Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Technology

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

Structure & Syllabus of

B. Tech. (Industrial Engineering)

Pattern 'B21/C21/D21'

Effective from Academic Year 2021-22

Prepared by: - Board of Studies in Industrial & Production Engineering

Title: Course Structure				**FF No.: 653**
Branch: Industrial Engg	**Year:** S.Y.	**Academic Year:** 2021-22	**Semester:** I & II	**Module:** III & IV
Pattern: B-21				

S. Y. B. Tech. Industrial Engineering AY 2021-22 (B21)

Sr. No.	Subject Code	Subject Name	Teaching Scheme (Hrs/Week)			Examination scheme							Total	Credits
			Theory	Lab	Tut	CA				MSE	ESA			
						HA	Lab	Seminar	GD	MSE	ESE	CVV		
S1	MD2201	Data Science	3	2	1	10	20	15	15	10	10	20	100	5
S2	CS2221	Internet of Things	3	2	1	10	20	15	15	10	30	20	100	5
S3	CS2218	Object Oriented Programming	3	2	1	10	20	15	15	10	30	20	100	5
S4	IT2201	Computer Organization and Architecture	3	2	1	10	20	15	15	10	30	20	100	5
	ME2205	3-D Printing	3	2	1	10	20	15	15	10	30	20	100	
S5	Dept	Engineering Design & Innovation – III	-	-	-	-	-	-	-	-	-	-	100	4
S6	Dept	Software Development Project – I	-	-	-	-	-	-	-	-	-	-	100	3
Total														**27**
S1	PR2240	Manufacturing Technology	3	2	1	10	20	15	15	10	10	20	100	5
S2	PR2241	Kinematics & Thermo Fluid Machines	3	2	1	10	20	15	15	10	10	20	100	5
S3	PR2239	Mechanical Design	3	2	1	10	20	15	15	10	10	20	100	5
S4	CS2218	Object Oriented Programming	3	2	1	10	20	15	15	10	10	20	100	5
S5	PR2238	Product Design & Modeling	3	2	-	10	20	15	15	10	10	20	100	4
S6	PR2286	Engineering Design & Innovation - IV	-	-	-								100	4
Total														**28**

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: 5

Teaching Scheme Theory: 3 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.

SECTION-1

- Introduction to Data Science, Role of data scientist, introduction to R, R studio; introduction to univariate and multivariate systems, understanding databases, Data Processing - Data collection; Data preparation; Data visualization techniques and inferences - scatter plot, scatter matrix, histogram, box plot. (6 Hours)
- Normal distribution, evaluating normal distribution, Binomial distribution, confidence Intervals, central limit Theorem, hypothesis testing, inference for numerical data – t-distribution, paired data, ANOVA (8 Hours)
- Vector norms, distances & projections, discriminants, Principal Component Analysis, Optimization: constrained and unconstrained, Gradient Descent (6 Hours)

SECTION-2

- Supervised Learning – line fitting, residuals, correlation; line fitting by least squares regression; outliers in linear regression; Inference for linear regression; Multiple regression; Model selection; Logistic regression, Nearest Neighbor Classification – Knn; Naïve Bayes Classification – Bayesian methods, Bayes algorithm; Classification using decision trees and learners (9 Hours)
- Unsupervised Clustering - K-means clustering; Evaluation of model performance – Confusion matrices, sensitivity, specificity, kappa statistics, precision, recall, F-measure, ROC curve etc.; Methods of cross-validation, Bootstrapping; Meta-learning through ensemble approach – Bagging, boosting, Random Forests strategies. (7 Hours)
- Classifier performance measurement metrics – Training & Testing strategies – Resubstitution, Hold-out, Cross validation, Bootstrap ; Confusion matrix, Performance measures – Accuracy, Error rate, Sensitivity, Specificity, Precision, Recall, F-Measure, Receiver Ope[rating Characteristics curves (4 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 Practicals: (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 nonhierarchical systems
3. Linear - Non linear regression
4. Parametric-non parametric estimation
5. Overfitting and underfitting 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

Assessment Scheme:

Mid Semester Examination - 10 Marks
Presentation - 15 Marks
Laboratory - 10 Marks
Course Project - 10 Marks
Home Assignment - 10 Marks
Group Discussion - 15 Marks
End Semester Examination - 10 Marks
Comprehensive Viva Voce - 20 Marks

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

1. 'A Beginner's Guide to R' – Zuur, Leno, Meesters; Springer, 2009
2. 'Introduction to Data Science' – Igual, Segui; Springer, 2017
3. 'Mathematics for Machine Learning' – Diesenroth, 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**

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 & data visualization techniques - 3
2. Implement dimensionality reduction & optimization techniques for enhancing data suitability - 5
3. Perform Descriptive and Inferential statistical analysis for building reliable predictions - 4
4. Implement Supervised algorithms for classification and prediction - 4
5. Implement Unsupervised classification algorithms - 3
6. Evaluate the performance metrics of supervised and unsupervised algorithms - 2
7. Demonstrate complete Data Science life cycle with case studies - 4

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-inform**atics**

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

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FF No. : 654

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 networking 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: 5 **Teaching Scheme Theory: 3 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 interrelated 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.

IoT is highly relevant in this growing ecosystem of internet-enabled devices. IoT offers increasing opportunities to collect, exchange, analyse and interpret data in real-time. This robust access to data will result in opportunities to further enhance and improve operations. In a world which is moving towards an increasingly connected future, Internet of Things (IoT) is the next big thing. Right from our homes to our cars to our cities, everything is being connected and the technology of IoT is right in the middle of it.

SECTION-1
Introduction to IoT

Physical Design of IOT, Logical Design of IOT, IOT Enabling Technologies, IOT Levels & Deployment Templates, IoT and M2M (6 Hours)

IOT Platform Design Methodology

IoT Design Methodology Steps, Home Automation Case Study, Smart Cities, Health Care, Agriculture, Manufacturing and Logistics (7 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 (7 Hours)

SECTION-1I

Introduction to Wireless Sensor Network

Sensor Node, Smart Sensor Network, Wireless Sensor Network, RFID - Principles and Components, Node MCU (5 Hours)

Connectivity Technologies

Network Configuration in IoT, IoT Stack and Web Stack, IEEE 802.15.4 Standard, Zigbee, Bluetooth, Overview of IoT Protocols, MQTT, Cloud Architecture and Types, Cloud Service Providers (10 Hours)

Case Studies (Any Three from following List to be coveredJ

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 (5 Hours)

List of Practicals: (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. Middleware 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

Case Study:

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 Industry 4.0

Surveys:

1. Autonomous Vehicles
2. List of Indian companies which offer IoT solutions for agriculture and farming. Describe the problem they are addressing and their solution.
3. Make a list of Indian companies which offer IoT solutions for healthcare. Describe the problem they are addressing and their solution.
4. Make an exhaustive list of everything inside, just outside (immediate surroundings) and on the auto body which must be “observed” for safe and comfortable driving using autonomous vehicles.
5. 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,"

MOOCs Links and additional reading material:

https://proed.stanford.edu/course/view.php?id=191
https://nptel.ac.in/courses/106/105/106105166/
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 Attainment level: 2)
2. Recognize IoT Design Methodology Steps (CO Attainment level: 3)
3. Select sensors for different IoT applications (CO Attainment level: 3)
4. Analyze fundamentals of networking (CO Attainment level: 4)
5. Apply basic Protocols in IoT (CO Attainment level: 4)
6. Provide IoT solutions practically with the help of case study (CO Attainment level: 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.

Assessment Scheme:
Mid Semester Examination - 10 Marks
Presentation - 15 Marks
Laboratory - 10 Marks
Course Project - 10 Marks
Home Assignment - 10 Marks
Group Discussion - 15 Marks
End Semester Examination - 10 Marks
Comprehensive Viva Voce - 20 Marks

FF No.: 654

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

Credits: 5

Teaching Scheme Theory: 3 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.

SECTION-1

Introduction:
What is Object Oriented Programming (OOP)? The need of OOP, Characteristics of OOP.
Java overview: Classes and Objects, Java object storage, Different ways to create objects in Java, Access Modifiers, this reference, main method, Static vs Instance block, Static methods vs Instance methods in Java, Object class, Static class in Java, operators, keywords in java.
Constructors: Constructors in Java, Default constructor, Parameterized constructor, Copy Constructor, Private Constructors and Singleton Classes. Garbage Collection: Garbage Collection, How to make object eligible for garbage collection in Java?
Input and Output: Byte Stream vs Character Stream, Command Line arguments, use of Scanner Class, Scanner vs BufferReader Class, Formatted output, Reading input from console.
Arrays in Java: Arrays in Java, initialization, Default Array values, multi dimensional array, passing array to a function, Jagged arrays, java.util.Arrays class, string class, string buffer, string builder.
Methods in Java: Methods, Parameters passing, Returning Multiple values, Throwable fillInStackTrace() method in Java, Valid variants of main(), Variable Arguments (Varargs) method
Inheritance: Inheritance in Java, Types, Constructor in Inheritance, Using final with Inheritance, Accessing superclass member, Override private methods, 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

SECTION-2

Exception Handling: Exceptions, types, types of handling exception, Checked vs Unchecked Exceptions, Throw and Throws, User-defined Exception, Chained Exceptions.
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 Inner class, Marker interface.
Java Packages: Packages Introduction, default access specifier use, dealing with package.
Collection in Java: Collections Class, Enumeration, Iterators and ListIterator, Using Iterators, Iterator vs Foreach, ArrayList, Vector, Map, Set.
Multithreading: Thread life Cycle, Thread Priority, Thread Methods, Inter-thread Communication, Synchronization, Method and Block Synchronization, Deadlock situation in threading.
File Handling & Database connectivity: File Processing, Primitive Data Processing, Object Data Processing, Wrapper classes, Connecting Java with database (JDBC/ODBC).
Java GUI: AWT, Swing, Components, design patterns. Layout Manager: Flow, Border, Grid and Card. Label, Button, Choice, List, Event Handling (mouse, key), Menus, Tables

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 compairing 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 BufferReader 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

List of Group Discussion Topics:

1. Checked and unchecked exception, user defined and standard exception
2. Abstraction in Java and different ways to achieve Abstraction
3. Packages in Java – Types, Advantages & Techniques to Access Packages
4. Inner classes, nested interfaces in Java
5. Difference between Interfaces and abstract classes in Java
6. Exception Handling in Java Vs CPP
7. Difference between 1) throw and throws. 2) Final, finally and finalize in Java
8. Discuss Exception propagation and Discuss Exception handling with method overriding i
9. Discuss Packages, Access specifiers and Encapsulation in java.

10. Difference between abstraction and encapsulation in Java.
11. Daemon Threads Vs user threads
12. Preemptive scheduling Vs slicing
13. Is it possible to call the run()method directly to start a new thread? pls comment
14. Arraylist Vs Vector
15. Arrays Vs Collections
16. is Iterator a class or an Interface? what is its use?
17. List Vs Set
18. BufferedWriter and BufferedReader classes in java
19. BufferedReader Vs Scanner class in java
20. Buffered Reader Vs FileReader in java
21. Instanceofjava
22. Difference between CPP and JAVA
23. Difference between JDBC and ODBC connectivity
24. file processing in java
25. Difference between premitive data processing and object data processing
26. Creating GUI using swing
27. comparision between Swing, SWT, AWT, SwingX, JGoodies, JavaFX, Apache Pivot
28. Introduction To JFC And GUI Programming In Java
29. Introduction to wrapper classes
30. Why java uses Unicode System?

List of Practicals:

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: getdata and numsum. Function getdata 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:
    1. divide by zero
    2. Array index out of bounds exception
    3. 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:

Topics of Course Project would be discussed in Lab session.

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 usin 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 a 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
Assessment Scheme: Mid Semester Examination - 10 Marks Presentation - 15 Marks Laboratory - 10 Marks Course Project - 10 Marks Home Assignment - 10 Marks Group Discussion - 15 Marks End Semester Examination - 10 Marks Comprehensive Viva Voce - 20 Marks
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", 3rd 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 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

FF No.: 654

IT2201::COMPUTER ORGANIZATION AND ARCHITECTURE

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: 5 **Teaching Scheme Theory: 3 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.

SECTION I
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

SECTION II

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 (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 Archi**tecture.**

List of Course Group Discussion Topics:

1. GPU computing: CUDA
2. Memory System
3. Replacement Algorithms
4. Pipelining

5. Cache Coherance
6. Virtural 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 R1

Assume 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

Assessment Scheme:

Mid Semester Examination - 10 Marks
Presentation - 15 Marks
Laboratory - 10 Marks
Course Project - 10 Marks
Home Assignment - 10 Marks
Group Discussion - 15 Marks

End Semester Examination - 10 Marks
Comprehensive Viva Voce - 20 Marks

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
2. https://www.udemy.com/
3. https://learn.saylor.org/
4. https://www.coursera.org/
5. https://swayam.gov.in/

Course Outcomes:

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)

Future Courses Mapping:

Advance Computer Architecture, Advance Operating Systems

Job Mapping*:*

Application Developers, System programmer

FF No.: 654

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: 5 **Teaching Scheme Theory: 3 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
Unit-I Design Thinking (6 Hours) · 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 I and · Limits, fits and tolerancing I I · Concept of Geometric dimensioning and tolerancing.
Unit-II 3D Printing Materials (6 Hours) • 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.

Unit-III Introduction to Manufacturing and 3D Printing (8 Hours)

- Machining Processes
- Casting and Forming Process
- NC and CNC Machining and Automation
- Non-Conventional Manufacturing Processes
- Introduction Overview, Basic principle need and advantages of additive manufacturing,
- Procedure of product development in additive manufacturing,
- Classification of additive manufacturing processes,
- Challenges in Additive Manufacturing.

