional Energy Sources, Khanna Publishers,Delhi
5. S.P.Sukhatme, Solar Energyl Tata McGraw-Hill Publications, New Delhi
6. G R Nagpal Power Plant Engineering , Khanna Publication
7. Gas Turbines by V.Ganeshan, McGraw Hill Education
8. Steam Turbine Theory and Practice, William J. Kearton, CBS Publication
9. Power plant Engg / Elanchezhian/ I.K. International Pub

**Future Courses Mapping:**

There is a great and vast career scope in Power Plant Engineering and also a power plant engineer career can be very well established. Although thermal power is an obsolete source of energy requirements in India, which is fulfilled by many plants in India. Power Plant Engineering will be leading the world in energy requirements for 3-4 decades. You can also do a Postgraduate while working in the industry. Thus a career in Power Plant Engineering is not limited and has great opportunities in India as well as abroad.

**Job Mapping:**

Work in different power plants such as thermal, hydro, nuclear, gas as an engineer. This knowledge will be useful to study power station economics in detail. Defense and railways also are beneficial areas for them as these departments require thermal engineers to assist in the maintenance and design of their machinery.

Spraying and Maintenance Services

Milling Companies

Steam Pipelines Fabrication Services

Boiler Maintenance and Cleaning Services

Educational Institutes

Power Plant Engineering NPTEL

Dams

Hydro-companies

Power Houses

Electricity Departments

**CO PO Map:**

	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO1 2	PSO 1	PSO 2	PSO 3
<b>CO 1</b>	3	3	3	3	3	2	1	1	1	2	1	1	1	3	1
<b>CO 2</b>	3	3	3	3	3	2	1	1	1	2	1	1	1	3	1
<b>CO 3</b>	3	3	3	3	3	2	1	1	1	2	1	1	1	3	1
<b>CO 4</b>	3	3	3	3	3	2	1	1	1	2	1	1	1	3	1
<b>CO 5</b>	3	3	3	3	3	2	1	1	1	2	1	1	1	3	1
<b>CO 6</b>	2	2	3	3	3	3	1	1	1	2	1	1	1	3	1

**CO attainment levels:**

CO Number	Level
<b>1</b>	<b>4</b>
<b>2</b>	<b>5</b>
<b>3</b>	<b>4</b>
<b>4</b>	<b>3</b>
<b>5</b>	<b>4</b>
<b>6</b>	<b>3</b>

**Suggest an assessment Scheme:**

Suggest an Assessment scheme that is best suited for the course. Ensure 360 degree



assessment and check if it covers all aspects of Blooms Taxonomy.

MCQ Exam – Section I (30 Marks converted to 30 equivalent Marks)

Home Assignment 100 (Marks converted to 10 equivalent Marks)

MCQ Exam – Section II (30 Marks converted to 30 equivalent Marks)

Comprehensive Viva Voce (100 Marks converted to 30 equivalent Marks)

## Syllabus Template

**IE4206:MARKETING MANAGEMENT****Course Prerequisites: None****Course Objectives:**

1. To provide basic understanding of marketing management concepts and their relevance to business development
2. To make students aware of the questionnaire for market research
3. To provide understanding of consumer & industrial buying decision process & motives.
4. To provide understanding of the concept of product management and branding in context of consumer and industrial products
5. To develop knowledge for optimizing marketing mix to get competitive advantage

**Credits:2****Teaching Scheme: Theory: 2 Hours/Week**

**Course Relevance:** This course will provide basic knowledge of Marketing for working in a business environment.

SECTION-1
<p><b>1. Concepts of Marketing</b> Definition of Marketing, Core marketing concepts, Marketing Management philosophies, Micro and Macro Environment, Characteristics affecting Consumer behavior, Types of buying decisions, buying decision process, Classification of consumer products, Market Segmentation</p> <p><b>2. Marketing Information Systems And Research</b> Components of marketing information system–benefits &amp; uses marketing research system, marketing research procedure, Demand Estimation research, Test marketing, Segmentation Research - Cluster analysis, Discriminant analysis. Sales forecasting: objective and subjective methods</p> <p><b>3. Marketing of Industrial Goods</b> Nature and importance of the Industrial market, classification of industrial products, participants in the industrial buying process, major factors influencing industrial buying behavior, characteristics of industrial market demand. Determinants of industrial market demand Buying power of Industrial users, buying motives of Industrials users, the industrial buying process, buying patterns of industrial users.</p>
SECTION-II

**1. Product Management**

The concept of a product, features of a product, classification of products, product policies – product planning and development, product line, product mix – factors influencing change in product mix, product mix strategies, meaning of “New – product; major stages in new – product development product life cycle.

**2. Branding**

Reasons for branding, functions of branding features of types of brands, kinds of brand name.

**3. Pricing Policies**

Importance of Price, pricing objectives, factors affecting pricing decisions, procedure for price determination, kinds of pricing, pricing strategies and decisions

**4. Advertising and Sales Promotion (Digital marketing)**

Objectives of advertisement function of advertising, classification of advertisement copy, advertisement media – kinds of media, advantages of advertising. Objectives of sales promotion, advantages sales promotion,

**5. Packaging**

Meaning, growth of packaging, function of packaging, kinds of packaging.

**List of Tutorials: (Any Three)****List of Practicals: (Any Six) NA****List of Projects: NA****List of Course Seminar Topics: NA****List of Course Group Discussion Topics: NA****List of Home Assignments:****Design:**

1. Consumer Analysis for a firm
2. Market segmentation plan
3. Business market stakeholder analysis
4. Product line analysis
5. Pricing strategy for the product/service

**Case Study:**

1. How Social Media Insights Marketing
2. Impact of E-Commerce on marketing
3. Case study on societal Marketing
4. Product Development analysis
5. Personal Selling

**Blog**

1. Marketing through social Media
2. Changing buying motives for the consumer
3. Ethics in marketing
4. Marketing & Distribution

5. Industrial engineering tools for marketing

### Surveys

1. Consumer Analysis
2. Market analysis for particular Product or Service
3. Factors influencing industrial buying
4. Impact of promotion
5. Impact on advertisement on the consumer preferences.

### Assessment scheme

Sr. No	Type of Assessment	Conduction	Marks
1	MCQ Exam – Section I	Mid Semester	30 Marks converted to 30 equivalent Marks
2	Home Assignment	End of Semester	100 Marks converted to 10 equivalent Marks
3	MCQ Exam – Section II	End of Semester	30 Marks converted to 30 equivalent Marks
4	Comprehensive Viva Voce	End of Semester	100 Marks converted to 30 equivalent Marks

### Text Books: (As per IEEE format)

1. Philip Kotler, Principles of Marketing Prentice – Hall.
2. Philip Kotler, Marketing Management Prentice – Hall.

### Reference Books: (As per IEEE format)

1. Wiliam J Stanton, Fundamentals of Marketing Mcgraw Hill
2. R.S.N. Pillai and Mrs. Bagavathi , Marketing S. Chand

### Moocs Links and additional reading material: [www.nptelvideos.in](http://www.nptelvideos.in)

### Course Outcomes:

Students will be able to:

1. Understand basic marketing management concepts and their relevance to business development
2. Prepare a questionnaire to design marketing research plan for business organizations
3. Understand consumer & industrial buying decision process & motives.
4. Understand the concept of product management and branding in context of consumer and industrial products
5. Understand the pricing strategies in context of consumer and industrial products.
6. Optimize marketing mix to get competitive advantage

**CO PO Map**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	0	2	0	3	1	1	1	2	3	1	1	0	1
CO2	1	3	3	3	2	2	0	1	2	3	3	1	0	0	2
CO3	0	2	0	1	0	2	1	1	3	3	2	0	1	0	0
CO4	0	2	2	1	0	2	1	0	0	3	2	1	2	2	0
CO5	1	3	3	3	1	1	0	1	2	2	2	1	1	1	2
CO6	2	3	2	2	2	2	1	1	2	1	2	1	0	1	1
Avg	1.25	2.5	2.5	2	1.66	2	1	1	2	2.33	2.33	1	1.25	1.33	1.5

**CO attainment levels**

CO 1 - 2

CO 2 - 3

CO 3 - 3

CO 4 - 3

CO 5 - 3

CO 6 - 4

**Future Courses Mapping:***Mention other courses that can be taken after completion of this course***Job Mapping:***Students can get Job opportunities in the area of Marketing*

## Syllabus Template

**PR4213::WORLD CLASS MANUFACTURING & INDUSTRY 4.0****Course Prerequisites:**

Basics of How Factory works, Facility Planning, Manufacturing Systems and Strategy

**Course Objectives:**

1. Understand and Apply basic concepts and Principles of Lean Management
2. Understand Toyota Production System and apply it's principles
3. Acquire knowledge of Total Productive Maintenance Philosophy and
4. Understand and Apply Theory of Constraints to solve industry problems
5. Apply Lean, TPS, TPM and TOC in Service sector like Healthcare, Banking etc.