SECTION-II

UNIT IV Pre-Processing in 3D Printing (3D Modeling and Design) (7 Hours)

- 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

Unit V Advance Thermal Manufacturing Processes (6 Hours)

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

Unit VI: Additive Manufacturing Processes (7 Hours)

- Stereolithography apparatus (SLA), Fused deposition modeling (FDM), Laminated Object Manufacturing (LOM),
- Selective deposition lamination (SDL), Selective laser sintering (SLS), Direct Metal deposition (DMD),
- Hybrid manufacturing, In situ process monitoring and control, Large scale additive manufacturing.
- 3D Printing of Metals
- Post processing requirements & Techniques
- Applications of Additive Manufacturing Applications in Aerospace, Automotive, Tooling, Defense, Jewelry, Repair and Biomedical industries
- Micro- nano- and bio-additive manufacturing

Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies

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 3D printing

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

Assessment Scheme:

Mid Semester Examination - 10 Marks
Presentation - 15 Marks
Laboratory - 10 Marks
Course Project - 10 Marks
Home Assignment - 10 Marks
Group Discussion - 15 Marks
End Semester Examination - 10 Marks
Comprehensive Viva Voce - 20 Marks

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., Schöffer 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); 6. 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***

IE2236::MANUFACTURING TECHNOLOGY

Course Prerequisites: Basic maths, trigonometry, material science, chemistry, physics

Course Objectives:

1.Acquire knowledge of various methods by which different industrial, household, agricultural products are made
2.Understand equipment ,tooling and other requirements of producing parts
3.To be able to decide material, processes and parameters for economical production of parts.

Credits: 5. **Teaching Scheme Theory: 3** Hours/Week

Tut: 1 Hours/Week

Lab: **2** Hours/Week

Course Relevance: 1.The course explains wide variety of processes that are used for making different parts that are used in industry and other places
2.It deals in details with technology aspects of production of various products
3.For Engineers to be able to work in any industry or to become entrepreneur this knowledge is essential

SECTION-1
Casting processes:-Classification, applications and advantages and limitations of casting process, **Patterns and Molds,** Patterns: Pattern materials, allowances, types of pattern, pattern design, Pattern color codes. Types of molding sand, properties of molding sands sand mold, molding sand materials, composition of molding sand Green and dry sand molding process. hand molding,and machine molding, ramming methods, CO_2 molding process, **Core & Core making**: Core sands, core sand composition, Functions of cores, types of cores and core boxes. Core making procedure, core prints, chaplets, Shell molding and core making, forces on cores and molds.melting furnaces. **Welding Process:-Gas arc and resistance welding, equipment, HAZ, soldering and brazing, Special welding techniques**: Ultrasonic welding, Explosive Welding, Friction welding, Thermit welding, Laser welding, Electron beam welding. Inspection and Testing of Welds, Weld Defects: Common Weld defects, Causes and remedies of defects **3**.Machining and finishing Processes: Construction, working and application of lathe, drilling, milling, planing and grinding, honing and lapping machines, various operations performed on these machines, cutting speed ,feed ,depth of cut ,tooling, attachments, coolants, high speed machining. **Metrology**-Standards-line and end, Measurement of linear and angular dimensions using linear and angular measuring instruments- vernier calliper, micrometer, sine bar etc, form and surface roughness measurement, using various measuring instruments and CMM.,IS for measurement.
SECTION-1I

4. Gear and Thread Cutting:
Thread cutting - internal and external chasers, dies, thread rolling thread milling, lapping and grinding. Gear cutting - Forming & generation, gear cutting on milling, gear hobbing, gear shaping, gear shaving, lapping & grinding, various machines use for gear manufacturing. Thread cutting & processes. Measurement of thread and gear parameters.
5. Broaching Operations and Non-conventional machining processes: Definitions, types of broaching, machines cutters for broaching, materials for broach, cutting action, chip disposal, broaching speeds, application of broaching, Advantages and limitations of broaching operations
6.Basic and secondary metal and plastic forming processes:-
Fundamentals of hot and cold working, rolling, forging, extrusion, drawing processes, sheet metal processes-blanking, piercing, bending etc ,simple ,compound and progressive dies, presses, applications, materials, dies, defects, advantages and limitations.
Plastics-compression, transfer and injection moulding, thermoforming, blow moulding, applications, machines, dies.

List of Tutorials: (Any Three)
1. Linear measurements by precision measuring instruments
2. Angular measurements by sine bar
3. Calculations for gear ratios for thread cutting and setting angle for taper turning
4. Gear cutting on milling calculations
5- Solidification of metal in casting.
6 -Dies in extrusion and drawing
7-Calculations of rolling force,angle of bite.
8-Calculation of forces,dimensions of tools in sheet metal operations
9. Measurement of roundness using Johanson's comparator
10. Surface finish measurement
11 Use of interferometer for study of various surfaces.
12. Process sheet of machining component.

List of Practicals: (Any Six)
1. Preparation of green sand with additives.
2. To determine compatibility of Green sand Mould.
3. Permeability testing of green sand.
4. Grain size distribution and estimation of AFS no of system sand and silica sand.
5. To measure green compressive strength of sand.
6. To measure green shear strength of sand.
7. Mold hardness test of Green sand Mould.
8. Core hardness test of Shell sand or Oil sand core.
9. Moisture test of green sand mould.
10.- One composite job on lathe involving the various operations..
.11. Profile Projector for measurement of screw thread parameters and saw tooth parameter
12. Measurement of gear tooth parameters
13 Measurement of screw thread parameters using floating carriage micrometer

14.Measurement of dimensions and form on CMM.

List of Projects:

1. Design of cope, drag pattern and core box, gating ratio and casting yield for Cover casing casting.
2Case study of Aluminum casting manufactured by high pressure dies casting process. (Die design, Metal composition, Process parameters, gating system & Rejection analysis
3Design and manufacture of permanent mould..
4. Manufacturing of Cu-Zn-Al casting plate by permanent mould process
5 Manufacturing of Cu-Al-Mn casting plate by permanent mould process
6 Mechanical and metallurgical Characterization of welded samples.
7 Optimization of soldering gap for soldering metal sheets
8 Optimization of brazing of steel sheets.
9Welding of dissimilar metals
10.Optimisation of weld parameters using laser welding.
11.Design of gear box for lathe machine
12..Design of quick return mechanism for shaping machine
13.Alignment test on various machine tools.
14.Measurement of forces on lathe,milling machines.
15.Simulation Model for solex pneumatic comparator
16.Simulation Model for electrical comparator (visual gauging head)
17.Programming for CMM.
18.Measurement strategy for complex casting on CMM.
19.Process sheet design for complex round part
20.Process sheet design for milling of component.
21.simulation and modelling for rolling process
22.Simulation and model for extrusion process

List of Course Group Discussion Topics:

1.Cutting speed feed depth of cut and economics of machining
2.Machining of Aluminium
3.Selection of appropriate grade of carbide tool for machining
4.Machining of square pocket
5.Extrusion Vs Drawing process
6.Elimination of defects in rolling process
7.Die design for various materials in drawing process
8.Measurement strategy for complex part on CMM
9.Measurement of roundness.
10.Selection of appropriate welding process for various types of jobs
11.NTM processes for die manufacturing
12.comparison of NTM finishing processes

List of Course Seminar Topics:

1 Cutting tool materials and coatings
2 Grinding wheel marking system
3 Super finishing processes
4 5-S Principles
5 Cutting tool signature
6 Total Productive maintenance
7 Speed-feed mechanisms in machine-tools
8 Computer integrated manufacturing
9 Surface treatment processes after machining
10 Machine-tool erection & alignment tests
11 Jigs & fixtures
12 Industry 4.0
13 Non conventional machining processes
14 Flexible manufacturing system
15. Automation in Foundry
16. support of IT to Foundry
17. Expert system for casting defects
18. Pollution and safety in foundry
19. Japanese Investment Casting Technology
20. Rail welding technology
21 Robot welding technology
22. Friction steer welding
23. Laser Welding
24. Ultrasonic Welding

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13 Non conventional machining processes
14 Flexible manufacturing system
15. Automation in Foundry
16. support of IT to Foundry
17. Expert system for casting defects
18. Polution and safety in foundry
19. Japanese Investment Casting Technology
20. Rail welding technology
21 Robot welding technology
22. Friction steer welding
23. Laser Welding
24. Ultrasonic Welding

List of Home Assignments:

Design:

1.Design optimum shape of riser for casting a component.
2.Design an experimental method for measuring only the force required for forging the flash
3.Design of dies for products having constant curvature
4.Design of titanium ball joint for hip replacement
5.Machining parameters for titanium machining

Case Study:

1.Manufacture of *Baseplate for a Household Steam Iron*
2.Forging of turbine blades.
3. *Fabrication of a One-Piece Brass Flashlight Case*
4. *Fabrication of Lavatory Wash Basins*
5.Machining of cast steel body valve
6. *Estimating the Machining Time for Turning*

Blog

1.Automated casting line
2. Consider the various means of producing tubular products, such as extrusion, seam welding, butt welding during forming, piercing, and the various drawing operations. Describe the advantages,limitations, and typical applications of each
3.High speed machining
4.Manufacturing in competitive environment
5.Design for manufacturing
6.Green manufacturing.
7.Modular fixturing

Surveys

1.Survey of different die and mould materials used in various casting processes
2. Survey of different rolling mill stands
3.Manufacturing steps involved in making long metallic hypodermic needles.
4.Process capabilities of various machining processes
5.Applications of various NTM processes.

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. P. N. Rao; Manufacturing Technology I,II: Foundry, Forming & Welding; Tata McGraw Hill.
2. P.L. Jain; Principles of Metal casting; Tata McGraw Hill
3. O.P. Khanna; Foundry Technology; Khanna Publisher
4. O.P. Khanna; Welding Technology; Khanna Publisher
5. Chapman, Workshop Technology vol1,2,3 ELBS
6 Hazra Choudhary, Manufacturing Processes: Vol. 1 and 2,New Delhi 2010

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

1. R.L. Timings, Manufacturing Technology, Vol I&II, 3/e, Pearson Education
2. W.A.J Chapman, Workshop Technology: Volume I, II, III: ELBS.
3. Hazra Choudhary S. K. Bose S. K., Elements of Workshop Technology: Volume I, II.Asia Publishing House:
4. Begeman, Manufacturing Processes.
5. Production Technology, HMT: TMH Publishing Co., New Delhi, 1985..
6 T. V. Ramana Rao; Metal Casting: Principles & Practice; New Age International Pvt. Ltd.
7 P. C. Mukharjee; Fundamentals of Metal Casting; Oxford & IBH Publishing Co.
8. Heine, Loper, Rosenthal; Principles of Metal Casting; Tata McGraw Hill.
9. Richard Little; Welding & Welding Technology, Tata McGraw Hill.
10. Dr. R.S. Parmar; Welding Processes and Technology; Khanna Publisher.

Moocs Links and additional reading material: www.nptelvideos.in
https://www.edx.org/course/fundamentals-of-manufacturing-processes

Course Outcomes:

1) Select and design and perform different pattern and mould making to manufacture castings.
2) Apply fundamentals of gas welding, soldering and brazing techniques for joining of appropriate material and job
3) Understand basic construction and working of various Machine tools used for metal removal processes
4) Illustrate conventional and unconventional machining processes performed on various machines
5)Understand various methods of producing gears and threads
6)Select appropriate process from hot and cold metal deformation processes.

CO PO Map

CO attainment levels-CO1-5,CO2-3,CO3-2,CO4-3,CO5-4,CO6-5

Future Courses Mapping:

1.Software applications in manufacturing.
2.Additive manufacturing
3Process engineering
4.Die and mould design

Job Mapping:

Student may get job in any type of manufacturing industry.

FF No. : 654

IE2237::KINEMATICS & THERMO-FLUID MACHINES

Course Prerequisites: Physics, Chemistry, Basic mathematics

Course Objectives:

1. To develop the ability to analyze and understand the dynamic (position, velocity, acceleration, force and torque) characteristics of mechanisms such as linkages and cams.
2. To familiarise with the basics of Spur gear and gear trains.
3. To familiarize application of the concepts of thermodynamics in gas power cycles and the latest technological developments in engine technology.
4. Explain Refrigeration and Air-Conditioning Processes and their application.
5. To understand Boilers and steam generation processes and their application in different process industries.
6. To study Fluid statics and Fluid machinery and fluid flow measurement techniques..

Credits:5 **Teaching Scheme Theory: 3** Hours/Week

Tut: 1 Hours/Week

Lab: **2** Hours/Week

Course Relevance:

- The course provides students with instruction in the fundamentals of theory of machines. The Theory of Machines and Mechanisms provides the foundation for the study of displacements, velocities, accelerations, and static and dynamic forces required for the proper design of mechanical linkages, cams, and geared systems.
- Thermal engineering is controlling heating or cooling processes in an enclosed or open environment using various equipment. It involves the science of thermodynamics, Fluid mechanics, heat and mass transfer.

SECTION-1
1. Simple Mechanism: Kinematic link, types of link, machine, structure, types of constrained motion, kinematic pair, classification of kinematic pairs, degrees of freedom, kinematic chain, mechanism, inversion, four bar chain and its inversion, single slider crank chain and its inversion and double slider crank chain and its inversions. Ackerman steering mechanism, Hooke's joint **2. Kinematic Analysis of Mechanisms:** Introduction, Motion of a link, velocity of a point on a link by relative velocity method, velocity in a slider crank mechanism, introduction, acceleration diagram for a link, acceleration of a point on a link by relative acceleration method, Klein's construction **3. Cams and Followers:** Introduction, applications, types of cams and followers, terms used in radial cams, analysis of motion of follower, displacement, velocity, and acceleration diagrams

for various types of follower motions: uniform velocity, SHM, uniform acceleration and retardation, cycloidal motion, construction of cam profile for roller, knife edge, flat faced followers and oscillating follower.

4. Spur Gear: Advantages and disadvantages of gear drive, classification of toothed wheel, terms used in gears, involute and cycloidal profile, condition for constant velocity ratio-law of gearing, length of path of contact, length of arc of contact, interference in involute gears.

5. Gear Trains: Types of gear trains- simple gear trains, compound gear trains, reverted gear trains, epicyclic gear train

SECTION-1I

1. I.C. Engines: Classification of I.C. Engines, construction and working of two stroke, four stroke, S.I. and C.I. Engines, terms used in air cycles, thermodynamic air cycles- Otto, Diesel combustion cycles, cooling and lubrication systems of I.C.engines.,Supercharging and turbocharging methods, applications of I.C. Engines, hybrid vehicles.Introduction to electric vehicles.