**Credits: 2**

**Teaching Scheme Theory: 02 Hours/Week**

**Course Relevance:**

Course helps to understand and implement Lean Principles, Toyota Production System, TPM and Theory of Constraints in Industries.

SECTION-1
<b>Topics and Contents</b> <b>Lean Manufacturing</b> – Definition & Concept. Characteristics of Lean Manufacturing. Concept of MUDA, MURA & MURI, Value Added and NVA activities <b>Value Stream Mapping</b> – VSM Symbols, Current State and Future State, Kaizen- Types, Format. Kaizen Development, <b>Toyota Production System-</b> Toyota's 14 Principles of Management, Problem Solving Approach, Design of JIT- Pull System, Kanban-Types, Calculations of Kanban, Concept of Standard Work – Standardization, Standard Operating Procedures <b>Set-up Time Reduction:</b> SMED Methodology for Set-up reduction, OTED (One Touch Exchange of Dies), Quick Attachment Devices. <b>Group Technology</b> Approaches, Characteristics of A Group/Cell Families of Parts, Group Technology – Codification & Classification Systems , Production Flow Analysis and Choice Of Family , Benefits and Applications Of Group Technology. <b>Cellular Manufacturing:</b> Work cell concepts and applications, Work cell design, work cell staffing and equipment issues.
SECTION-II

**Topics and Contents**

**Japanese Lean Principles:** Heijunka (Resource Leveling), Jidoka (Autonomation), Genechi

Genbutsu (Go and See)

**Maintenance Management** – Breakdown, Preventive, Predictive. Total Productive Maintenance (TPM): Concept & Origin, Outline of TPM – 8 Pillars, TPM Performance Measures – PQCDSP & OEE (Overall Equipment Effectiveness), Introduction to Autonomous Maintenance (Jishu Hozen) activities, Planned Maintenance, Small-Group activities of TPM.

**Visual Management System-** , Introduction to 5S: Steps in 5S Methodology, Concept of 1S(Seiri), 2S(Seiton), 3S (Seiso), 4S (Shiketsu), 5S, (Shitsuke). Implementation of 1S & 2S, Visual Displays, Visual Controls

**Theory of Constraints:** Introduction to TOC, Concept, Constraints – Types, Factory Physics

Laws and Bottleneck Scheduling, Concept of Throughput, Inventory & Operating Expenses, Throughput Accounting, TOC Methodology, Numerical & Cases in TOC. Application of TOC in industry, Drum-Buffer-Rope Approach.

**Lean Applications in Service Sector** - Logistics, Healthcare

**Industry 4.0:** Introduction, Globalization and Emerging Issues, The Fourth Revolution, Smart Factories, Drivers and Enablers of Industry 4.0, Cyber Physical Systems, Industrial IoT (IIoT)

**List of Tutorials: (Any Three) NA**

**List of Practicals: (Any Six) NA**

**List of Projects: NA**

**List of Course Seminar Topics: NA**

**List of Course Group Discussion Topics: NA**

**List of Home Assignments:**

**Design:**

1. Design Kanban or JIT system for manufacturing / service organization
2. Design and Implement Single Piece Flow System
3. Design Cellular manufacturing systems by using Lean principles
4. Design TOC based manufacturing / service system
5. Design Industry 4.0 and Lean based integrated system

**Case Study:**

1. Case study based on Value Stream Mapping
2. Case study based on Kanban Simulation
3. Case study based on TPM Performance measures and OEE
4. Case study based on Theory of Constraints (TOC) methodology
5. Case study based on Integration of Lean and Industry 4.0

**Blog**

1. Application of any lean technique for the hypothetical or simulated scenario
2. Implementation of any lean technique to solve industry problems (Manufacturing)
3. Understand and Implementation of any lean technique to solve industry problems (Service)
4. Apply Theory of Constraints methodology to solve industry problems
5. TPM benefits and abnormalities

**Surveys**

1. Survey of Companies for Lean Implementation
2. Survey of MSME's to know challenges of Lean Implementation
3. Survey of Companies implemented TPM and its effect on Business
4. Survey of Lean Implementation methodologies in Domestic and MNCs
5. Survey of Critical Success and Failure Factors for Lean implementation

**Assessment scheme**

Sr. No	Type of Assessment	Conduction	Marks
1	MCQ Exam – Section I	Mid Semester	30 Marks converted to 30 equivalent Marks
2	Home Assignment	End of Semester	100 Marks converted to 10 equivalent Marks
3	MCQ Exam – Section II	End of Semester	30 Marks converted to 30 equivalent Marks
4	Comprehensive Viva Voce	End of Semester	100 Marks converted to 30 equivalent Marks

**Text Books: (As per IEEE format)**

1. B.S. Sahay, Saxena, World Class Manufacturing - A strategic perspective, Laxmi Publications Pvt Ltd, 1st Edition, 2018
2. Richard Schonberger, World Class Manufacturing – The Next Decade: Building Power, Strength, and Value, Free Press, 1996
3. Jeffrey Liker, The Toyota Way, McGraw Hill Publications, Indian Edition, 2017

**Reference Books: (As per IEEE format)**

1. Mishra R.C., Pathak K, Maintenance Engineering and Management, PHP Publications, 2<sup>nd</sup> Edition, 2016
2. James Womack & Daniel Jones, Learning to See, 1998
3. John Bicheno, Cause and Effect Lean – The essentials of Lean Manufacturing, 1994
4. Nakajima Seiichi, Introduction to TPM: Total Productive Maintenance, 1995
5. Terry Wireman, Total Productive Maintenance, Industrial Press, 2004
6. Kelley, M.J. Harris, Management of Industrial Maintenance, Newness Butterworths

**Moocs Links and additional reading material:** [www.nptelvideos.in](http://www.nptelvideos.in)



<https://nptel.ac.in/courses/110/107/110107130/>

<https://www.coursera.org/learn/lean-manufacturing-services>

**Course Outcomes:**

1. Identify, eliminate and reduce the non-value added activities (wastes) in manufacturing organization
2. Apply the tools and techniques of lean manufacturing to improve productivity in manufacturing organizations
3. Understand the principles and benefits of Toyota Production System philosophy
4. Apply the concept, tools and techniques in TPM philosophy
5. Apply the tools and techniques of constraint management to improve productivity in manufacturing and service organizations
6. Apply the tools and techniques of lean manufacturing to improve productivity in service organizations

**CO PO Map**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	0	1	0	1	1	1	0	1	0	0	0	1	0
CO2	2	1	0	1	0	1	1	0	0	1	0	0	1	1	1
CO3	2	1	0	1	0	1	1	0	0	1	0	0	0	1	0
CO4	1	1	0	2	0	1	1	1	0	1	0	0	0	1	1
CO5	2	1	0	3	0	0	0	0	1	1	0	0	2	1	1
CO6	1	1	0	2	0	1	1	0	2	0	0	0	1	1	0
Avg	1.67	1	0	1.67	0	0.83	0.83	0.33	0.5	0.83	0	0	0.67	1	0.5

**CO attainment levels**

CO1- 3

CO2- 3

CO3- 3

CO4- 2

CO5- 3

CO6- 3

**Future Courses Mapping:**

Logistics & Supply Chain Management, Project Management, Design For X

**Job Mapping:**

Industrial Engineer

TPM Facilitator

Lean Implementor

Service sector industries

Health care

## Syllabus Template

**IE4211:DESIGN FOR X AND PRODUCT LIFECYCLE  
MANAGEMENT****Course Prerequisites:****Course Objectives:**

1. Understand the significance of Product Life Cycle Management and its strategies
2. Understand the importance of Product Design and New Product Development
3. Understand & apply principles of Design for Manufacturing and Assembly
4. Apply techniques such as QFD, FMEA for existing/ new products in industries
5. Understand the importance of DFX viewpoint in Product Design and Business .