2. Steam Generators: Introduction, formation of a steam at a constant pressure, temperature versus total heat graph during steam formation, steam properties, boiler performance, boiler efficiency, equivalent of evaporation.

3.Properties of Fluid: Definition of fluid, Newton's law of viscosity, classification of fluid: Newtonian & Non-Newtonian fluids, ideal & real fluids, fluid properties: viscosity, compressibility, cohesion, adhesion, surface tension, capillarity, vapour pressure, types of flow, Pascal's law, continuity equation, Bernoulli's equation, applications of Bernoulli's equation, orifice meter, venturimeter, pitot tube

4. Fluid Machinery: Construction, working and applications of centrifugal pumps and reciprocating pumps. Construction, working and applications of hydraulic turbines – Impulse-Pelton turbine, Reaction turbines- Francis and Kaplan turbine, draft tubes, governing of turbines.

5. Refrigeration and Air conditioning: Air refrigeration working on Bell Coleman cycle, Simple vapour compression cycle, vapour absorption cycle, types and properties of refrigerants, p-h and T-s diagram, Air conditioning: window, split, central, and industrial air conditioning systems

List of Tutorials: (Any Three)

1. Graphical solution of problems on velocity in mechanisms by relative velocity method.
2. Graphical solution of problems on acceleration in mechanisms by relative acceleration method.
3. Graphical solution of problems on velocity and acceleration in mechanisms by Kleins construction method.
4. Motion analysis and plotting of displacement–time, velocity-time and acceleration-time, of cam profiles.

5. Develop and build mechanisms to provide specific motion.
6. Calculate boiler efficiency and assess boiler performance.
7. To study controls and applications of refrigeration and air conditioning.
8. Analytical method to find velocity and acceleration in a single slider mechanism.
9. Determination of boiler efficiency, equivalent evaporation and assess boiler performance.
10. Determination of engine efficiency,work done, mean effective pressure and pressure and temperature at salient points in the otto cycle.
11. Determination of engine efficiency,work done, mean effective pressure and pressure and temperature at salient points in the diesel cycle.

List of Practicals: (Any Six)

1. Determination of moment of inertia of rigid body by bifilar suspension method.
2. Determination of moment of inertia of rigid body by trifilar suspension method.
3. To draw a cam profile for specific follower motion.
4. Determination of radius of gyration of a connecting rod using theory of compound pendulum.
5. Verification of cam jump phenomenon.
6. To perform an experiment on Watt Governors and to find speed, height of a Watt governor and obtaining the graph of governor speed V s height of governor.
7. Verification of Bernoulli's equation.
8. Trial on multi cylinder four stroke petrol engine.
9. Trial on single cylinder four stroke diesel engine.
10. Trial on reciprocating air compressor.
11. Study and demonstration on Pelton wheel.
12. Study and demonstration on Francis turbine.
13. Study and demonstration of engine systems

List of Projects:

1. Automatic bar feeding mechanism
2. Gear indicator for two wheelers
3. Peddling washing machine
4. Material handling system
5. Peddling pump
6. Sheet metal bend removing machine
7. Power generation using Speed breaker
8. Automated material transferring system
9. Foot step pressure electrical power generator
10. Automatic rain activated wiper
11. Cam operated expanding mandrel
12. Hydraulic forklift
13. Pedaling dress washing machine

14.Pedal controlled mobile charger cum emergency light
15. Automatic fuel tank filling system
16. Automatic speed breaking systems
17. Digital vehicle fuel level indicator
18. Automatic rain operated wiper
19. Pneumatic pick & placement robot
20. Automatic packaging and stamping systems
21. Automatic gear display
22. Automatic brake failure indicator
23. Automatic soap rapping machine.
24. Automatic bottle filling system
25. Mechanical four wheels steering
26. Speed control governor
27. Conveyor using geneva mechanism.
28. Cam operated punching machine.
29. Pentograph
30. Cam operated hammer

List of Course Seminar Topics:
1.Four wheel independent suspension
2.Advanced materials in automobile
3.Speed controlled governors
4.Automatic gear changer
5.Four wheel drive
6.Crisis in the automobile industry
7.Magnetic gears
8.Ackerman steering mechanism
9.Regenerative brakes
10. Hybrid vehicles

List of Course Group Discussion Topics:
1.Electric vehicles in India
2.Automation in automobile
3.Ecofriendly refrigerant
4.Best alternatives to petrol and diesel
5.Micro hydraulics
6.Breakthrough in I C engine efficiency
7.Smart pneumatics
8.I C engine combustion and environment
9.High speed precise gear boxes
10.Use of renewable energy in Industrial sector

List of Home Assignments:

Design:

1.Desing of solar air dryer
2.Desing of solar air conditioner
3.Desing of Cam followers Mechanism to suit the given input data.
4.Design of four wheel drive
5.Desing of A/C by peltier effect
6.LPG kit design for two wheelers
7. Turbocharge for two wheelers
8.Design of LPG Refrigeration system with zero operating cost

Case Study:

1.Thermal power plant exhaust gases and environment
2.Gear technology in automobile sector
3.Advances in steering Mechanism
4.Recent development in pump technology
5.Crises in automobile industry

Blog

1.Electronic fuel injectors
2.Hybrid vehicles
3.Dynamic speed governors
4.Intillegent reverse braking system
5.Vapour absorption cooling system

Surveys

1.Speed controlled governors -today's need
2.Automatic versus manual transmission
3.Need of electric vehicles
4.Compressed air production from speed breakers
5.Air driven engines

Suggest an assessment Scheme:

Mid semester exam-15 marks
End semester exam-15 marks
Lab assignments - 10 marks
Tutorial - 5 marks
Home assignment - 5 marks
Course project - 10 marks
Seminar/Group discussion - 10 marks
Orals - 10 marks

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

1.S. S. Ratan Theory of Machines 11th Tata McGraw Hill 2008
2. R. S. Khurmi, K. Gupta Theory of Machines 14th S Chand Co. Delhi 2005
3. Ballaney P. L., Khanna Theory of Machines and 3rd Khanna Publisher 1999
Sadhu Singh Theory of Machines and Mechanism 5th Pearson Education 2009
5. Ghosh Amitabh and Malik Ashok Theory of Machines and Mechanisms
5th Affiliated East-West Press 1998
6. V.P. Singh Theory of Machines 8th Dhanpat Rai Publishing 2004
7.Bansal R.K Fluid Mechanics and Hydraulic Machines 9th Laxmi Publication (P) Ltd. 2005
8.S.C. Gupta Fluid Mechanics and Hydraulic Machines 5th Pearson Education India, 2006
9.Jain A.K Fluid Mechanics and Hydraulic Machines 6th Tata Mcgraw Hill 1998
10.R K Rajput Thermal Engineering 8th Laxmi Publication (P) Ltd. 2010
11.P.K.Nag Engineering Thermodynamics 5th Tata McGraw-Hill Education 2005

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

1.Shigley Joseph Edward and Vicker John Joseph Theory of Machines and Mechanisms 5th Oxford University Press 2016
2. Thomas Bevan Theory of Machines 1st Pearson Education Ltd. 2016
3. Abdullah Shariff Howard L. Harrison Theory of Machines 3rd Dhanpat Rai Publishing 1981
4. V.K.Bansal Theory of Machines 3rd Laxmi Publications Pvt Limited 2006
5.Modi P. N. and Seth S. M Hydraulics and Fluid Mechanics
14th Standard Book House, New Delhi 2002
6.Khurmi R. S. and Gupta J. K Thermal Engineering 15th S. Chand & Company Ltd, 2015
7.Kumar Vasant Adani Thermal Engineering 4th Metropolitan Book Co., Delhi. 2006
8.P.L. Ballaney Thermal Engineering 20th Khanna Publisher 2009

Moocs Links and additional reading material: www.nptelvideos.in

Course Outcomes

1. Classify different types of links and mechanisms and draw velocity and acceleration diagrams of various mechanisms.
2. Construct cam profile for the specific follower motion.
3. Understand the mechanism of spur gear, types of gears and gear trains.
4. Understand basic concepts of fluids, thermodynamics, refrigeration and air conditioning principles and classification of flows
5. Analyze performance of boilers.
6. Distinguish various types of hydraulic turbines and pumps

CO PO Map

CO attainment levels:
CO 1- 5
CO 2 - 5
CO 3 - 4
CO 4 - 4
CO 5 - 5
CO 6 - 5

Future Courses Mapping:
Dynamics of machines
Robotics
Renewable Energy
Mechatronics
Computational Fluid dynamics
Advances in heating and refrigeration
Autonomous and electric vehicles
3D/4D Printing
Advanced gas turbine technology
Nanotechnology
Steam power engineering

Job Mapping:
Manufacturing Industry
Power Industry
Research and development Industry
Automobile Industry
Defence Industry
Marine Industry
Consumer goods Industry
Metal and mining Industry

F No. : 654

IE2201::MECHANICAL DESIGN

Course Prerequisites: Basic Idea of Mechanical, Material related information

Course Objectives:

1. Understanding of Simple Stresses and Strains concept
2. Understanding of Beams and axially loaded columns
3. Understanding of torsional and shear stresses
4. Understanding of Shafts, Keys and Couplings
5. Understanding of Fluctuating Loads and Flywheel

Credits: 05 **Teaching Scheme Theory:** 03 **Hours/Week**

Tut: 01 **Hours/Week**

Lab: 02 **Hours/Week**

Course Relevance: Basic concept of strength of materials and design of material elements

SECTION-1
1. Simple Stresses and Strains: Types of stresses and strains, Hooke's law, Poisson ratio, modulus of elasticity, modulus of rigidity, stress-strain diagrams for ductile and brittle materials, factor of safety, working stress, bulk modulus, interrelation between elastic constants. Introduction to principal stresses, principal planes and methods for determination of its position ***2.*** **Stresses in Beams & Axially Loaded Columns:** Theory of simple bending, assumptions, flexural formula, second moment of area of common cross sections with respect to centroidal and parallel axes. Bending stress distribution diagrams, moment of resistance and section modulus calculations. Shear Force and Bending Moment Diagrams: SF and BM in determinate beams due to concentrated loads, uniformly distributed loads, uniformly varying loads and couples. SF and BM diagrams for cantilevers, simple and compound, cantilever beams Buckling of columns, Uses and limitations of Euler's and Rankine's formulae for buckling of columns under various end conditions, equivalent length for various end conditions. ***3.*** **Concepts of torsional and shear stresses:** Theory of pure torsion, torsional moment of resistance, polar modulus, torsional rigidity, cases of stepped and composite shafts with circular and non circular sections, polar moment of inertia, shear and torsional resilience, Shear Stresses, shear stress distribution diagrams for common symmetrical sections, maximum and average shear stress, shear connection between flange and web
SECTION-1I
1. Design of Shafts, Keys and Couplings: Design of solid and hollow shafts based on strength, rigidity, ASME code for shaft design. Keys, Types of keys, Design of keys and key ways Couplings, Types of Couplings, Design of muff coupling, Design of rigid and flexible couplings. **2 Design for Fluctuating Loads and Flywheel:** Design for Fluctuating Loads- Fluctuating stresses, Fatigue failure, fatigue strength and endurance limit, Introduction to S-N diagram,Low cycle and High cycle fatigue, Stress concentration factor and Notch sensitivity. Factors affecting fatigue strength. Goodman and Soderberg diagram, Modified Goodman's diagrams for fatigue design. Cumulative fatigue damage

3. Rolling Contact Bearings: Types, Static and Dynamic load Capacity, Stribeck's Equation, Concept of equivalent load, Load life Relationship, Selection of bearing from Manufacturer's Catalogue, Design forbearing for variable loads and Speeds, Bearings with Probability of Survival other than 90%. Lubrication and Mounting of bearings, oil Seals and packing used for bearings.

4. Design of Threaded, Welded Joints and Power Screw: Design of Power Screw - Types, materials used, thread forms and their applications; types of stresses induced, overhauling and self-locking properties, design of nuts. Design of bolted joints subjected to transverse and eccentric loads. Design of welded joints for various loading conditions

5. Design of Springs: Types, Application and materials of springs, Stress and deflection equation for Helical springs, Styles of ends, Design of helical springs, Helical Springs in Parallel and Series, Design of Helical Springs for Variable Load

List of Tutorials: (Any Three)

1) Calculations of simple stresses & strains
2) Shear Force & Bending Moment Calculations
3). Principal planes and Principal stresses
4). Buckling of columns and struts
5) calculations of shaft design
6) calculations of coupling
7) calculations of power screw jack
8) calculations of bearings
9) calculations of Welded Joints
10) Calculations on springs

List of Practicals: (Any Six)

1. To study the Brinell Hardness testing machine and the Brinell hardness test
2. To study the Rockwell Hardness testing machine and perform the Rockwell hardness test
3. To study the Impact Testing machine and Perform Izod impact test
4. To study the Impact Testing machine and Perform charpy impact test
5. To study the UTM and perform the tensile, compression test
6. To Perform compression test on UTM
7. Buckling of columns and struts
8. Design of shaft.
9. Design and sheet drawing of coupling
10. Design of spur gear

List of Projects:

1. Models for different types of loadings of columns
2. Representation models of SFD and BMD for concentrated loaded beams
3. Representation models of SFD and BMD cantilever beam
4. Representation models of SFD and BMD for UDL beam
5. Representation models of SFD and BMD for UVL beam
6. Design and drawing of shaft subjected under static and dynamic loads.
7. Design and drawing of rigid flange coupling for any industrial application
8. Design and drawing of flexible flange coupling for any industrial application.
9. Design and drawing of levers used in industry
10. Design and drawing of helical spring for any industrial application

List of Course Seminar Topics:

1. Torsion of Shafts Cylinders
2. Torsion of Thin Cylinders
3. Deflection of Beams
4. McCauley's method for simply supported beams
5. Graphical solution using Mohr's circle of stresses
6. Rolling Contact Bearings
7. Design of Threaded jobs,
8. Design of Welded Joints
9. Design of Power Screw
10. Two stage Gear box.

List of Course Group Discussion Topics:

1.Torsional models of shafts
2. Moment of Inertia models
3. Models of Principal planes and stresses
4. Design Two stage Gear box used for any industrial applications
5. Design Three stage Gear box used for any industrial applications
6. Design of break in any automobile
7. Design of spring used in two wheeler
8. Design of spur gear used for any industrial applications
9. Design of screw jack assembly used in daily life.
10. Design of threaded joint used in real life application

List of Home Assignments:

Design:
1.Design of welded joint
2. Design of power screw
3. Design and sheet drawing of screw jack assembly
4. Design of spring
5. Design of helical gear

Case Study:
1.Testing on mild steel rod
2. Shear Force & Bending Moment Calculations
3. Principal planes and Principal stresses
4. Design under variable load
5. Design of flywheel

Blog
1. Design of bearings
2. Stress and strains analysis
3. Bending moment analysis
4. Design of any product
5. Design of threaded joint

Surveys
1. Stress analysis based practical analysis
2. Bending moment based practical analysis
3. Material Testing based
4. Design of plastic products
5. Design Of other type of material

Suggest an assessment Scheme:
Mid semester - theory - 15
End semester theory - 15
Lab assignments - 10 marks
Tutorial - 5 marks
Home assignment - 5 marks
Course project - 10 marks
Seminar/Group discussion - 20 marks
Orals - 20 marks

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

1. Beer and Johnston – Mechanics of Materials – Tata McGraw Hill Publication
2. Timoshenko and Young – Strength of Materials, CBS Publisher
3. A Text book of machine design – R. S. Khurmi & J. K. Gupta, S Chand
4. V. B. Bhandari, Design of Machine Elements, Tata McGraw Hill Publications,
5. R. K. Jain, Machine Design, Khanna Publication,

6. Pandya and Shah Machine Design, Charotar Publication,
7. Hall, Holowenko Laughlin Machine Design, Tata McGraw Hill Publication,
8. J.F. Shigley Design of Machine Element, McGraw Hill Publication
9. M. F. Spotts Design of Machine Element, Pearson Education Publication,
10. PSG Design data Book

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

1. U.C. Jindal, Design of Machine Elements, Pearson Education
2. E.P. Popov – Introduction to Mechanics of Solids, Prentice Hall Publication.
3. Singer and Pytel – Strength of materials, Harper and Row Publication.
4. P. Kannaiah, Design of Machine Elements Scitech Publication,
5. H. Burr and Cheatam, Mechanical Analysis and Design, Prentice Hall Publication,
6. P. Kannaiah, Design of Transmission Systems, Scitech Publication,
7 R. L. Norton Machine Design An Integrated Pearson Education
8 S. S. Wadhwa and S. S. Jolly Machine Design A Basic ApproachDhanapat Rai and Sons

Moocs Links and additional reading material: www.nptelvideos.in

Course Outcomes:

1. Calculate normal stress, shear stress, and deformation and applications of the analysis and design of members subjected to an axial load or direct shear
2. Analyze and design circular determinate shafts subjected to torsional loading for its shear stress distribution and angle of twist.
3. Establish the shear force and bending moment diagrams for a beam
4. Select different types of rolling contact bearings from manufacturer's catalogue for various industrial applications.
5. Analyze the stress and strain in power Screw and design the same for various industrial applications.
6. Analyze the stress and strain in threaded and welded joints and design the same for various

CO PO Map

CO attainment levels

CO 1 - 3
CO 2 - 3
CO 3 - 4
CO 4 - 4
CO 5 - 4

Future Courses Mapping: *CAD/CAM*
Job Mapping: *Design and analysis field, Manufacturing sector industries*

FF No. : 654

IE2240::PRODUCT DESIGN & MODELING

Course Prerequisites: Basics of Engineering Drawing, Need of Visualization, Orthographic and Isometric Views, Concepts of Missing views, etc.

Course Objectives:

1. To understand the Process of product design and development, with emphasis on creativity and the systematic planning of subsequent manufacturing processes.
2. To study and apply the innovative problem solving techniques like TRIZ, lean and value engineering for better solutions to the Engg. problems.
3. Understanding the concepts of limits, fits and tolerances with GD & T dimensions and standards with their applications to actual machine parts.
4. Learn the 2D CAD software for sketching and dimensioning along with all its features.
5. Learn the 3D modeling software for part, assembly, surface and sheet metal modeling along with mechanism simulation.

Credits:..4 **Teaching Scheme Theory: 3** Hours/Week

Tut: -- Hours/Week

Lab: **02** Hours/Week

Course Relevance: The course will provide students with the most important skills needed to conceptualize and design new products, make and interpret drawings of design and production as well as develop skills on CAD softwares, which are very important from the career point of view.

SECTION-1
Introduction to product design and development process - Key concepts, processes and methods, including product classification / specifications, Generic product development process, Product life cycle. Product mix. Proof of concept, Value Engineering / Value Analysis. Ergonomics / Aesthetics, Intro. To TRIZ- axiomatic design, Concurrent Engg., Rapid prototyping, **Conceptual Design -** Innovative / Creative thinking. Concept generation, selection & embodiment of concept, Design morphology. Engineering drawings, Design for prototyping, and manufacturing. Product architecture. Designing to codes and standards, DFX. Product costing. Legal, ethical and social issues in design. **Sketching and Engg. Drawing techniques, standards and Conventions :** Freehand drawing, perspective, sketching and editing. Dimensioning technique for machine components, Conventional representation of machine components as per IS code: SP-46 such as screw threads, springs, gears, bearing, tapped holes, knurling, splined shafts, tapers, chamfers, countersunk and counter bores, keys, & welded joints, **Standard Machine components and Fasteners -** Rivets - forms & proportions of rivet heads, types of riveted joints. Thread terminology, thread forms, designations, single and multi-start threads, right and left hand threads, types of screws , bolts and nuts, nut locking arrangements using pins, washers & screws. Std. components - Bearings, Seals, retaining rings, etc
SECTION-1I

Surface Roughness - Introduction, terminology, machining symbol with all parameters, roughness values (Ra) and roughness grade numbers, indicating surface roughness on drawing.
Tolerances, Fits, GD&T - Definitions applied to tolerances, types of tolerance, types of fits, fit system. Geometrical tolerances – Nomenclature, tolerance frame, types of geometrical tolerances & their symbols, indicating geometric tolerances on drawing,
Assembly & Details of Machine Parts - Introduction to assembly & part drawing ,examples- Revolving Centers, Machine Vice, Tool post, Screw Jack, jigs & fixtures, tailstock, Cotter Joint, Knuckle Joint, Flange Joint, Rigid and Flexible Coupling, Drawing reading. – Title block, part list / bill of material, revision block etc.
Basics of computer graphics & CAD - Software configurations, functions of CAD package, constructing the geometry, various graphics elements such as line, circle, rectangle, ellipse, arc, spline etc. Geometric transformations, translations, rotation, mirror, concatenations, etc. Examples in Typical CAD software like AutoCAD,

List of Practicals: (Any Six)
1. On Full Imperial Sheets - Conventional representation of machine components as perIS Code: SP 46
2. On Full Imperial Sheets - Types of screws, Bolts and nuts, Nut locking arrangement.
3, 4, 5.On Full Imperial Sheets - Assembly and details of any 3 of machine Assembly :Cotter joint, Knuckle joint, Flange joint, Rigid and flexible coupling, Stop valve, Non returnvalve, Revolving centers, Machine vice, Tool holder.
6. 2D / 3D CAD modeling assignments on min. 6 drawings / parts
7,8,9. on 2D CAD - Assembly and details of any 3 of machine Assembly :Cotter joint, Knuckle joint, Flange joint, Rigid and flexible coupling, Stop valve, Non return valve, Revolving centers, Machine vice, Tool holder.
10,11,12 - on 3D CAD - Assembly and details of any 3 of machine Assembly :Cotter joint, Knuckle joint, Flange joint, Rigid and flexible coupling, Stop valve, Non return valve, Revolving centers, Machine vice, Tool holder. (Using Solid, surface and assembly modeling)

List of Project Areas:
1. Blueprint reading and comprehension
2. Assembly modeling and animation
3. Programs on parametric programming involving: Programming for standard machine components, Programming involving decision making and looping.
4. Use of Standard part libraries
5. Use of script files and CAD customization
6. Special CAD modeling assignments

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. Gill P. S., A Text book of Machine Drawing, Revised Edition K. Kataria and Sons, NewDelhi, 2008,
2. Farazdak Haideri, Machine Drawing and Computer Graphics, NiraliPrakashan, Pune,1998.
3. George Omura, ABC's of Autolisp, BPB Publications, 2002.
4. Zeid Ibrahim, Mastering CAD/CAM, Tata McGraw Hill.
5. Xiang Z. & Roy P., Computer Graphics, 2nd Edition, McGraw-Hill International Edition,2001,
6. Sham Tickoo, Catia V5-6r15 for Designers, 13th Edition, Dreamtech Press, 2016
7. Ajit Singh, Machine Drawing, Tata McGraw Hill,

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

1. Narayana K. L., Kannaiah P., Venkatata Readdy K., Machine Drawing, 2nd Edition, New Age international Publishers, Delhi, 2008, ISBN 81-224-1917-8.
2. Bhat N. D., Panchal, Machine Drawing, Charotar Pub. House, 2000.ISBN: 9380358466
3. John Hood D., Using AutoCAD with Auto LISP, McGraw Hill Book Company 1990.ISBN:0070297487 2.

Moocs Links and additional reading material: www.nptelvideos.in

CO PO Map

CO attainment levels

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

Pattern: C-21

T. Y. B. Tech. Industrial Engineering AY 2021-22 (C21)

Sr. No.	Subject Code	Subject Name	Teaching Scheme (Hrs/Week)			Examination scheme							Total	Credits
			Theory	Lab	Tut	CA				MSE	ESA			
						HA	Lab	Seminar	GD	MSE	ESE	CVV		
S1	IE3205	Work Systems & Ergonomic Design	3	2	1	10	20	15	15	10	10	20	100	5
S2	IE3201	Facilities & Operations Management	3	2	1	10	20	15	15	10	10	20	100	5
S3	IE3236	Manufacturing Systems & Strategies	3	2	1	10	20	15	15	10	10	20	100	5
S4	IE3208	Software Applications In Industrial Engineering	3	2	-	10	20	15	15	10	10	20	100	4
H1 (RA)	IE3210	Advanced Robotics & Digital Manufacturing	3	2	1	10	20	15	15	10	10	20	100	5
H1 (AM)	PR3210	Additive Manufacturing	3	2	1	10	20	15	15	10	10	20	100	5
S6	IE3273	Engineering Design And Innovation - V	-	-	-								100	4
Total														**28**
S1	IE3240	Logistics & Supply Chain Management	3	2	1	10	20	15	15	10	10	20	100	5
S2	IE3207	Statistical Quality & Reliability Engineering	3	2	1	10	20	15	15	10	10	20	100	5
S3	IE3242	World Class Manufacturing & Industry 4.0	3	2	1	10	20	15	15	10	10	20	100	5
S4	IE3239	Operations Modeling & Simulation	3	2	-	10	20	15	15	10	10	20	100	4
H2 (RA)	IEXXXX	Mechatronic & Industrial Robotics	3	2	1	10	20	15	15	10	10	20	100	5
H2 (AM)	PRXXXX	DFX & PLM	3	2	1	10	20	15	15	10	10	20	100	5
S5	IE3286	Engineering Design And Innovation-VI	-	-	-	-	-	-	-	-	-	-	100	4
Total														**28**

FF No. : 654

IE3205::WORK SYSTEMS & ERGONOMIC DESIGN

Course Prerequisites :

Basic knowledge of industrial operations and manufacturing processes

Course Objectives:

1. Understand and apply productivity concepts and principles and analyze work content
2. Systematically record; critically examine methods of doing work to effect improvements
3. Design the workplace using principles of motion economy and develop improved methods
4. Establish standard time to carry out a specified job using work measurement techniques
5. Design workplaces, products by applying Ergonomic design principles, anthropometry

Credits: 5 **Teaching Scheme Theory: 3** Hours/Week

Tut: 1 Hours/Week

Lab: **2** Hours/Week

Course Relevance:

Understanding Industrial operations, resource optimisation for productivity improvement

SECTION-1
Productivity - Introduction to Industrial Engineering, Historical background, Contribution of Taylor and Gilbreth, Productivity – Definition, Types, Improvement, Work Content Analysis, Definition and Scope of Work Study, Productivity study, productivity ratios, Numerical and Cases on Productivity **Methods Analysis** - Definition, Steps in Method Study, Various Considerations to select a job for Method Study, Recording – Significance, Need, Charting Symbols, Recording Techniques - Charts and Diagrams, Examine – Questioning Techniques – Primary & Secondary Questions, Methods improvement - cost benefit analysis, Cases on Recording Techniques **Methods Improvement** - Introduction to Principles of Motion Economy, Develop – Alternate Methods of Doing Work, Evaluate – Criteria for Evaluating & Selecting Best Method, Define – Develop Standard Operating Procedures, Work Instructions, Implement – Practical Aspects in Implementing New Method, Overcoming Resistance to Change, Maintain,
SECTION-1I

Work Measurement – Definition, Steps, Concept of Observed Time, Basic/Normal Time, Standard Time, Video Time Study – Elemental breakdown of tasks, types of elements, Rating – Concept, Types, Allowances – Concept, Types, Application, Calculation of Standard Time, Numerical on estimating standard time, Work Sampling – Steps Involved, Applications, Advantages, Introduction to Predetermined Motion Time Standards

Introduction to Human Factors Engineering - Human Factors Engineering – Definition and scope, objectives, history, human-machine system, characteristics of human-machine system, need for application of Human Factors Engineering in industry and society Applied

Anthropometry and Ergonomic Workplace Design - Introduction to Anthropometry, type of dimensions, use of anthropometry data, Principles in the application of anthropometric data, Ergonomic Design - work spaces, work space envelopes, design of work space, science of seating,. Principles of seat design, design of work surfaces,

List of Tutorials: (Any Three)

1. Numerical on productivity
2. Outline process chart
3. Two handed process chart
4. SIMO chart using therbligs
5. Man machine chart
6. Travel chart
7. Flow process chart - Worker type
8. Flow process chart - Machine type
9. Flow process chart - Material type
10. Flow diagram