**Credits: 2****Teaching Scheme Theory: 2 Hours/Week****Course Relevance: NA**

SECTION-1
<b>Product Life Cycle &amp; Product Design</b> Introduction to Product Life, Importance of Product Life Cycle, Technology / Development Cycle, PLC Strategies, New Product Design Process, Value Chain, Sequential Vs. Concurrent Design Approach. Competitive Advantage & Competitive Strategy, Economics of Process Selection – General Design Principles of Manufacturability, Material Selection – Strength and Mechanical Factors- Applications of Form Design, Selection of Shapes, Digital Manufacturing
<b>Design for Manufacture &amp; Assembly</b> Review of Manufacturing Processes, Selection of manufacturing Processes, Design for Casting, Design for Bulk Deformation Processes, Design for Sheet Metal Forming Processes, Design for Machining, Design for Plastic Processing, Injection Molding etc. Review of Assembly Processes, Design for Welding, Design for Brazing and Soldering, Design for Adhesive Bonding. Types of assembly, DFA, Evaluation of Assembly, Assembly Cost Reduction, Case Studies based on DFMA
SECTION-II
<b>Design for Quality, Reliability and Maintainability</b> Design for Quality, House of quality for QFD process, Human Engineering Considerations in Product Design, Identification of controls, Design for Optimization, Design for Reliability, Approach to Robust Design, Failure Mode and Effect Analysis. Design for Maintainability - MTTF, MTTR, MTBF, FIT
<b>Design for X ( Specific Purpose)</b> Design for Safety- Safety aspects in Manufacturing Environment, Design for Safety

Application for Products and Equipments, Design for Additive Manufacturing, Design for Logistics, Design for Delayed differentiation, Design for ergonomics, Design for Environment, Design for recycling, Case studies based on above DFX concepts,

**List of Tutorials: (Any Three) NA**

**List of Practical's: (Any Six) NA**

**List of Projects: NA**

**List of Course Seminar Topics: NA**

**List of Course Group Discussion Topics: NA**

**List of Home Assignments:**

**Design:**

1. Product Design and Material Selection
2. Design for Manufacturing and Assembly of new product of your choice
3. Design of a QFD for existing or new product of your choice
4. Develop FMEA for existing or new product of your choice
5. Design product from DFX point of view

**Case Study:**

1. Case study based on Material and Shape Selection
2. Case study based on Product Design and NPD
3. Case study based on Design for Manufacturing and Assembly
4. Case study based on Design for Quality and Reliability
5. Case study based on Maintenance & Safety
6. Case study based on Quality Function Deployment
7. Case study based on Failure Modes and Effects Analysis
8. Case study based on Design for Sustainability (Recycling, Logistics etc.)

**Blog**

1. Detailed design process
2. Product Life Cycle of products around us
3. Prepare QFD of products around us
4. Prepare FMEA of products around us
5. Process and Assembly method selection

**Surveys**

1. Survey based on Product Life Cycle strategies across various industries
2. Survey based on Product Design & NPD Processes within the same industry of your choice
3. Survey based on usability of DFMA principles in practice
4. Survey based on usability of QFD / FMEA techniques in practice
5. Survey based on Safety and Maintenance aspects for product / equipment
6. Survey based on Design for Sustainability, Recycling, Logistics etc.

**Assessment Scheme:**

Mid semester - 30

End semester - 30

Home assignment - 10 marks

CVV - 30 marks

**Text Books: (As per IEEE format)**

1. Dieter George E, Engineering Design, 3<sup>rd</sup> Edition Mc Graw Hills Publications 2000.
2. G Boothroyd, P Dewhurst and W Knight, Product design for manufacture and assembly, John Wiley, NY: Marcel Dekkar, 1994.

**Reference Books: (As per IEEE format)**

1. K G Swift and J D Booker, Process selection: from design to manufacture, London: Arnold, 1997.
2. J G Bralla, Handbook for Product Design for Manufacture, McGraw Hill, NY, 1998.
3. ASTM Design handbook.
4. M Fashby and K Johnson, Materials and Design - the art and science of material selection in product design, Butterworth-Heinemann, 2003.

**Moocs Links and additional reading material:** [www.nptelvideos.in](http://www.nptelvideos.in)**Course Outcomes:**

1. Understand the role and impact of New Product Development and Product Life Cycle on any business
2. Utilize DFMA and Concurrent Engineering Principles on a "real life" project
3. Apply the concept of DFMA for Conventional manufacturing and assembly processes
4. Apply the Quality and Reliability aspects of design for manufacture and assembly
5. Apply the Maintainability and Safety aspects of design for manufacture and assembly
6. Apply the concept of DFX for specific purpose such as recycling, delayed differentiation, logistics, ergonomics, sustainability

**CO PO Map**

CO/PO	PO:1	PO:2	PO:3	PO:4	PO:5	PO:6	PO:7	PO:8	PO:9	PO:10	PO:11	PO:12	PO:13	PO:14	PO:15
CO:1	0	0	0	1	0	0	0	1	1	1	0	1	0	0	0
CO:2	1	1	0	2	1	0	0	0	2	2	2	1	0	0	0
CO:3	1	1	0	2	2	0	0	0	2	2	2	2	1	2	1
CO:4	1	0	0	2	2	1	0	0	2	0	0	2	1	2	1
CO:5	1	0	1	0	1	1	0	0	1	0	0	2	0	1	1
CO:6	0	1	1	0	0	2	2	1	2	2	2	2	0	1	0

Freezed...

**CO attainment levels**

CO-1 :4

CO-2 :4

CO-3 :4

CO-4 :4

CO-5 :4

CO-6 : 4

**Future Courses Mapping:**

Industry Internship or Capstone Project

**Job Mapping:**

Design Engineer

## Syllabus Template

**IE4212: DATA ANALYTICS FOR ENGINEERS****Course Prerequisites: Nil****Course Objectives:**

1. To help students learn, understand, and practice big data analytics and machine learning approaches, which include the study of modern computing, big data technologies and scaling up machine learning techniques focusing on industry applications.
2. To understand and learn the conceptualization and summarization of concepts like big data and machine learning, trivial data versus big data, big data computing technologies, machine learning techniques, and scaling up machine learning approaches.
3. To gain insight in basic techniques for processing large amounts of data in an efficient, reliable, and consistent way and develop skills in understanding, interpreting, and documenting data and information in the context of realistic scenarios.
4. To get understanding of the data life cycle and develop skills for structuring their solutions of practical problems along the phases of the data life cycle and apply data analytics techniques to realistic data-sets in which they can recognize the demands within their area of specialization.
5. To obtain basic knowledge of statistical concepts and techniques and develop skills to apply them in practice and learn to implement their solutions for data analytics problems in a programming language (Python), and apply a structured and systematic approach to data processing.

**Credits: 02****Teaching Scheme Theory: 02 Hours/Week**

**Course Relevance:** The course can help the students to prepare for data analytics related tasks and jobs, needed in the various areas of knowledge, science and technology.

**SECTION-1**

**Introduction to Data Science and Analytics** Introduction to big data:– Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting. Data in Engineering and Management Research, Types of data, Measures of Frequency Distribution, Big data Analytics (Apache Spark), Application Area: Finance, Time series Analysis, Advertisement, NLP, IOT.

**Introduction to Data Science in Python:** Python Core Objects and built-in functions, Number Object and operations, String Object and Operations, List Object and Operations, Tuple Object and operations, Dictionary Object and operations, Set object and operations, Boolean Object and None Object, Different data Structures, data processing Conditional Statements and Loops, UDF Functions and Object Functions, File Handling with Python, Python Modules and Packages, Exceptional Handling and Object-Oriented Python, Python OOPS.

**Database System:** Database interaction with Python Creating Database with MYSQL, CRUD

Operations, Creating a Database Object. Python MySQL / SQLite Database Access Disconnecting Database, Data Analytics Tool Spreadsheet, ML Tool, BI Tools
<b>SECTION-1I</b>
<b>Machine Learning :</b> Data Visualization - Matplotlib, Data Analysis Using Python Modules- Numpy, Pandas, Tableau Machine Learning Algorithms Supervised Learning Regression Linear Regression (Simple and Multiple) Logistic Regression. <b>Machine Learning Algorithms</b> Supervised Learning Regression Linear Regression Multiple Linear Regression Bias-Variance Trade-Off <b>Classification Modelling :</b> Logistic Regression, K-Nearest Neighbors (KNN), Simple Vector Machine (SVM), Decision Trees or Ensemble Methods - Random Forest <b>Unsupervised Learning Clustering:</b> K-Means Clustering Hierarchical Clustering DBSCAN
<b>List of Practicals: (Use of Excel / R / Python / Minitab / SAS / SPSS/Google Data Studio)</b> NA
<b>List of Projects: NA</b>
<b>List of Course Seminar Topics: NA</b>
<b>List of Course Group Discussion Topics: NA</b>
<b>List of Home Assignments:</b> 1. Bayesian Data Analysis 2. Educational data mining 3. Business intelligence predictive Analytics 4. Big data and Business Intelligence(BI) or Market Intelligence (Related: Big Data) 5. Open source Data Mining 6. Data Mining System 7. Data mining Trends 8. Health data mining 9. Web Analytics solution 10. Data Mining marketing 11. Data Mining in Search Engine Analytics (related SEO) 12. Tools for Data Cleaning and Munging 13. Text Classification 14. Evaluation Methods for Machine Learning 15. Integrating Big Data platforms with traditional DW/BI environments 16. Data visualization and in-memory data 17. NoSQL BI Tools and applications

18. Analyzing Big Data using Self-Service BI Tools,
19. Using Data virtualization to simplify access Big Data and traditional DW/BI systems
20. SQL connectivity initiatives to Big Data
21. Managing stream computing in a Big Data environment
22. MapReduce developer tools
23. Creating Sandboxes for Data Science projects
24. Tools for ETL processing
25. Creating a multi-platform analytical ecosystem
26. The role of Data Virtualization in a Big Data environment

**Text Books: (As per IEEE format)**

1. Chris Albon : *Machine Learning with Python Cookbook*, O'Reilly Media Inc. 2018
2. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014
3. Jeffrey Stanton, *An Introduction to Data Science*, 2012.
4. Tom M. Mitchell, *Machine Learning*, India Edition 2013, McGraw Hill Education

**Reference Books: (As per IEEE format)**

1. Wes McKinney, "Python for Data Analysis", O'Reilly Media Inc. 2013
2. Samir Madhavan, "Mastering Python for Data Science", PACKT publishing, 2015
3. Jake Vanderplas, "Python Data-science Handbook", O'Reilly Media Inc. 2017
4. Joel Grus, "Data science from Scratch, First Principles with Python", O'Reilly Media Inc 2015

**Moocs Links and additional reading material:**

- [1] Kevin Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012, <https://www.cs.ubc.ca/~murphyk/MLbook/pml-intro-5nov11.pdf>
- [2] Professor S. Sarkar IIT Kharagpur "Introduction to machine learning", <https://www.youtube.com/playlist?list=PLYihddLFCgYuWNL55Wg8ALkm6u8U7gps>
- [3] Professor Carl Gustaf Jansson, KTH, Video Course on Machine Learning [https://nptel.ac.in/noc/individual\\_course.php?id=noc19-cs35](https://nptel.ac.in/noc/individual_course.php?id=noc19-cs35)
- [4]. Tom Mitchell, "Machine Learning", [http://www.cs.cmu.edu/~tom/10701\\_sp11/lectures.shtml](http://www.cs.cmu.edu/~tom/10701_sp11/lectures.shtml)
- [5]. Charles Severance: University of Michigan, Python for Everybody [COURSERA]. Available: <https://www.coursera.org/>
- [6]. Madhavan Mukund, (12, may, 2018). Programming, Data Structures & Algorithms using Python [NPTEL]. Available: <http://nptel.ac.in/>
- [7]. Keith Galli Complete Python NumPy Tutorial (Creating Arrays, Indexing, Math, Statistics, Reshaping) Available: <https://www.youtube.com/watch?v=GB9ByFAIAH4>
- [8]. Keith Galli Complete Python Pandas Data Science Tutorial! (Reading CSV/Excel files, Sorting, Filtering, Groupby) Available: <https://www.youtube.com/watch?v=vmEHCJofslg>
- [9]. CS Dojo, Intro to Data Analysis / Visualization with Python, Matplotlib and Pandas | Matplotlib Tutorial Available: <https://www.youtube.com/watch?v=a9UrKTVEeZA>



**Assessment Scheme:**

Mid semester - 30

End semester - 30

Home assignment - 10 marks

CVV - 30 marks

**Course Outcomes:**

1. Ability to integrate machine learning libraries and mathematical and statistical tools with modern technologies and assess the appropriateness of different kinds of research designs and methodology.
2. Ability to identify the characteristics of datasets and compare the trivial data and big data for various applications.
3. Ability to select and implement machine learning techniques and computing environments that are suitable for the applications under consideration and also recognize and implement various ways of selecting suitable model parameters for different machine learning techniques.
4. Ability to solve problems associated with batch learning and online learning, and the big data characteristics such as high dimensionality, dynamically growing data and in particular scalability issues.
5. Ability to understand and apply scaling up machine learning techniques and associated computing techniques and technologies

**CO-PO Mapping:**

CO/PO	PO:1	PO:2	PO:3	PO:4	PO:5	PO:6	PO:7	PO:8	PO:9	PO:10	PO:11	PO:12	PSO:13	PSO:14	PSO:15
CO:1	3	2	3	2	2	3	2	1	3	2	2	3	0	1	2
CO:2	2	3	2	3	1	0	2	2	1	1	3	2	0	1	1
CO:3	2	2	1	2	1	2	3	3	2	2	2	1	0	0	1
CO:4	1	1	2	1	0	1	1	1	1	1	1	2	0	1	1
CO:5	1	0	1	2	3	2	2	2	0	2	1	2	0	0	2

**CO Attainment Levels:**

CO1- 4, CO2- 4, CO3- 4, CO4- 4, CO5- 4, CO6- 4

**Future Courses Mapping:**

NA

**Job Mapping:**

To help the students to prepare for jobs in data analytics related tasks and jobs, needed in the various areas of knowledge, science and technology.

FF No. : 654

## Syllabus Template

**MD4202:: PROJECT MANAGEMENT****Course Prerequisites:****Course Objectives:**

6. Understand the significance of Product Life Cycle Management and its strategies
7. Understand the importance of Product Design and New Product Development
8. Understand & apply principles of Design for Manufacturing and Assembly
9. Apply techniques such as QFD, FMEA for existing/ new products in industries
10. Understand the importance of DFX viewpoint in Product Design and Business.

**Credits: 2****Teaching Scheme Theory: 2 Hours/Week****Course Relevance: NA**

SECTION-1
<p><b>Introduction: (6 Hours)</b> Definition &amp; Characteristics of Project, Performance Parameters: Time, Cost &amp; Quality. Difference with respect to Standard Routine Production. Classification of Projects: Sector based, Investment based, Technology based, Causation based, Need based (BMERD) - Balancing, Modernization, Replacement, Expansion &amp; Diversification Project Life Cycle Phases – Concept/Initiation Phase: Parameters Involved in Project Identification. Sources of New Project Ideas. Governmental Framework for Identification of Opportunities, Incentives from state &amp; central govt.; Import-substitution projects</p> <p><b>Project Conceptualization &amp; Feasibility Analysis (4 Hours)</b> Project Definition Phase: Project Formulation &amp; Feasibility. Types of Feasibility Studies – Pre-feasibility, Support/Functional, Feasibility Study. Preparation of Project Feasibility Report</p> <p><b>Project Planning, Implementation &amp; Control (6 Hours)</b> Planning &amp; Organization Phase: Project Planning, Scheduling &amp; Monitoring, Statement of Works, Project Specifications, Work Breakdown Structure, Network Analysis &amp; Duration Estimating Network Diagrams – PERT/CPM, Estimate Activity Times, Milestone Scheduling. Project Crashing.</p>
SECTION-1I
<p><b>Project Human Resource (4 Hours)</b></p>