List of Practicals: (Any Six)

1. Assignment on Recording Tools & Techniques – Charts
2. Methods Analysis (Record, Examine)
3. Methods Improvement (Develop, Define)
4. Setting Time Standards using Time Study – Video Analysis using WorkPro Software
5. Work System Analysis for reducing standard time using WorkPro Software
6. Recording sound levels in various work environments
7. Recording light intensity in various work environments
8. Estimating energy consumption for various manual activities.
9. Analysis of effect of postural variations on human effort in using WorkPro Software
10. Analysis of effect of temperature on human effort in service sector industry

List of Projects:

11. Design a workplace by applying principles of Ergonomic design
12. Design a product by applying principles of Ergonomic design
13. Workplace Design (SeatingWorkstation)Ergo moduleWorkPro Applied Anthropometry
14. Workplace Design (StandingWorkstation)Ergo module orkPro Applied Anthropometry
15. Analyzing and quantifying human effort for carrying out manual work
16. Work content analysis for Productivity improvement
17. Methods improvement in manufacturing sector using WorkPro Software
18. Methods improvement using in service sector industry WorkPro Software
19. Design Work Sampling plan to find out resource utilisation.
20. Establishing Time standards using Work Measurement techniques using WorkPro

List of Course Seminar Topics:

1. Application of work system design for productivity improvement in agriculture
2. Application of work system design for productivity improvement in health care
3. Application of work system design for productivity improvement in auto sector
4. Application of work system design for productivity improvement in service sector
5. Ergonomic principles for workstation design
6. Ergonomic principles for workplace design
7. Ergonomic principles for product design
8. Work Related musculoskeletal disorders in service sector
9. Work Related musculoskeletal disorders in manufacturing sector
10. Human comfort and cost optimization using Human Factors in design

List of Course Group Discussion Topics:

1. Productivity improvement for human welfare
2. Methods improvement and labour reduction
3. Effect of time estimation - Is time estimation necessary?
4. Effective methods save labour cost and time?
5. Usefulness of Work content analysis for waste elimination
6. Ergonomic product design saves cost
7. Ergonomic workplace design saves human effort and provides human comfort
8. Ergonomic design reduces WMSDs
9. Ergonomic analysis reduces occupational issues
10. Is an Ergo audit necessary for better workplace ?

List of Home Assignments:

Design:

1. Ergonomic design - classroom bench
2. Ergonomic design - computer work station
3. Ergonomic design - kitchen platform
4. Ergonomic design - Material handling trolley
5. Ergonomic design - assembly bench

Case Study:

1. Case study on productivity improvement in service sector
2. Case study on productivity improvement in manufacturing sector
3. Case study on standard time estimation
4. Case study on methods improvement
5. Case study on Ergonomic workplace design

Blog

1. Productivity improvement for benefit of society and industry
2. Need of Ergonomic product design
3. Ergonomic workplace design for human comfort
4. Ergonomic analysis for reducing WMSDs
5. Ergo audit for system improvement

Surveys

1. Anthropometric data collection and analysis- male population
2. Anthropometric data collection and analysis- female population
3. Anthropometric data collection and analysis- school children (primary school)
4. Anthropometric data collection and analysis- school children (secondary school)
5. Anthropometric data collection and analysis - senior citizens

Suggest an assessment Scheme:

Mid semester - theory - 15
End semester theory - 15
Lab assignments - 10 marks
Tutorial - 5 marks
Home assignment - 5 marks
Course project - 10 marks
Seminar/Group discussion - 10 marks
Orals - 10 marks

Text Books:

1.George Kanawaty, Introduction to Work Study, Fourth revised edition, Universal Book Corporation, Bombay. International Labour Office, Geneva

Reference Books:

1. Kjell B. Zandin, Most Work Measurement Systems, Second revised edition, Marcel Dekker, Inc, New York
2. M. S. Sanders and Ernest J. McCormick, "Human Factors Engineering and Design", Seventh edition, McGraw-Hill Inc

Moocs Links and additional reading material: www.nptelvideos.in

1. Work system Design - NPTEL course
2. Applied Ergonomics - NPTEL course
3. Workplace Ergonomics - Coursera

Course Outcomes:

Student will be able to

1. apply productivity concepts and analyze work content
2. systematically record critically examine methods of doing work to effect improvement
3. design the workplace and effective methods using principles of motion economy
4. establish standard time to carry out a specified job using work measurement techniques
5. apply basics of various disciplines of Human Factors Engineering in design
6. Design Workplaces, products by applying Anthropometry, Ergonomic design concepts

CO PO Map

CO 1,2,3,4,5,6 -> PO 1,2,4, 6,8,10,11,12, 13,14,15,16

CO attainment levels

CO 1 - 3
CO 2 - 3
CO 3 - 4
CO 4 - 4
CO 5 - 4
CO6 - 4

Future Courses Mapping:

Work system Analysis and Design
Human Factors Engineering in Design

Job Mapping:*Manufacturing sector industries*
Service sector industries
Health care
Furniture design and manufacturing industries
Product design and development

FF No. : 654

IE3201::FACILITIES & OPERATIONS MANAGEMENT

Course Prerequisites:

Basic knowledge of industrial operations

Course Objectives:

1. To inculcate students about the importance of location decisions for business organization.
2. To make students aware of the formulations, models, and analytical procedures for the layout analysis.
3. To make aware of fundamental principles of material handling systems
4. To make aware of operations management strategies and its usefulness.
5. To inculcate students about effective measures like using of Lot Sizing mechanisms & scheduling techniques used in Production system

Credits: 5 **Teaching Scheme Theory: 3** Hours/Week

Tut: 1 Hours/Week

Lab: **2** Hours/Week

Course Relevance:

This course provides students the fundamental knowledge of Facilities location, layout analysis and operations strategies. This will help in developing the foundation for resource optimisation in the manufacturing and the service organisations.

SECTION-1

1. Introduction to Facilities Planning - Scope of Facilities Planning – Importance & Objectives, Nature Of Location Decision, Factors affecting Facility Location, Single & Multiple Facility Location Models, Qualitative Considerations in Facility Location, Factors Urban v/s Rural Location, Site Selection Location Pattern In India.

2. Layout Planning - Plant Layout – Introduction, Types of Plant Layout: Product, Process, Fixed Postion, Hybrid – Cellular, FMS, etc. Phases of Layout Planning,

3. Systematic Layout Planning - P-Q Analysis, Flow of Materials Analysis, Charting & Diagram Techniques, Activity Relationship Analysis – REL Diagram, Space Requirements & Availability, Techniques of Space Determination. Modifying Considerations, Practical Limitations, Selection of Layout – Techniques of Layout, Installation of Layout

4. Computerized Layout Planning - Computerized Layout Planning – Introduction & Concept. CRAFT, CORELAP, ALDEP

5. Assembly Line Balancing - Concept of Line Balancing: Heuristics, Assessing Performance.

6. Material Handling - Principles of Material Handling , Material Handling Function, Scope and Functions of Material Handling , MH Equipment Types Positioning Equipment, Unit Load

Equipment, Auto Identification & Control Equipment, Transport Equipment – Conveyors, Cranes, Industrial Trucks. Storage Equipment, AGVs & Robots

7. Systematic Handling Analysis - Handling Analysis, External Integration, Classification of Materials, Layout Considerations, Analysis of Moves, Visualization of Moves, Flow Diagram – DI Plot, Preliminary Handling Plans, Modifications & Practical Limitations, Calculation of Requirements, Evaluation of Alternatives, Installation

SECTION-1I

1. Scope of Operations Management - Nature, Scope, Importance, Various Functions in Operations, Types of Production Systems – Project type, Job shop, Batch Production, Flow Continuous Production, Mass Production - Characteristics and applicability of each type. Operations Strategies: Process choice – Select the appropriate production system, Competitiveness with Operations, Competing on cost, quality, flexibility, speed, reliability. Order Winners & Order Qualifiers. Introduction to ETO, MTO, ATO & MTS

2. OPC and Material Requirement Planning (MRP I) - Operations Planning & Control – PPC – Functions, Operations Planning & Control Framework. Material Requirement Planning (MRP I): Inputs to MRP – MPS, BOM –Types of BOM, BOM Explosion, Inventory Transaction Files, MRP Processing (Logic) Time Phased Operation Plan, Numerical on BOM Explosion Netting Requirements, Lot sizing methods.

3. MRP II (Manufacturing Resource Planning) - Operations Control – Gantt Charts, Planning & Scheduling Techniques: Scheduling v/s Loading, Scheduling Types – Forward Scheduling & Backward Scheduling, Scheduling Techniques –Single machine scheduling- SPT, WSPT, Slack per operations, Critical Ratio, EDD, etc. –Evaluate lateness, tardiness. Hogdson algorithm, Minimizing tardiness heuristics

List of Tutorials: (Any Three)

1) Numericals on single facilities location analysis.
2) Numericals on muli facilities location analysis.
3) Development of REL Chart
4) Preparation of Form to Chart for layout evaluation
5) Computerised layout planning
6) Assembly Line balancing
7) Classification of Material handling equipments
8) Selection of the appropriate production system
9) MRP-I
10) MRP-II

List of Practicals: (Any Six)

1. Single facility location problems
2. Multiple facility location problems
3. Charting & Diagram Techniques for Layout Planning
4. Line Balancing
5. Computerized Layout Planning
6. Layout Evaluation Techniques
7. Systematic Handling Analysis
8. Case study assignment on Production Systems & Operations Strategy
9. Assignment on MRP 1 – BOM Explosion & Netting Requirements
10. Assignment on Johnson's method for 2, 3 and M machines problem

List of Projects:

1. Layout Creation and Improvement
2. Material Handling Systems Design
3. Line Balancing
4. Computerized Layout Planning
5. Operations strategies Implementation
6. MRP-I Calculation & Lot sizing calculations
7. MRP-II & Aggregate Planning
8. Scheduling Types
9. Production System Analysis
10. Location Analysis

List of Course Seminar Topics:

1.Qualtative methods for facility location decision analysis
2. Quantitative methods for facility location decision analysis
3. Methods for Layout improvements
4. Computer assisted layout planning
5. Assembly line optimisation Techniques
6. Automation in Material handling system
7. Advances in Operations Management
8. Evolution of Production Systems
9. MRP- I implication for Business Organisations
10. MRP- II implication for Business Organisations

List of Course Group Discussion Topics:

1. Qualitative Vs Quantitative location analysis techniques
2. Single Vs. Multiple facilities location analysis
3. Comparison of layout improvement methodologies
4. Computerised vs Manual layout planning
5. Single piece flow Vs Batch Production
6. Automated Vs Manual Material Handling
7. Comparison of Manufacturing System
8. MRP-I Vs. MRP-II
9. Automated Guided Vehicles Comparisons
10. Production Planning & Control

List of Home Assignments:

Design:

1. Design of facility selection problem
2. Design of Layout using SLP approach
3. Development of Computer program for layout planning
4. Design of MRP-I
5. Design of MRP-II

Case Study:

1. Case study on Location analysis
2. Case study on Layout improvement
3. Case study on Assembly Line Balancing
4. Case Study on MRP-I
5. Case Study on MRP-II

Blog

1. Framework for Site Selection
2. Layout planning for productivity improvement
3. Material Handling & Productivity
4. MRP-I
5. MRP-II

Surveys

1. Survey on Relative importance of Location analysis methods
2. Survey on Relative importance of Layout planning tools
3. Survey of material handling equipments
4. Survey of production systems for specific applications
5. Operations strategies for service organisations

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

1.R. Muther and L. Hales, Systematic Layout Planning, Fourth. Management & Industrial Research Publications, 2015.
2. R. Muther and L. Hales, Systematic Handling Analysis. Management and Industrial Research Publications, 1969.
3. R. Panneerselvam, Production And Operations Management, Third. PHI Learning Pvt. Ltd.,

2012.

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

1. J. M. Apple, Plant Layout and Material Handling. Ronald Press, 1950.
2. Chary; Production & Operations Management; 1st Edition, McGraw Hill Publications
3. Chase; Production & Operations Management; 1st Edition, Pearson Publications

Moocs Links and additional reading material: www.nptelvideos.in

Course Outcomes:
Students will be able to -
1. Select location of facilities for business organizations
2. Learn formulations, models, and analytical procedures for the study of facilities layout Planning to design and improve existing and new layouts incorporating products, process and personnel requirements for manufacturing and service organizations
3. Learn and apply fundamental principles of material handling to select appropriate material handling systems for manufacturing organizations
4) Aware of operations management strategies and its usefulness.
5)Develop understanding of effective measures like using of Lot Sizing mechanisms
6) Develop understanding different scheduling techniques used in Production system

CO PO Map

CO attainment levels
CO-1- 3
CO-2- 4
CO-3- 3
CO-4- 3
CO-5- 4
CO-6- 4

Future Courses Mapping:
Supply Chain Management
World Class Manufacturing

Job Mapping:
Job opportunities in the area of optimisation of the layout and the production scheduling can be opened for the students after learning this course

FF No. : 654

IE3236::MANUFACTURING SYSTEMS & STRATEGIES

Course Prerequisites:

Basics of How Factory works

Course Objectives:

1. Understand Value Chain, Competitive Advantage for various Industries
2. Understand various manufacturing systems and its applicability
3. Understand Business priorities and linkage with Manufacturing systems
4. Develop Manufacturing Strategy for a given business scenario

Credits: 5 **Teaching Scheme Theory: 03 Hours/Week**

Tut: 01 Hours/Week

Lab: 02 Hours/Week

Course Relevance:.....

Course helps to understand manufacturing systems and implement strategies in Industries.

SECTION-1

Principles of Competitive Strategy: Industry Structure, Value Chain, Value System, Competitive Advantage, Competitive Strategies- Cost Leadership, Differentiation, Best Value Strategy; Creating and Sustaining Competitive Advantage, Early mover advantage.