<p>Project Organization &amp; Management. Project Organization Structure, Role of Project Manager, Resource Levelling, Resource Smoothing,</p> <p><b>Project Cost Management (4 Hours)</b></p> <p>Project Cost Estimation: Need, Causes of Cost &amp; Time Overruns. Nature of Cost Estimates, Types of Project Cost Estimates</p> <p><b>Project Implementation &amp; Control (4 Hours)</b></p> <p>Implementation Phase: Activities Involved: Erection &amp; Commissioning, Installation, Trial Runs &amp; Commencement of Commercial Production. Cleanup / Shutdown Phase</p>
<p><b>List of Home Assignments:</b></p> <p><b>Design / Case Study / Blog / Surveys</b></p> <ol style="list-style-type: none"> <li>1. HA Based on Project Planning by using MS- Project</li> <li>2. HA Based on CPM with or without using MS- Project ( On actual projects )</li> <li>3. HA Based on PERT with or without using MS- Project ( On actual projects )</li> <li>4. HA Based on Project Crashing ( Cost Optimization )</li> <li>5. HA Based on Resource Optimization - Resource Levelling and Smoothing</li> <li>6. Survey based on PM Softwares and its applicability</li> <li>7. Study based on Project Cost Management</li> <li>8. Analysis based on Earned Value Management of any project</li> <li>9. Blog based on Best practices in Project Management</li> <li>10. Blog based on Project Management Softwares and its usage</li> <li>11. Use of MS Project in Construction / IT/ Technology/ NPD Projects</li> <li>12. Use of Project Management in Engg fields</li> <li>13. Use of PM in Education ( From student's perspective)</li> <li>14. Feasibility study of any project or Business plan</li> <li>15. Blog on Scope of Project Management domain in India</li> <li>16. Blog on Challenges in Project Management for IT / Construction / Govt sector</li> <li>17. Survey based on Project Manager's experience about Challenges/ Benefits in the PM domain</li> <li>18. Study of Project Life Cycle Management</li> <li>19. Study of Cost or Time or Quality aspects of Project Management</li> <li>20. Study of Industry 4.0 feasibility in Project Management</li> </ol>
<p><b>Assessment Scheme:</b></p> <p>Mid semester - 30</p> <p>End semester - 30</p> <p>Home assignment - 10 marks</p> <p>CVV - 30 marks</p>
<p><b>Text Books: (As per IEEE format)</b></p> <ol style="list-style-type: none"> <li>1. Harold Kerzner, "Project Management: A Systems Approach to Planning, Scheduling, and Controlling"</li> <li>2. K. Nagarajan, "Project Management" Second Edition, New Age International, 2004</li> </ol>

**Reference Books: (As per IEEE format)**

1. A Guide to Project Management Body of Knowledge (PMBOK guide) 6th Edition

**Moocs Links and additional reading material:**

[https://onlinecourses.nptel.ac.in/noc19\\_mg30/preview](https://onlinecourses.nptel.ac.in/noc19_mg30/preview)

**Course Outcomes:**

1. Learn the basic concepts of project and project management
2. Ascertain the feasibility of small and medium projects with respect to managerial, marketing, operational, financial and socio-economic perspectives
3. Apply Plan and schedule small and medium projects to achieve the triple constraint of time, cost and quality using software package
4. Understand the concept of earned value management system and critical chain in managing projects
5. Understand the concepts of project risk management and critical chain project management
6. Monitor the progress of projects to determine variances and recommend corrective actions

**CO PO Map**

CO/PO	PO:1	PO:2	PO:3	PO:4	PO:5	PO:6	PO:7	PO:8	PO:9	PO:10	PO:11	PO:12	PSO:13	PSO:14	PSO:15
CO:1	0	0	0	0	0	0	0	0	1	1	3	1	1	0	0
CO:2	2	0	0	0	0	0	0	0	1	1	3	1	0	0	0
CO:3	0	0	0	0	3	0	0	0	2	1	3	1	0	0	0
CO:4	0	1	0	0	0	0	0	0	0	0	3	1	0	0	0
CO:5	0	2	0	0	0	0	0	0	0	0	3	1	0	0	0
CO:6	0	0	0	0	0	1	1	0	0	0	3	1	0	0	0

**CO attainment levels**

CO-1 :3

CO-2 :3

CO-3 :3

CO-4 :3

CO-5 :3

CO-6 :3

**Future Courses Mapping:** Industry Internship or Major Project**Job Mapping:** Project Engineer, Project Manager,

FF No. : 654

**IE4005: Operations Scheduling****Course Prerequisites:** None**Course Objectives:**

- 1.To provide basic understanding of scheduling management concepts and their relevance to Production Planning & Control
- 2.To make students aware of the different techniques used for Single Machine Scheduling
- 3.To make students aware of the different techniques used for Parallel Machine Scheduling
- 4.To provide understanding of the concept of Flow shop model & its usage
- 5.To develop knowledge for optimizing scheduling values like Makes span, Machine Idle time

**Credits:**2**Teaching Scheme:** Theory: 2 Hours/Week

**Course Relevance:** This course will provide basic knowledge of Marketing for working in a business environment.

**SECTION-1****Unit I:**

Single Machine Scheduling & Other Objectives in a single machine scheduling Basic theorems performance measures – mean flow time, mean tardiness etc. Hodgson's algorithm, method to minimize tardiness, Branch and Bound method, Commonly used heuristics like Cost over Time rule ( COVERT ), LPUL Rule, SWPT Rule, Largest Weight (WT) Rule and LPUL rule. Backward forward (BF) heuristic method, single machine scheduling problems with early and late penalties.

**Unit II:** Problems with early and late due dates, Minimize number of jobs delayed, problems of different types like maximizing the number of jobs completed when the available time is less, when the sequence dependent jobs, minimizing Variation of flow time, sequence dependent set up times, multiple criteria scheduling, Jobs arriving at different times.

**Unit III:** Parallel Processing & Batch Sequencing, Parallel machine models, Make span minimization of independent and dependent jobs – Mc Naughton's algorithms, Weighted mean flow time minimization, Parallel Processing- Job with equal weights, Job with due dates, Batch scheduling for a limited capacity, fixed-period process problem, baking problem-ovens in sequence. DSRO-Network Base scheduling of jobs on m machines, LCR method used for line balancing, mixed model assembly.

## SECTION-1I

**Unit IV:** Flow shop models, Introduction of Flow shop model, objectives of flowshop model, Use of Gantt chart –Minimize machine idle time method, Nawaz heuristic, Campbell Dudek method, Palmer's method.

**Unit V:** Job Shop Models, Minimize makes pan- SPT rule, Network approach to Job shop scheduling, Modified shifting bottleneck heuristic (MODSB), Two stage job shop scheduling heuristic, Job shop scheduling CEXSPT rule.

**Unit VI:** Graphical representation – Feasible, semi-active and active schedules – Single pass approach –Non-delay schedule generation. Heuristic schedule generation – Priority dispatching rules – Dynamic job shop simulation.

### List of Home Assignments:

#### Design:

1. Common Due Date single machine scheduling
2. Jobs arriving at different times system design
3. Dependant Jobs production system
4. System design for reducing Tardy jobs

#### Case Study:

1. Parallel processing of identical jobs
2. Makespan calculation for parallel machines
3. McNaughton's Algorithm application in Parallel machining
4. Batch Processing scheduling

#### Blog

1. Flow shop Model & its Practical applications
2. CDS Model & its Practical applications
3. Minimize Machine Idle time Mechanism
4. Johnson's Algorithm for flow shop model

#### Surveys

- 1 Job shop model & its Practical applications
- 2 CEXSpt model & its Practical applications
- 3 SPT in Job shop model & its Practical applications
- 4 MODSOB Method in Job shop model & its Practical applications

### Assessment scheme

Sr. No	Type of Assessment	Conduction	Marks
1	Home Assignment	End of Semester	100 Marks converted to 10 equivalent Marks

2	MCQ Exam – Section I	Mid Of Semester	30 Marks converted to 30 equivalent Marks
3	MCQ Exam – Section II	End of Semester	30 Marks converted to 30 equivalent Marks
4	Comprehensive Viva Voce	End of Semester	100 Marks converted to 30 equivalent Marks

**Text Books: (As per IEEE format)**

1. Industrial Scheduling – Dileep R Sule, Ist edition, International Thomson Publishing Company, London
2. Kenneth R. Baker, “Introduction to sequencing and scheduling”, Ist edition, John Wiley and Sons, 2000

**Reference Books: (As per IEEE format)**

1. Michael Pinedo, “Scheduling: theory, algorithms and systems”, Ist edition, Prentice Hall of India, 1996.
2. King, J.R, “Production planning and control”, Ist edition, Pergamum International Library, 1975

**Moocs Links and additional reading material:** [www.nptelvideos.in](http://www.nptelvideos.in)

**Course Outcomes:**

Students will be able to:

1. Understanding of single machine scheduling , its other objectives etc.
2. Understanding of Parallel Processing & Batch Sequencing.
3. Analysis of Flow shop models & its implications
4. Analysis of Job shop models & its implications

**CO PO Map**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS13	PS14	PS15
CO1	3				2						1		2	2	
CO2	3				2						1		2	2	
CO3	3				2						1		2	2	
CO4	3				2						1		2	2	

**CO attainment levels**

CO 1 - 2

CO 2 - 3

CO 3 - 3

CO 4 - 3

**Future Courses Mapping:**

Mention other courses that can be taken after completion of this course

**Job Mapping:**

Students can get Job opportunities in the area of scheduling of Process



Syllabus Template  
**ME4202 : Computer Integrated Manufacturing**

**Course Prerequisites:**

Manufacturing processes, Industrial management, CAD/CAM

**Course objectives:**

1. To acquaint the students with databases and numerical analysis related to CIM.
2. To introduce students with Computer Aided Process Planning Systems and Cellular Manufacturing Systems.
3. To study the role and components of different Automation strategies.

**Credits: 02****Teaching Scheme: Theory: 2 Hours/Week****Course Relevance:**

This course gives the integration of automated production processes by using computers and delivers a benefit of streamlining production processes with reduced costs and improved scheduling flexibility. Data storage and handling is also the need of contemporary manufacturing systems. This is also catered using software.

**SECTION—I****Introduction**

Introduction of CAD and CAM, Manufacturing planning and control, Concurrent Engineering, Concept and elements of CIM, Mathematical model of production performance, manufacturing control, elements of automated system, lean production and Just-in-Time production.

**Production planning and control**

Process planning, Computer aided process planning and steps, Aggregate production planning and master production schedule, Material Requirement planning, capacity planning, control system, shop floor control, Inventory control, Manufacturing Resource planning (MRPII), Enterprise resource planning (ERP)

**Cellular Manufacturing**

Group Technology, part families and part classification and coding, composite part concept, machine cell design and layout, Arranging machines in a GT cell, Production Flow Analysis (PFA)

**SECTION—II**

**Flexible manufacturing System**

Automation, Introduction, Automation strategies, Types of Automation - Hard and Soft Automation, FMS, FMS components, Applications and benefits, FMS planning and control, quantitative analysis in FMS, Automated Guided vehicle systems, and AS/RS, Vehicle guidance technology, vehicle management and safety.

**Manufacturing system control**

Computerized statistical process control, shop floor control, inventory control, pull system of production control, introduction to automated inspection devices: Coordinate Measuring Machine (CMM), Inspection probes etc.

**Industrial Robotics**

Robot anatomy and related attributes, classification of robots, Robot control system, sensors in robotics, end effectors, accuracy and repeatability, Industrial robot applications, Robot part programming, simple problems.

**List of Home Assignments:****Design:**

1. Flexible manufacturing system
2. Machine cell
3. Material handling system
4. Mathematical model of production performance
5. Manufacturing Order Report

**Case Study:**

1. Available computer/automation hardware, and software.
2. Production Flow Analysis
3. Master Production Schedule
4. Aggregate production planning
5. Enterprise Resource planning in Manufacturing

**Blog**

1. Open CIM System Management Software
2. Real Time monitoring in CIM
3. Robot Control Programming
4. CNC Milling Station and Control software
5. Benefits of Computer Integrated Manufacturing

**Surveys**

1. Islands of automation and software
2. Product related activities of a company
3. Plant operations

4. Computer Managed Production planning
5. Product data management

**Suggest an assessment Scheme:**

Suggest an Assessment scheme that is best suited for the course. Ensure 360 degree assessment and check if it covers all aspects of Blooms Taxonomy.

1. MSE
2. HA
3. CVV
4. ESE

**Text Books: (As per IEEE format)**

1. Groover M.P. "Automation, production systems and computer integrated manufacturing", Prentice Hall of India
2. Deb S.R., "Robotics Technology and Flexible Automation", Tata McGraw Hill
3. Radhakrishnan P. and Subramanyam S., "CAD,CAM,CIM", New Age International Pvt. Ltd.
4. John J., Craig, "Introduction to Robotics", Pearson Publication.

**Reference Books: (As per IEEE format)**

1. Eric Teicholz and Joel orr, Computer Integrated Manufacturing Handbook, McGraw Hill Book Co.
2. Yoram Coren, "Computer control and Manufacturing Systems", McGraw Hill publication.
3. Paul G. Ranky, "Computer Integrated Manufacturing", PHI.
4. Nanua Singh, John, "Systems Approach to Computer Integrated Design and Manufacturing", Wiley publication

**Moocs Links and additional reading material:**

<https://nptel.ac.in/courses/112/104/112104289/>

**Course Outcomes:**

Students will be able to:

- 1) Apply knowledge about Computer Aided Quality control and Process Planning Control.
- 2) Design Flexible manufacturing cell after carrying out Group technology study and finally creating FMS
- 3) Analyze and Design appropriate automated assembly systems
- 4) Apply Computer aided process planning and MRP.
- 5) Distinguish various automated flow lines in high volume production systems.
- 6) Understand the robot systems and their applications in manufacturing industries.

**CO-PO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	------	------	------	------	------	------

<b>C O 1</b>	2	1	1	2	1	1	0	1	2	1	2	1	1	2	2
<b>C O 2</b>	2	1	2	1	1	1	1	2	1	2	2	1	1	1	1
<b>C O 3</b>	1	2	2	1	2	1	1	1	1	1	1	1	1	1	2
<b>C O 4</b>	2	1	1	2	1	1	0	1	2	1	2	1	1	2	2
<b>C O 5</b>	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1
<b>C O 6</b>	1	1	1	0	1	1	0	0	1	1	1	1	1	0	1

**Course Outcomes attainment level**

- 1) Apply knowledge about Computer Aided Quality control and Process Planning Control. (4)
- 2) Design Flexible manufacturing cell after carrying out Group technology study and finally creating FMS (3)
- 3) Analyze and Design appropriate automated assembly systems (2)
- 4) Apply Computer aided process planning and MRP. (3)
- 5) Distinguish various automated flow lines in high volume production systems.(4)
- 6) Understand the robot systems and their applications in manufacturing industries(4)

**Future Courses Mapping:**

Automation in Production, computer aided manufacturing, CNC

**Job Mapping:**

Course will help students to work in an automated sector, management systems Jobs in Manufacturing at Machining and Machinery Industry, cellular manufacturing which will be useful for Industry 4.0

**ME4255: MAJOR PROJECT****Course Prerequisites:**

All Engineering Courses Studied so far including Mathematics and Physics

**Course Objectives:**

1. To make students aware in the selection of domain, area and topic of their interest
2. To orient the students to identify the problem precisely, analyze the same and subsequently do the synthesis.
3. To orient the students to apply their knowledge preferably to real life engineering problem solving
4. To evolve students in conceptual, lateral, and out of box thinking
5. To provide an opportunity to them to acquire hands on experience of manufacturing processes
6. To provide platform to learn how to work in a group and gain basic management skills

**Credits: 10****Teaching Scheme:****Lab: 20** Hours/Week

**Course Relevance:** By this academic component students are exposed to the process of selection of manufacturing methods, materials, fits and tolerances, assembling and disassembling of system, equations or correlations, boundary conditions, input parameters, dependent and independent variables, technical data, analysis techniques, data generation techniques etc. Also it gives an exposure to selection of Standards, Standard processes, Standard Techniques, Standard components, Standard Mechanisms, Standard measuring and regulating instruments etc. This lead to an overall growth of the student as professional Mechanical Engineer

SECTION-I
Design/Development/Retrofitting/Fabrication/Atomization/Optimization/Modeling/Coding /Simulations/Experimental-analysis/Computational-analysis/Mathematical-analysis/Use of analogies/Use of commercially available software/Use of available codes/Use of open source codes and software's/Performance improvements of Mechanism/Machine/Model /Prototype/System based on existing/new ideas/principle etc.
SECTION-II
Energy audit /conservation/management, Use of renewable energy sources etc. Validation or Bench marking of the outcome/ results. Demonstration of Prototype or actual model. Results and Discussions. Concluding remarks.

**INSTRUCTIONS**

A report containing maximum 30 pages (printed on both sides excluding certificate, permission letter, and title pages) shall be submitted based on the background, motivation and scope of the project, project specifications, activities involved in the project and activity plan, literature review made, basic theory, details of methodology adopted and data reduction, results and discussions, conclusions extracted and proposed future work (if any) followed by referencing and appendices (if any).