History and Evolution of Craft, Mass, Batch and Lean Production Systems

Manufacturing Systems:, Concept and Components of Manufacturing System, 6 Ps of Manufacturing, **Seven Production Systems**- Job shop, Batch flow, Operator-paced line flow, Equipment-paced line flow, Continuous flow, Just-in-time (JIT), Flexible manufacturing system (FMS), Product Volume – Layout Flow (PV-LF) matrix, Industry Case studies based on Manufacturing Systems

International Manufacturing Networks and Factory Types: Network Outputs, Levers and Capabilities, Factory Types – Server Factory, Offshore Factory, Source Factory, Outpost Factory, Contributor Factory, Lead Factory, Source Factory, Applicability of each factory type, Changing a Factory-Type and Manufacturing Network,**World Class Manufacturing Systems:** Critical success factors for World Class Manufacturing, Concept of XPS, Toyota Production System, Quality Management and Manufacturing Excellence, Achieving World Class Status through Total Productive Maintenance, Green and Agile Manufacturing, Sustainable Manufacturing Systems

SECTION-1I

Manufacturing Strategy in a Factory: Factories and Networks, Macro and Focused Factories, Manufacturing Outputs - Cost, Quality, Performance, Delivery, Flexibility and Innovativeness; Measures or Attributes for the Manufacturing Outputs,

Manufacturing Levers and Capability- Levers: Human resources, Organization structure and controls, Sourcing, Production planning and control, Process technology, Facilities. Manufacturing Capability: Levels: Infant, Average, Adult and World Class

Competitive Analysis- Selecting the Best Production System: Basic Characteristics and Specifi-c Dimensions of Order Winners, Order Qualifiers, Order Losers. Changing Production System, Simple Competitive Analysis Tool,

Frameworks for Manufacturing Strategy in a Factory: Skinners' view and Hayes and Wheelwright framework of Manufacturing Strategy, Alternative paradigm of manufacturing strategy, Some Generic Manufacturing Strategies, Developing Manufacturing Strategy, Industry Case studies based on Manufacturing strategies, Improvement Programs in Manufacturing

Integrating Manufacturing Strategy with Business Strategy: Elements of Business Strategy, Seven Strategies for International Manufacturing, Focus, Soft Technologies, Hard Technologies, Evaluation of Investments in Manufacturing, Adaption of Recent Technologies IoT, Industry 4.0 in to Manufacturing Strategy,

List of Tutorials: (Any Three)

1) Study of Industry Structure
2) Comparison of Craft, Mass and Lean Production Systems
3) Comparative study of Seven Production Systems
4) Study of International Factory Types and its applicability
5) Study of World Class Manufacturing Systems i.e. TPS, TPM
6) Study of Manufacturing Outputs and its attributes (Case study)
7) Study of Simple Competitive Analysis Tool
8) Study of Manufacturing Strategy Frameworks
9) Study of Improvement Programs and Technologies in Manufacturing
10) Study of Seven Strategies for International Manufacturing

List of Practical's: (Any Six)

1) Classification of Organizations based on Competitive Strategies and Competitive Advantage
2) Understand and Map Value Chain / System for any industry/ company of your choice
3) Prepare Product Volume – Layout Flow (PV-LF) matrix
4) Comparative study of World Class Manufacturing Systems
5) Modification in Production System due to changing business
6) Study and Identify Order Winners/ Qualifiers/ Losers for a company of your choice
7) Build relationships among Manufacturing Outputs, Levers and Capabilities
8) Develop Manufacturing Strategy for a given scenario
9) Study and Choose appropriate Manufacturing Strategy and its framework
10) Use of Simple Competitive Analysis Tool

List of Projects:

1. Competitive Strategy and Competitive Advantage
2. Value Chain / System
3. Seven Production Systems
4. Product Volume – Layout Flow (PV-LF) matrix
5. Manufacturing Outputs, Levers, Capabilities
6. Manufacturing Strategy – Selection or Modification
7.Competitive Analysis
8. International Manufacturing Strategies
9. Manufacturing Network and Focused Factories
10. Blend of Manufacturing with Industry 4.0

List of Course Seminar Topics:

1. Competitive Strategy and Competitive Advantage
2. Value Chain / System
3. Production Systems and it's Applicability
4. International Factory Types and its applicability
5. World Class Manufacturing Systems in India
6. Business Strategy - Order Winners/ Qualifiers/ Losers
7. Integration of Business Strategy and Manufacturing Strategy
8. Competitive Analysis Techniques
9. Strategies for International Manufacturing
10. Adoption of Manufacturing Systems with Technologies and Industry 4.0

List of Course Group Discussion Topics:

1. Competitive Advantage is just a management jargon.
2. Which Production System is the Best in India?
3. What is more important – To improve Order Winners or To eliminate Order Losers ?
4. Justify Competitive Strategies in Industries? (Manufacturing / Service)
5. Does Same Competitive Strategy works across the Globe? Why?
6. Lets develop manufacturing strategy together for Indian Company.
7. Manufacturing Strategy in India, US and China. Select the best one.
8. What should be the manufacturing strategy for Self-Reliant India?
9. To become a World Class Manufacturing System in India.
10. Is Manufacturing blend with Industry 4.0 justifiable?

List of Home Assignments:

Design:

1. Develop Competitive Strategy for MSME's
2. Design Production System
3. Redesign Production System due to change in Manufacturing Outputs
4. Develop Manufacturing System
5. Feasibility Study of Manufacturing blend with Industry 4.0

Case Study:

1. Case Study based on Competitive Strategy and Competitive Advantage
2. Case Study based on Selection of Production System
3. Case Study based on Order Winners / Qualifiers / Losers.
4. Case Study based on Manufacturing Strategy
5. Case Study based on Integration of Manufacturing Strategy with Technology / IoT

Blog

1. Competitive Strategy and Competitive Advantage
2. Value Chain / System
3. Suitability of Seven Production Systems
4. Manufacturing Outputs, Levers, Capabilities
5. Order Winners/ Qualifiers/ Losers

Surveys

1. Survey Based on Use of Production System
2. Survey Based on "Linkage of Production System and Manufacturing Outputs"
3. Survey Based on " Approaches of Developing Manufacturing Strategy"
4. Survey Based on " Benefits and Limitations of Focused Factories"
5. Survey Based on " Suitability of International Factory Types in India"

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.

Mid semester - theory - 15
End semester theory - 15
Lab assignments - 10 marks
Home assignment - 10 marks
Course project - 10 marks
Seminar - 10 marks
Group discussion – 10 Marks
Orals - 10 marks

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

1. John Miltenburg, Manufacturing Strategy, 2nd Edition, Productivity PressPublisher

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

1. J. M. Apple, Plant Layout and Material Handling. Ronald Press, 1950.
2. Chary; Production & Operations Management; 1st Edition, McGraw Hill Publications
3. Richard Schonberger, World Class Manufacturing – The Next Decade: Building Power, Strength, and Value, Free Press, 1996
4. Jeffrey Liker, The Toyota Way, McGraw Hill Publications, Indian Edition, 2017
5. Nakajima Seiichi ,Introduction to TPM: Total Productive Maintenance, 1995

Moocs Links and additional reading material: www.nptelvideos.in
Manufacturing Strategy: https://nptel.ac.in/courses/110/107/110107116/#

Course Outcomes:
1) To Understand Competitive Advantage & Competitive strategies for any business
2) To Develop PVLF matrix and Select appropriate Manufacturing system and factory type
3) To Understand and apply principles of World Class Manufacturing Systems
4) To Analyze organizations by using Competitive Analysis Techniques

5) To Design Manufacturing Strategy for any given business scenario 6) To Learn & apply Recent Technologies to strengthen Manufacturing System and Strategy
CO attainment levels CO1- 3 CO2- 4 CO3- 3 CO4- 4 CO5-4 CO6-4
Future Courses Mapping: World Class Manufacturing, Logistics & Supply Chain Management
Job Mapping: Job opportunities that one can get in to Production or Industrial Engineering

FF No. : 654

IE3208::SOFTWARE APPLICATIONS IN INDUSTRIAL ENGINEERING

Course Prerequisites: Basic knowledge of Excel

Course Objectives:

1. To make students apply various softwares used in industrial Engineering
2. To make students understand the objective of using each software in industrial Engineering
3. Students should establish how the software helps overall processing
4. To Increase Students's technical know how
5. To develop software skills in Industrial Engineering Applications

Credits: 04 **Teaching Scheme Theory: 03 Hours/Week**

Lab: **02 Hours/Week**

Course Relevance: Understanding of Software applications in Industrial Engineering field

SECTION-1

Topics and Contents

Simulation Process understanding – Definition, Use of Simulation modeling In industrial engineering sector, basic Concept of simulation, The basic blocks of simulation, Creation of Multiple scenarios and Results analysis, result validation, Conclusions of simulation. Basic steps for model making, Collection of data, making of simulation model, adding 3D features, Creation of Animation process and throughput analysis. Use of standard library objects, model entity, default entity, drawing tool objects, animated objects, Floor label creation, . Addition of Status label, addition of static objects, addition of dynamic objects (animated objects) recording of simulation, setting of simulation run length, converting of data into suitable format for further analysis. Entry relationship Diagram (E-R) and data flow diagram for system design and analysis (SAS)

Creation of Scenarios using simulation modeling in Industrial Engineering area– Single server single entity processing, Multiple server Multi entity processing, Job sequencing in job shop scheduling , Worker Assigning to multiple machines, Vehicle assigned for transporting entities, entities combining & separating , Use of Arrival Rate Tables , Jobs coming in predefined sequence , Use of conditional Routing, Fixing of job sequencing, redirecting of queue in case of server failure, Use of simulation in inventory management , Use of Add on process triggers, Batch processing of jobs Post simulation result analysis. Showing the multiple scenario results to management for formal implementation of proposed improved system.

Application areas of Simulation Modeling-

Health Care Management- Out Patient Department, Setting up of Bank Organizations- setting up of counters, Setting up of Hotel industries, Queue Management in Temples and suggesting alternate methods to reduce crowd and simulation of office working procedure and manual movement for any type of office. Use of simulation in shop floor activities under Flow shop model, Job shop model, Parallel processing, Single machine scheduling, oven Processing. Use of Simulation in Transportation of logistic materials.

SECTION-1I

Use of software in Calculations of Industrial Engineering problems- Use of solver in Optimization of resources in maximizing profits, use of solver in Optimization of Costs under minimization case, Use of excel in minimizing total transportation cost in case of logistic management, Use of excel in Cargo loading for optimizing revenue return keeping in mind vehicle load capacity. Solving travelling salesman problem using excel, excel used as statistical tool for analysis, excel used for calculation of forecasting. Use of excel in integer programming for Branch and bound method, use of excel in calculations of Tardiness, number of Tardy jobs and non tardy jobs. Assigning of worker to job, single machine scheduling , job to machine or machine to worker to minimize processing time, cost etc. use of excel solver for maximizing profit in case of assignment model salesman to district problem. Use of Excel in Operation management, Use of Excel functions in calculation financial calculation.

Use of software in project management (MS Project software)-

Construction of Network Diagram, Concept of CPM and PERT, calculations of float values, solving Resource smoothing and leveling Problems using software.

Introduction to different softwares like AnyLogic, JaamSIM, CPLEX their applications, their uses

List of Practicals: (Any Six)

1) Introduction to simulation software
2) Basic blocks used for simulation Modeling
3) Use of Process triggers in simulation Modeling
4) Use of status label and Use of specific objects for specific actions
5) Addition 3 D features in simulation Modeling
6) Adding animation features and recording of simulation
7) Using of analytical tool for analysis of results
8) Use of software for fixing project deadline
9) Use of software for resource levelling
10) Use of Excel in Industrial engineering

List of Projects:

1. Simulation Modelling of Hospital Management
2. Simulation Modelling of Hotel Management
3. Simulation Modelling of Setting up of Bank counters
4. Simulation Modelling of Setting up of Car Washing Terminals
5. Simulation Modelling of Setting up of Shop Floor Activities
6. Simulation Modelling of Setting up of commodity distribution system
7. Resource levelling Projects
8. Resource Smoothing Projects
9. Project Scheduling Projects
10. Financial Appraisal Projects

List of Course Seminar Topics:

1. Simulation of Hotel Industry
2. Simulation of Banking sector
3. Simulation applications in Health care
4. Simulation applications in Logistic management
5. Simulation applications in Shop Floor management
6. Simulation applications in management of queues in service management
7. Project scheduling
8. Project Crashing
9. Man power Levelling
10. Resource Smoothing

List of Course Group Discussion Topics:

1. Role of simulation in Man power Requirement planning
2. Role of simulation in Machine Requirement planning
3. Role of simulation in Line balancing projects
4. Role of simulation in Flow shop Scheduling
5. Role of simulation in Job shop Scheduling
6. Role of simulation in Single machine Scheduling
7. Role of excel in Financial calculation
8. Role of excel in Cargo Loading calculation
9. Role of Any logic software
10. Role of JaamSIM Software

List of Home Assignments:

Design:

1. Simulation design in Covid Screening system
2. Simulation design in Health care system
3.Simulation design in Line balancing system
4. Simulation design in Reservation counter system
5. Simulation design in machine shop

Case Study:

1. Practical case study on use of excel functions in Financial calculation
2. Practical case study on use of excel in Forecasting calculation
3. Practical case study on use of excel in Logistic management calculation
4. Practical case study on use of excel in Resource allocation
5. Practical case study on use of excel in Scheduling

Blog

1. Use of simulation software in service industries
2. Use of software in project scheduling
3. Use of software in job scheduling
4. Use of software in financial calculations
5.Use of software animation in simulation modelling

Surveys

1. Simulation in Manufacturing field
2. Simulation in service provider set up
3.Simulation in effective queue management of Religious places
4. Effective use Projects scheduling in fixing project deadlines
5. Use of Job scheduling softwares in any plant

Suggest an assessment Scheme:

Mid semester - theory - 15
End semester theory - 15
Lab assignments - 10 marks
Home assignment - 10 marks
Course project - 10 marks
Seminar/Group discussion - 10 marks
Orals - 20 marks

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

1. Jeffrey A. Joines, SIMIO AND SIMULATION: MODELING, ANALYSIS, APPLICATIONS - NEW 5TH EDITION
2. Simulation modeling with SIMIO- 4th Edition

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

1. Simio LLC , Introduction to simio, First edition

Moocs Links and additional reading material: www.nptelvideos.in
Course Outcomes: 1 Students will start using software for real life application project based on the objective 2. Students get hands on experience regarding the use of most of the softwares in industrial Engineering 3. Students logical IQ will increase with use of softwares 4. Students will be ready for different applications using different software 5. Definite upgradation in skills of software usage for each student 6. Students will be Industry ready as far as use of software is concerned
CO PO Map **C01-Po1** **C02-Po2** **C03-Po2** **C04-Po3** **C05-Po4**
CO attainment levels CO-1 :3 CO-2 :3 CO-3 :3 CO-4 :4 CO-5 :4
Future Courses Mapping: One can go for advanced courses in simulation
Job Mapping: *Software simulation jobs*

FF No. : 654

PR3210::ADDITIVE MANUFACTURING

Course Prerequisites:

Manufacturing processes, product design

Course Objectives:

Credits:....5.... **Teaching Scheme Theory:3...** Hours/Week
Tut:…1 Hours/Week
Lab:**2...** Hours/Week

Course Relevance:...