**GUIDELINES**

- Report shall be typed and printed in standard format.
- Figures and tables shall be at appropriate positions, with numbers and captions.
- Project title and approval sheets shall be attached at the beginning of the report followed by Index and Abstract of the project.
- References shall be mentioned at the end followed by appendices (if any).
- When a group of students is doing a project, names of all the students with GR No and Roll No shall be included on every certified project report copy.
- Each group of students shall submit to the concerned the required number of copies of project reports as decided by the department and one copy shall be prepared for each individual student.

**List of Tutorials: -NA-**

**List of Practical's: -NA-**

**List of Projects: -NA-**

**List of Course Seminar Topics: -NA-**

**List of Course Group Discussion Topics: -NA-**

**List of Home Assignments: -NA-**

**Suggest an assessment Scheme:**

*Suggest an Assessment scheme that is best suited for the course. Ensure 360 degree assessment and check if it covers all aspects of Blooms Taxonomy.*

1. MSE
2. ESE

**Text Books: (As per IEEE format)**

Any Book relevant to your Project Topic.

**Reference Books: (As per IEEE format)**

- 1.Reference Books, Text Books, Handbooks, PSG Data Book, Various Catalogues, Property Tables, Property Charts etc.
2. Cited Papers from Journals and Conferences
3. Literature available from open source

**Course Outcomes:**

After completing this academic activity, students will be able to;

1. Apply theoretical concepts for solving the project problem,
2. Define/Develop/Select methodology to execute the project work.
3. Decide and apply the manufacturing techniques and instrumentation
4. Develop the procurement skills
5. Assemble and demonstrate the working model
6. Develop skills of technical report/paper/patent writing and presentation

**CO PO Map**

CO/ PO	PO: 1	PO: 2	PO: 3	PO: 4	PO: 5	PO: 6	PO: 7	PO: 8	PO: 9	PO: 10	PO: 11	PO: 12	P S O : 1	P S O : 2	P S O : 3
CO:1	3	3	3	3	2	2	2	1	1	3	3	3	3	3	1
CO:2	3	3	3	3	3	2	2	1	1	3	3	3	3	3	1
CO:3	3	3	3	3	3	2	2	2	1	3	3	3	3	3	2
CO:4	1	1	1	1	1	1	1	3	1	3	2	2	1	1	1
CO:5	2	2	2	2	2	1	1	1	1	3	3	3	3	3	2
CO:6	1	1	1	1	1	1	1	3	2	3	3	3	1	1	1

CO attainment levels	
CO Number	Level
1. Apply theoretical concepts for solving the project problem,	1
2. Define/Develop/Select methodology to execute the project work.	2
3. Decide and apply the manufacturing techniques and instrumentation	2
4. Develop the procurement skills	3
5. Assemble and demonstrate the working model	4
6. Develop skills of technical report/paper/patent writing and presentation	4
<b>Future Courses Mapping:</b> <i>Mention other courses that can be taken after completion of this course</i>  -NA-	
<b>Job Mapping:</b> <i>What are the Job opportunities that one can get after learning this course</i>  For all kinds of Jobs this exposure will count.	



# **B.TECH. MECHANICAL MODULE-VIII**

## Syllabus Template

**ME4273: RESEARCH INTERNSHIP****Credits: 16****Teaching Scheme: .... Hours / Week**

[Semester long (minimum 4 and a half months) Research Assistantship under a Professor/Guide at a reputed research organization / Institute / University]

**A. Literature Review**

Exhaustive literature review based on published literature in the research area

**B. Project work**

Prospective Project Areas:

Design / Development / Retrofitting / Fabrication / Atomization / Optimization / Modeling / Coding / Simulations / Experimental-analysis / Computational-analysis / Mathematical-analysis / Use of analogies / Use of commercially available software / Use of available codes / Use of open source codes and software's / Performance improvements of Mechanism / Machine / Model / Prototype / System based on existing / new ideas, principle / Energy audit / conservation/management / Use of renewable energy sources / Validation or Bench marking of the outcomes, results etc.

**Project Execution Guidelines:**

- understand domain, area and topic of project
- identify the problem precisely, analyze the same and subsequently carry out the synthesis
- apply engineering concepts / knowledge to the real life engineering problem at hand
- ensure conceptual, lateral, and out of box thinking
- acquire hands on experience of manufacturing processes
- learn to work in a group and gain basic management skills
- understand process of selection of manufacturing methods, materials, fits and tolerances, assembling and disassembling of system, equations or correlations, boundary conditions, input parameters, dependent and independent variables, technical data, analysis techniques, data generation techniques etc.
- selection of Standards, Standard processes, Standard Techniques, Standard components, Standard Mechanisms, Standard measuring and regulating instruments etc
- organizing proper results and present relevant discussion from it
- present relevant conclusions and future scope from the work carried out

**C. Internship Report:**

A report containing maximum 60 pages (printed on both sides excluding certificate, permission letter, and title pages) should be submitted based on the industry in-plant training, the background,

motivation and scope of the project, project specifications, activities involved in the project and activity plan, literature review carried out, basic theory, details of methodology adopted and data reduction, results and discussions, conclusions extracted and proposed future work (if any) followed by referencing and appendices (if any).

#### Reference Books / Material:

1. Reference Books, Text Books, Handbooks, PSG Data Book, Various Catalogues, Property Tables, Property Charts etc.
2. Cited Papers from Journals and Conferences
3. Already available literature from open source

#### Course Outcomes:

The student will be able to –

1. correlate the theoretical and practical concepts (4)
2. understand working of organizations and management (3)
3. demonstrate verbal, written and graphical communication skills. (5)
4. undertake technical discussions. (4)
5. define / develop / select methodology for executing the project work (5)
6. apply theoretical concepts for solving the project problem (5)

#### CO PO Map

CO	PO 1	2	3	4	5	6	7	8	9	10	11	12	PS O1	2
1	3	2	3	3	2	3	3	2	3	2	3	2	3	3
2	3	2	3	3	2	3	3	3	2	3	2	3	2	3
3	3	2	3	3	2	3	3	2	3	2	3	2	3	3
4	3	2	3	3	2	3	3	3	2	3	2	3	2	3
5	3	2	3	3	2	3	3	2	3	2	3	2	3	3
6	3	2	3	3	2	3	3	3	2	3	2	3	2	3

#### CO attainment levels

CO Number	Level
1	3

	2	5	
	3	4	
	4	3	
	5	4	
	6	5	

## Syllabus Template

**ME4275: PROJECT INTERNSHIP****Credits: 16****Teaching Scheme: .... Hours / Week**

[Semester long (minimum 4 and a half months) Research Assistantship under a Professor/Guide at a reputed research organization / Institute / University]

**A. Literature Review**

Exhaustive literature review based on published literature in the research area

**B. Project work**

Prospective Project Areas:

Design / Development / Retrofitting / Fabrication / Atomization / Optimization / Modeling / Coding / Simulations / Experimental-analysis / Computational-analysis / Mathematical-analysis / Use of analogies / Use of commercially available software / Use of available codes / Use of open source codes and software's / Performance improvements of Mechanism / Machine / Model / Prototype / System based on existing / new ideas, principle / Energy audit / conservation/management / Use of renewable energy sources / Validation or Bench marking of the outcomes, results etc.

**Project Execution Guidelines:**

- understand domain, area and topic of project
- identify the problem precisely, analyze the same and subsequently carry out the synthesis
- apply engineering concepts / knowledge to the real life engineering problem at hand
- ensure conceptual, lateral, and out of box thinking
- acquire hands on experience of manufacturing processes
- learn to work in a group and gain basic management skills
- understand process of selection of manufacturing methods, materials, fits and tolerances, assembling and disassembling of system, equations or correlations, boundary conditions, input parameters, dependent and independent variables, technical data, analysis techniques, data generation techniques etc.
- selection of Standards, Standard processes, Standard Techniques, Standard components, Standard Mechanisms, Standard measuring and regulating instruments etc
- organizing proper results and present relevant discussion from it
- present relevant conclusions and future scope from the work carried out

**C. Internship Report:**

A report containing maximum 60 pages (printed on both sides excluding certificate, permission letter, and title pages) should be submitted based on the industry in-plant training, the background, motivation and scope of the project, project specifications, activities involved in the project and

activity plan, literature review carried out, basic theory, details of methodology adopted and data reduction, results and discussions, conclusions extracted and proposed future work (if any) followed by referencing and appendices (if any).

#### Reference Books / Material:

1. Reference Books, Text Books, Handbooks, PSG Data Book, Various Catalogues, Property Tables, Property Charts etc.
2. Cited Papers from Journals and Conferences
3. Already available literature from open source

#### Course Outcomes:

The student will be able to –

1. correlate the theoretical and practical concepts (4)
2. understand working of organizations and management (3)
3. demonstrate verbal, written and graphical communication skills. (5)
4. undertake technical discussions. (4)
5. define / develop / select methodology for executing the project work (5)
6. apply theoretical concepts for solving the project problem (5)

#### CO PO Map

CO	PO 1	2	3	4	5	6	7	8	9	10	11	12	PS O1	2
1	3	2	3	3	2	3	3	2	3	2	3	2	3	3
2	3	2	3	3	2	3	3	3	2	3	2	3	2	3
3	3	2	3	3	2	3	3	2	3	2	3	2	3	3
4	3	2	3	3	2	3	3	3	2	3	2	3	2	3
5	3	2	3	3	2	3	3	2	3	2	3	2	3	3
6	3	2	3	3	2	3	3	3	2	3	2	3	2	3

#### CO attainment levels

CO Number	Level
1	3

	2	5	
	3	4	
	4	3	
	5	4	
	6	5	

## Syllabus Template

**ME4276: Industry Internship / (CAPSTONE PROJECT)****Credits: 16****Teaching Scheme: .... Hours / Week****[Semester long (minimum 4 and a half months) internship in a Industry]****A. Industry in-plant training**

Study of products, processes, structure, organization, strategies, technology of the industry

**B. Project work**

Prospective Project Areas:

Design / Development / Retrofitting / Fabrication / Atomization / Optimization / Modeling / Coding / Simulations / Experimental-analysis / Computational-analysis / Mathematical-analysis / Use of analogies / Use of commercially available software / Use of available codes / Use of open source codes and software's / Performance improvements of Mechanism / Machine / Model / Prototype / System based on existing / new ideas, principle / Energy audit / conservation/management / Use of renewable energy sources / Validation or Benchmarking of the outcomes, results etc.

**Project Execution Guidelines:**

- understand domain, area and topic of project
- identify the problem precisely, analyze the same and subsequently carry out the synthesis
- apply engineering concepts / knowledge to the real life engineering problem at hand
- ensure conceptual, lateral, and out of box thinking
- acquire hands on experience of manufacturing processes
- learn to work in a group and gain basic management skills
- understand process of selection of manufacturing methods, materials, fits and tolerances, assembling and disassembling of system, equations or correlations, boundary conditions, input parameters, dependent and independent variables, technical data, analysis techniques, data generation techniques etc.
- selection of Standards, Standard processes, Standard Techniques, Standard components, Standard Mechanisms, Standard measuring and regulating instruments etc
- organizing proper results and present relevant discussion from it
- present relevant conclusions and future scope from the work carried out

**C. Internship Report:**

A report containing maximum 60 pages (printed on both sides excluding certificate, permission



letter, and title pages) should be submitted based on the industry in-plant training, the background, motivation and scope of the project, project specifications, activities involved in the project and activity plan, literature review carried out, basic theory, details of methodology adopted and data reduction, results and discussions, conclusions extracted and proposed future work (if any) followed by referencing and appendices (if any).

#### Reference Books / Material:

1. Reference Books, Text Books, Handbooks, PSG Data Book, Various Catalogues, Property Tables, Property Charts etc.
2. Cited Papers from Journals and Conferences
3. Already available literature from open source

#### Course Outcomes:

The student will be able to –

1. correlate the theoretical and practical concepts (4)
2. understand working of organizations and management (3)
3. demonstrate verbal, written and graphical communication skills. (5)
4. undertake technical discussions. (4)
5. define / develop / select methodology for executing the project work (5)
6. apply theoretical concepts for solving the project problem (5)

#### CO PO Map

CO	PO 1	2	3	4	5	6	7	8	9	10	11	12	PS O1	2
1	3	2	3	3	2	3	3	2	3	2	3	2	3	3
2	3	2	3	3	2	3	3	3	2	3	2	3	2	3
3	3	2	3	3	2	3	3	2	3	2	3	2	3	3
4	3	2	3	3	2	3	3	3	2	3	2	3	2	3
5	3	2	3	3	2	3	3	2	3	2	3	2	3	3
6	3	2	3	3	2	3	3	3	2	3	2	3	2	3

#### CO attainment levels

<b>CO Number</b>	<b>Level</b>
<b>1</b>	<b>3</b>
<b>2</b>	<b>5</b>
<b>3</b>	<b>4</b>
<b>4</b>	<b>3</b>
<b>5</b>	<b>4</b>
<b>6</b>	<b>5</b>

## Syllabus Template

**ME4277: INTERNATIONAL INTERNSHIP****Credits: 16****Teaching Scheme: .... Hours / Week**

[Semester long (minimum 4 and a half months) 'Internship at a Mechanical Industry' OR 'Research Assistantship under a Professor at a reputed research organization / Institute /University']

**A. 'Industry In-plant Training (for Industry Internship)' OR 'Literature Review (for Research Assistantship)'**

Industry In-plant Training –

Study of products, processes, structure, organization, strategies, technology of the industry  
OR

**Literature Review –**

Exhaustive literature review based on published literature in the research area

**B. Project work**

Prospective Project Areas:

Design / Development / Retrofitting / Fabrication / Atomization / Optimization / Modeling / Coding / Simulations / Experimental-analysis / Computational-analysis / Mathematical-analysis / Use of analogies / Use of commercially available software / Use of available codes / Use of open source codes and software's / Performance improvements of Mechanism / Machine / Model / Prototype / System based on existing / new ideas, principle / Energy audit / conservation/management / Use of renewable energy sources / Validation or Benchmarking of the outcomes, results etc.

**Project Execution Guidelines:**

- understand domain, area and topic of project
- identify the problem precisely, analyze the same and subsequently carry out the synthesis
- apply engineering concepts / knowledge to the real life engineering problem at hand
- ensure conceptual, lateral, and out of box thinking
- acquire hands on experience of manufacturing processes
- learn to work in a group and gain basic management skills
- understand process of selection of manufacturing methods, materials, fits and tolerances, assembling and disassembling of system, equations or correlations, boundary conditions, input parameters, dependent and independent variables, technical data, analysis techniques, data generation techniques etc.
- selection of Standards, Standard processes, Standard Techniques, Standard components, Standard Mechanisms, Standard measuring and regulating instruments etc

- organizing proper results and present relevant discussion from it
- present relevant conclusions and future scope from the work carried out

**C. Internship Report:**

A report containing maximum 60 pages (printed on both sides excluding certificate, permission letter, and title pages) should be submitted based on the industry in-plant training, the background, motivation and scope of the project, project specifications, activities involved in the project and activity plan, literature review carried out, basic theory, details of methodology adopted and data reduction, results and discussions, conclusions extracted and proposed future work (if any) followed by referencing and appendices (if any).

**Reference Books / Material:**

1. Reference Books, Text Books, Handbooks, PSG Data Book, Various Catalogues, Property Tables, Property Charts etc.
2. Cited Papers from Journals and Conferences
3. Already available literature from open source

**Course Outcomes:**

The student will be able to –

1. correlate the theoretical and practical concepts (4)
2. understand working of organizations and management (3)
3. Demonstrate verbal, written and graphical communication skills. (5)
4. Undertake technical discussions. (4)
5. define / develop / select methodology for executing the project work (5)
6. apply theoretical concepts for solving the project problem (5)

**CO PO Map**

CO	PO 1	2	3	4	5	6	7	8	9	10	11	12	PS O1	2
1	3	2	3	3	2	3	3	2	3	2	3	2	3	3
2	3	2	3	3	2	3	3	3	2	3	2	3	2	3
3	3	2	3	3	2	3	3	2	3	2	3	2	3	3

<b>4</b>	3	2	3	3	2	3	3	3	2	3	2	3	2	3	2
<b>5</b>	3	2	3	3	2	3	3	2	3	2	3	2	3	3	3
<b>6</b>	3	2	3	3	2	3	3	3	2	3	2	3	2	3	2
<b>CO attainment levels</b>															
<b>CO Number</b>								<b>Level</b>							
<b>1</b>								<b>3</b>							
<b>2</b>								<b>5</b>							
<b>3</b>								<b>4</b>							
<b>4</b>								<b>3</b>							
<b>5</b>								<b>4</b>							
<b>6</b>								<b>5</b>							