SECTION-1
INTRODUCTION Overview – History – Need-Classification -Additive Manufacturing Technology in product development - Materials for Additive Manufacturing Technology – Tooling – Applications **CAD & REVERSE ENGINEERING** Basic Concept – Digitization techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology: CAD model preparation – Part Orientation and support generation – Model Slicing –Tool path Generation – Softwares for Additive Manufacturing Technology: MIMICS, MAGICS **LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS** Classification – Liquid based system – Stereolithography Apparatus (SLA) - Principle, process, advantages and applications – Solid based system –Fused Deposition Modeling – Principle, process, advantages and applications, Laminated Object Manufacturing
SECTION-1I
POWDER BASED ADDITIVE MANUFACTURING SYSTEMS Selective Laser Sintering – Principles of SLS process – Process, advantages and applications, Three Dimensional Printing – Principle, process, advantages and applications- Laser Engineered Net Shaping (LENS), Electron Beam Melting **MEDICAL AND BIO-ADDITIVE MANUFACTURING** Customized implants and prosthesis: Design and production, Bio-Additive Manufacturing - Computer Aided Tissue Engineering (CATE) – Case studies **DESIGN FOR ADDITIVE MANUFACTURING PROCESSES** Motivation, DFMA concepts and objectives, AM unique capabilities, Exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturing Constraining Features, Interlocking Features, Reduction of

Part Count in an Assembly, Identification of markings/ numbers etc.

List of Tutorials: (Any Three)

List of Practicals: (Any Six)

List of Projects

1. Creation of input files for 3D Model and logic behind it
2. Analysis and modeling of different slicing strategies
3. Blending and G Code generation
4 3D Printing of objects
5. 3D printing defects and methods to avoid/overcome them
6. Shape optimization
7 Printing of assemblies
8. Assessment of different fill patterns.
9. Parametric assessment on VAT Photopolymerisation
10. Parametric assessment on Fused Deposition Modeling

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. Chua, C.K., Leong, K.F., Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley and Sons Inc., 2000.
2. Pham, D.T., Demov, S.S., Rapid Manufacturing: The Technologies and Applications 87th Senate approved Courses Scheme & Syllabus for M.E. CAD/CAM Engg. (2015) of Rapid Prototyping and Rapid Tooling, Springer-Verlag London Limited, 2001.
3. Noorani, R., Rapid Prototyping: Principles and Applications, John Wiley & Sons, Inc., New Jersey, 2006.
4. Patri, K. V., Weiyin, Ma, Rapid Prototyping - Laser-based and Other Technologies, Kluwer Academic Publishers, U.S.A., 2003.

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

Moocs Links and additional reading material: www.nptelvideos.in,mitsubhishi ecnc,

Course Outcomes: 1. Understand various additive manufacturing processes for different applications 2. Use correct CAD file formats in 3D printed parts manufacturing 3. Select appropriate 3D printing parameters considering shape features, part quality and printer specifications 4. Apply AM concepts for Bio medical and medical fields 5. Perform reverse engineering steps to prepare virtual model 6. Operate 3D printer machine to manufacture desired 3D objects
CO PO Map **All COS map to PO1,PO2,PO3,PSO14 and PSO 15 to level 3**
CO attainment levels-CO-1-5,CO2-5,CO3-4,CO4-3,CO5-5,CO6-5
Future Courses Ma
Job Mapping:

FF No. : 654

IE3240::LOGISTICS & SUPPLY CHAIN MANAGEMENT

Course Prerequisites:

Basics of How Business works, Manufacturing Systems & Strategy

Course Objectives:

1. Understand basic concepts and strategies of Supply Chain Management
2. Design Logistics models and Transportation schedules
3. Establish Inventory Policy by using inventory models and SIC techniques
4. Analyze and Improve Supply Chain functions by using quantitative an

5. Understand role of IT and Technologies in Supply Chains

Credits: 05 **Teaching Scheme Theory: 3** Hours/Week

Tut: 1 Hours/Week

Lab: 2 Hours/Week

Course Relevance:

Understanding Supply Chain Operations, Planning and Design activities to satisfy customers in effective way.

SECTION-1
Basics of Supply Chain Management: Concept, Objective. Decision Phases in Supply Chain. Process View of Supply Chain – Cycle View, Push/Pull view, Supply Chain Performance – Achieving Strategic Fit. Types of Supply Chain – Responsive, Efficient, Achieving Strategic Fit. Supply Chain Drivers – Facilities, Inventory, Transportation, Information, Pricing and Sourcing. **Logistics -** Logistics Function: Transportation–Significance in SCM, Modes of Transportation– Rail, Road, Pipelines, Water, Air, Multimodal –Advantages & Disadvantages, Concept of TL, LTL, FTL. Selection of Appropriate Modes of Transportation. **Warehouse Management:** Warehousing – Objectives, Functions, Types. Concept of SKUs, Warehousing Principles & Best Practices in Receiving, Shipping, Order Picking, Storage & Put away, Warehouse Activity Profiling, Warehouse Layout Planning, Order Processing – Role of IT, Material Handling, Warehouse Management Systems **Network Design in Supply Chain -** Factors Influencing Distribution Network Design – Response time, Product variety, Product availability, Customer experience, Order visibility, Return ability. **Transportation Modeling & Optimization**: Transportation Model: Vogel's Approximation Method, UV Method, Stepping Stone Method, Transshipment problems, Shortest Path Problem, Minimal Spanning Tree, Maximal Flow Problem, Traveling Salesman Problem, Vehicle Routing Problem. **Managing Supply and Demand**: Managing Capacity – time flexibility of workforce, seasonal workforce, subcontracting, use of dual facilities, and design product flexibility into production processes. Managing Inventory – use common components across multiple products; build inventory of high demand of predictable demand products Managing Demand: Variable pricing, Forward buying. Collaborative Planning Forecasting & Replenishment
SECTION-1I

Inventory Management in Supply Chain - Managing Economies of Scale: Cycle Inventory Role in SC - Lot sizing for single product, multiple products or customers, Aggregating multiple products in single order Managing Uncertainty: Safety Inventory – Role in SC – Determine appropriate level of safety inventory. Pipeline/ In-transit Inventory, Seasonal Inventory, Transportation & Inventory Cost Trade-off: Choice of Transportation Mode, Inventory Aggregation. Transportation cost and customer-responsiveness trade-off;
Pricing & Revenue Management in Supply Chain: Role, Revenue Management for Multiple Customer Segments, Seasonal Demand, Bulk & Spot Customers
Outsourcing & Co-ordination in Supply Chain: Procurement Process, Sourcing, 3PL, 4PL, Vendor Managed Inventory. Co-ordination in Supply Chain: Lack of SC Coordination & Bullwhip Effect. Obstacles to SC Coordination. Manager Levers to Achieve Coordination.
Supply Chain Analytics – Inventory Analytics, Procurement Analytics, Logistics and Warehousing Analytics, Distribution Analytics etc.
IT and Technology in Supply Chain: Role of IT in Supply Chain IT Framework. E-business & Supply Chain, ERP Solutions, Future of Supply Chain. Cases on E-business and supply chains, Recent Technologies in SCM – Blockchain, Artificial Intelligence and Machine Learning Application in Supply Chain
Special Cases in Supply Chain : Sustainable -Green SCM, Reverse Logistics, Global Supply Chain Management – Case studies, Cold & Liquid Supply Chain

List of Tutorials: (Any Three)

1. Elements and Structures of Supply Chain
2. Competitive and Functional Strategies
3. Strategies for Managing Supply and Demand
4. Mapping of Supply Chain Drivers with Strategy
5. Quantitative Supply Chain Models
6. Transportation- Role in SCM, various Strategies
7. Warehousing - Role in SCM, various Strategies, WMS
8. Design/ Develop Inventory policy
9. Selective Inventory Control
10. Supply Chain Optimization and Integration
11. Application of Recent Technologies in SCM
12. Special Cases in Supply Chain

List of Practicals: (Any Six)

1. Detailed Study of Supply Chain of any one company in an Industry of your choice
2. Study of Industry or Sector Based on Economics Times Intelligence Group
3. Single Facility Location Models
4. Multiple Facility Location Models
5. Allocation Models – Transportation, Transshipment model
6. Application of Travelling Salesman Problem
7. Application of Vehicle Routing Problem
8. Design/ Develop Inventory policy
9. Selective Inventory Control – ABC, FSN, VED etc.
10. Computerized Simulation Games – Bullwhip Effect
11. Supply Chain Optimization and Integration
12. Application of Recent Technologies in SCM
13. Excel – Solver based modeling

List of Projects:

1. Study end to end Supply Chain activities for an organization of your choice
2. Inventory Management by using Selective Inventory Control Techniques
3. Warehouse Layout Planning
4. Application of IT to make efficient and responsive Supply Chains
5. Inventory Analytics,
6. Procurement Analytics,
7. Logistics and Warehousing Analytics,
8. Distribution Analytics
9. Use of Recent Technologies in Supply Chain
10. Cost Reduction Projects
11. Delivery or Lead Time Reduction Projects
12. Supply Chain Optimization and Integration

List of Course Seminar Topics:

1. Supply Chain Models in Various Business Environments
2. Decision Making in Supply Chain Management
3. Logistics Outsourcing – 3PL, 4PL
4. Logistics – Transportation Modelling and Scheduling
5. Warehouse Management- Layout Design, warehousing Operations, WMS
6. Inventory Management – Inventory models and Inventory Control
7. Supply Chain Analytics- Analysis and Improvement
8. Use of IT in SCM – ERP, EDI
9. Technology based automated supply chains
10. Special cases in Supply Chain – Sustainable, Reverse, Liquid, Green Supply Chains**.**

List of Course Group Discussion Topics:

1. Which Supply Chain is better – Efficient or Responsive?
2. Inventory Boon or Bane?
3. Just in Time or Huge Inventory fix the problems?
4. Warehousing Strategy – Centralized or Decentralized? Which one most suitable?
5. What makes Supply Chain Profitable- Capital Intensive Technologies or Skilled Personnel.
6. What makes supply chain faster: Capital Intensive Technologies or Skilled Personnel.
7. Make in India – Supply Chain Challenges and Opportunities
8. Use of Technologies in Supply Chains- Success Stories and Disasters
9. Challenges in Sustainable Supply Chains
10. Supply Chain Challenges for MSME and Startups in India

List of Home Assignments:

Design:

1. Design Supply Chain Network
2. Design Transportation Policy
3. Design Inventory Policy
4. Design Warehouse Layout
5. Design IT based automated Supply Chain
6. Supply Chain Analytics
7. Design Agile Supply Chain Systems

Case Study:

1. Case study based on Competitive and Supply Chain Strategies
2. Case study based on Logistics- transportation strategy
3. Case study based on Logistics – Warehouse Management
4. Case study based on Inventory Management
5. Case study based on IT and Technology based Supply Chains
6. Case study based on Supply Chain Analytics
7. Case study based on Responsive and Efficient Supply Chain

Blog

1. Supply Chain as Value Chain
2. Supply Chain Analytics
3. Logistics and Warehousing Management
4. Inventory Management
5. Supply Chain Technologies
6. Supply Chain Risk Management
7. Supply Chain Strategies to enhance supply chain surplus

Surveys

1. Survey of Best Supply Chain Companies to understand best practices
2. Survey of Supply Chain Strategies across different sectors
3. Survey of Supply Chain Strategies to compare domestics companies and MNCs
4. Survey of Supply Chain Strategies for Brick and Mortar model and E-commerce
5. Survey of 3PL and 4PL companies
6. Survey of Warehouses and their operational strategies
7. Survey of Use of Technologies in Supply Chains
8. Survey of Risks in Supply Chain 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.
Mid semester - theory - 15
End semester theory - 15
Lab assignments - 10 marks
Home assignment - 10 marks
Course project - 10 marks
Seminar - 10 marks
Group discussion – 10 Marks
Orals - 10 marks

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

1. Sunil Chopra & Peter Meindl, Supply Chain Management - Strategy, Planning & Operation –Pearson Education

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

1. Bowersox , Logistical Management - The Integrated Supply Chain Process
2. Christopher, Logistics & Supply Chain Management, Pearson Education
3. Logistics & Supply Chain Management – Raghuram
4. Business Logistics / Supply Chain Management – Ronald Ballou, Peason Education.

Moocs Links and additional reading material: www.nptelvideos.in
https://nptel.ac.in/courses/110/106/110106045/
https://www.coursera.org/learn/supply-chain-analytics-essentials
https://www.coursera.org/specializations/supply-chain-management?

Course Outcomes:
1. Identify the key elements and processes in a supply chain and their interaction
2. Understand and analyze the designing, planning and operational decisions of SCM.
3. Identify the techniques used in management of critical components of supply chain
4. Analyze, design and optimize supply chain networks for manufacturing organizations
5. Design and optimize inventories across the supply chain
6. Explain the likely future development of logistics and supply chain management

CO PO Map

CO attainment levels
CO-1 :3
CO-2 :3
CO-3 :3

CO-4 :4 CO-5 :4 CO-6 : 4
Future Courses Mapping: Design for X, Project Management, Business Operations Modelling
Job Mapping: Buyer / Purchase Engineer Logistics Executive Supply Chain Engineer Supply Chain Analyst

FF No. : 654

IE3207::STATISTICAL QUALITY & RELIABILITY ENGINEERING

Course Prerequisites:

1) Basic knowledge of descriptive and inferential statistics.
2) Good knowledge of probability theory, probability rules and conditional probability.
3) Fundamental knowledge of manufacturing systems, manufacturing shop floor operations and principle of interchangeability for the product assembly lines**.**

Course Objectives:

To impart knowledge and skills related to

1. Product quality and its importance**, v**arious features of product quality and its different types.

2. Various techniques of statistical sampling and sampling plans for product quality assurance.
3. Ascertain the cost of product quality and its impact on managerial decision making.
4. Various features of product reliability and its improvement.
5. Trade-offs among reliability,maintainability and availability**.**

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Credits:....5.... **Teaching Scheme Theory: ……3...** Hours/Week

Tut: ……1... Hours/Week

Lab: **…2…...** Hours/Week

Course Relevance: Knowledge and skills of "Statistical Quality" are essential for any production engineer to play the role of "Production In-charge / production supervisor/ Quality supervisor " effectively on the manufacturing shop floor of any product manufacturing company.

Knowledge and skills of Reliability engineering are essential for any production engineer to work in either the design department, Research and development department or Quality improvement department of any manufacturing company**.**

SECTION-1
1. Introduction: Meaning of Quality, Characteristics of Quality, Quality of Product versus Quality of Service, Cost of Quality – Prevention Costs, Appraisal Costs, Value of Quality, Cost-Quality Trade-off.Quality Improvement Tools: 7 QC Tools – Check Sheet, Histogram, Pareto Chart, Fishbone Diagram, Run Charts, Scatter Diagram, Process Flow Chart. Quality Function Deployment, FMEA 2. Review of fundamentals of Probability and Statistics : Measures of frequency distribution, Theory of probability, conditional probability, Discrete and continuous probability distributions, Sampling distribution of sample means, Central Limit Theorem 3. Control charts for variables : causes of variation, objectives of control charts, frequency of sampling, control limit calculations, SPC and process capability studies, selection of appropriate control chart, numerical problems 4. Control charts for attributes: necessity and importance, types, control limit calculations, sample collection and analysis, control charts plotting and interpretation, selection of appropriate control chart, numerical problems
SECTION-1I

1) Acceptance sampling : Fundamental of acceptance sampling, operating characteristics OC curve and its characteristics, Single, double, multiple and sequential sampling plans, comparison and selection of appropriate sampling plan, numerical problems
2) System Reliability : Definition, Series, parallel and mixed configurations, Reliability Block diagram and models, Techniques and methods to improve system safety and reliability, reliability cost trade offs , prediction and analysis, numerical problems
3) Maintainability and Availability : Introduction, definition and characteristics, Trade off among reliability, maintainability and availability, various maintenance strategies, Reliability optimization, Failure consequence and liability management, warranty management,
4) Six Sigma
5) TQM
6) DOE, ANOVA, Regression

List of Tutorials: (Any Three)

1. Quality assessment of Engineering Product
2. Descriptive statistics and measures of frequency distribution
3. Review of probability theory.
4. Control charts for variables
5. Control charts for attributes
6. Design of a single/double/ multiple/ sequential sampling plan
7. House of Quality and QMS
8. ISO certification procedure and benefits
9. Reliability calculations for series, parallel and mixed configuration systems.
10. Failure rate analysis and Bath-tub curve

List of Practicals: (Any Six)

1) Case on Constructing House of Quality (QFD) for any Product
2) Probability Distributions : Discrete and Continuous
3) Inferential Statistics using MS EXCEL
4) Control charts for Variables
5) Control charts for attributes
6) Case study on Failure Mode and Effect analysis (FMEA)
7) Case on Constructing House of Quality (QFD) for any Service
8) SPC and Process capability studies
9) Product and System Reliability
10) FMEA

List of Projects:

1. Project on Design Of Experiment
2. Application of FMEA in Real Life Situation
3. Development of Quality Function Deployment for specific product/ service/ real life situation
4. Project on Application of Quality Control tools for specific product/ service/ real life situation.
5. Quality improvement analysis for service organisation
6. Quality improvement analysis for Manufacturing Organisation
7. Project on Process Improvement through Six Sigma I (Define, Measure and Analyse phase)
8. Reliability analysis for specific product/ service/ real life situation
9. Maintainability and Availability analysis for specific product/ service/ real life situation
10. Project on Taguchi Robust Design

List of Course Seminar Topics:

1. Quality of Product versus Quality of Service
2. Contribution of Quality Gurus
3. Fundamentals of Probability and Statistics
4. Quality Control tools
5. Lean Six Sigma
6. Taguchi Robust Design
7. Reliability & Maintenance
8. FMEA
9. Data Analytics for Quality Improvement
10. Quality perspective in Industry 4.0

List of Course Group Discussion Topics:

1. Role of descriptive statistics and probability theory in Quality Engineering
2. Role of Inferential Statistics in Quality Engineering
3. Statistical Process Control : Design and Benefits
4. Role of Control charts in Quality Assurance
5. Use of process capability studies in Quality Engineering
6. Sampling plans for Quality Assurance : Design and Benefits
7. Product and system Reliability : Need and Benefits
8. FMEA : Design and Benefits
9. Bath-Tub-Curve and Maintenance Strategies
10. Maintainability and Availability

List of Home Assignments:

Design:

1. Design of QFD to evaluate customer voice
2. Design of Experiments for specific issue
3. Design of quality improvement tools for specific problem
4. Design of statistical analysis for quality issue
5. Design of control charts

Case Study:

1. Quality Assurance system for specific organisations
2. Case study on DOE
3. Case study on FMEA
4. Case study on Reliability analysis
5. Case study on Statistical Process Control

Blog

1. Evolution of Quality improvement movement
2. Quality & Customer satisfaction
3. Maintenance Strategies
4. Control charts in Quality Assurance
5. System reliability for quality improvement

Surveys

1. Analysis of quality parameters
2. Impact of quality parameters on customer satisfaction
3. Quality assessment
4. Survey of system reliability parameters
5. Quality tools impact analysis

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.

Lab : 10 marks
Course project : 10 marks
Seminar: 10 Marks
GD : 10 marks
Home Assignment : 10 marks
ESE: 50 marks (No MSE is required, ESE is sufficient due to heavy submission work during the entire semester.)

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

1. Amitav Mitra, Fundamentals of Quality Control & Improvement, Pearson Education
2. Phadke, Quality Engineering using Robust Design, Pearson Education
3. Charles E.Ebeling Reliability and maintainability engineering.,TMH (2000)
4. J.M. Juran & F.M.Gryna , Quality Planning and Analysis.
5. Feigenbaum A. V. , Total Quality Control, McGraw Hill

6. Rao S. S., Reliability Based Design, McGraw Hill

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

1. Juran's Quality Control Handbook.
2. E.L.Grant & R.S. Leavenworth, Statistical Quality Control, McGraw Hill
3. Kaoru Ishikawa, Guide to Quality Control, Asian Productivity Organisation, Tokyo.
4. ISO 9000 Quality Management System , International Trade Center, Geneva
5. Connor, P.D.T.O., Practical Reliability Engineering, John Wiley (1993).
6. Green A.E., and Bourne A.J. Reliability, Technology, Wiley Interscience, 1991

Moocs Links and additional reading material:

Asq.org
goskills.com/course/Staitistical-Process-Control
apanacourse.com/course/spc
My-mooc.com
uwm.edu/sce/courses
qualitytrainingportal.com/courses/baisc-spc
udemy.com/SQC
edex.org/learn/quality-control
Academy.alchemysystem.com
engineering.purdue.edu/SQC
nptel.com/quality

Course Outcomes: Student will able

1) To understand various features of product quality and its different types.
2) To apply various techniques of statistical sampling and sampling plans.
3) To analyze and ascertain the quality and its influences.
4) To select appropriate sampling plan for quality control analysis
5) To comprehend various features of product reliability and its improvement.
6) To comprehend various features of maintenance strategy

CO PO Map

CO attainment levels: CO1-4, CO2-4, CO3-4, CO4-4

Future Courses Mapping:

1) Product Life-cycle Engineering

2) Advanced Reliability Engineering
3) Quality Management systems (QMS)

Job Mapping:
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

FF No. : 654

IE3242::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: 5 **Teaching Scheme Theory: 03** Hours/Week
Tut: 01 Hours/Week
Lab: **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
Lean Manufacturing – Definition & Concept. Characteristics of Lean Manufacturing.Concept of MUDA, MURA & MURI, Value Added and NVA activities **Value Stream Mapping** – VSM Symbols, Current State and Future State, Kaizen-Types,Format. Kaizen Development, **Toyota Production System**- Toyota's 14 Principles of Management, Problem Solving Approach, **Design of JIT**- Pull System, Kanban-Types, Calculations of Kanban, Concept ofStandard Work – Standardization, Standard Operating Procedures **Set-up Time Reduction**: SMED Methodology for Set-up reduction, OTED (One Touch Exchange of Dies), Quick Attachment Devices. **Group Technology** 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. **Cellular Manufacturing**: Work cell concepts and applications, Work cell design, work cell staffing and equipment issues. **Japanese Lean Principles:** Heijunka (Resource Leveling), Jidoka (Autonomation), Genechi Genbitsu (Go and See)
SECTION-1I
Maintenance Management – Breakdown, Preventive, Predictive. Total Productive Maintenance (TPM): Concept & Origin, Outline of TPM – 8 Pillars, TPM Performance Measures – PQCDSM & OEE (Overall Equipment Effectiveness), Introduction to Autonomous Maintenance (Jishu Hozen) activities, Planned Maintenance, Small-Group activities of TPM, Predictive Maintenance Analytics **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 **Workplace Safety Management**- Introduction to Industrial Safety, OSHA Requirements, Hazard Analysis, Fault Tree Analysis, HAZWOPERM - Hazardous Waste Operations and Emergency Response Management, Workplace Safety Analytics **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)

1) Waste Identification and Classification -3M of Lean
2) Kaizen preparation- operator or circle level
3) Standardization of processes
4) Design Work Cell as per requirements
5) Identification and Reduction TPM Losses
6) Autonomous Maintenance -Jishu Hozen
7) Use of SIPOC Diagram
8) Identification of Bottleneck and constraint classification
9) Use of constraint management tools like CRT, FRT, Evaporating Cloud etc
10) Relevance of Industry 4.O in WCM

List of Practicals: (Any Six)

1. Value Stream Mapping- Current State and Future State **(e-VSM Software)**
2. Design of JIT / Kanban System for manufacturing firm
3. Design of Single Piece Flow
4. Assignment based on SMED approach
5. Group Technology- Cellular Manufacturing
6. Assignment on TPM Performance Measures
7. Assignment on Overall Equipment Effectiveness
8. Understanding and Implementation of 5S
9. Application of Theory of Constraints-
10. TOC based Case study
11. Industry 4.O applications

List of Projects:

1. Value Stream Mapping, (e-VSM Software)
2. Kaizen Improvement Projects
3. Setup Time Reduction using SMED approach
4. Autonomation (Jidoka) and Andon implementation
5. Kanban, JIT feasibility and implementation
6. Group Technology and Cellular Manufacturing
7. TPM- KK Pillar, Overall Equipment Effectiveness,
8. TPM-Pillars- JH and PM
9. TPM Abnormalities
10. 5S Implementation
11. Developing Maintenance Schedule
12. Standardization - Formation of SOP, Work Instructions
13. Theory pf Constraints Applications- (Goldratt's TOC Software)
14. Lean Applications in Services
15. Industry 4.O applications.

List of Course Seminar Topics:

1. Core of Lean – 3M: Muda, Mura and Muri in Manufacturing and Service sector
2. Lean Principles and its applicability in Manufacturing and Service sector
3. Value Stream Mapping
4. Just in Time Philosophy – Kanban in action
5. Achieving Flexibility by using SMED
6. Total Productive Maintenance
7. Toyota Production System – 4P's and 14 Principles
8. Theory of Constraints approach and Constraint Management
9. Integration of lean with Industry 4.O
10. Industry 4.O technologies and Operational Excellence

List of Course Group Discussion Topics:

1. Is there linkage between Lean Management and Order winners / Order Qualifiers ?
2. How should Companies attack to implement Lean – MUDA, MURA, MURI
3. Why companies fail to copy Toyota Production System (TPS) ?
4. Lean in Services – Feasibility, Challenges and Benefits.
5. TPM is way of doing business or just another certification
6. Lean Implementation in MSME India.
7. TPM is boon or just another certification?
8. Want Business Excellence: Choose Appropriate Strategy. Lean / TPM / TOC/ Any other?
9. Integration of Lean and Industry 4.O
10. Does Industry 4.0 really needed along with WCM in Indian companies.?

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.O 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.O

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

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.

Mid semester - theory - 15
End semester theory - 15
Lab assignments - 10 marks
Home assignment - 10 marks
Course project - 10 marks
Seminar - 10 marks
Group discussion – 10 Marks
Orals - 10 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, 2nd 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
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 attainment levels

CO1- 3
CO2- 3
CO3- 3
CO4- 4
CO5-4
CO6-4

Future Courses Mapping:
Logistics & Supply Chain Management, Project Management, Design For X

Job Mapping:
Industrial Engineer
TPM Facilitator
Lean Implementer
Service sector industries
Health care

FF No. : 654

IE3239::OPERATIONS MODELING SIMULATION

Course Prerequisites:

Course Objectives:

1. Understanding of Concept and application of Single Objective Optimization
2. Understanding of Concept and application of Queuing model Optimization
3. Understanding of Concept and application of Replacement Optimization
4. Understanding of Concept and application of Multiple Objective Optimization
5. Understanding of Concept and application of Multi stage big problem Optimization

Credits:04 **Teaching Scheme Theory: 03** Hours/Week
Lab: 02 Hours/Week

Course Relevance: Industrial engineering basically talks about optimization of resources and Optimization & Simulation concepts are the main things used for that purpose.

SECTION-1

Single Objective Optimization -

Introduction & Formulation of LP Model OR methodology, Definition of OR, Application of OR to engineering and Managerial problems, Features of OR models, Limitation of OR, formulation LPP Models. Definition, mathematical formulation, standard form, solution space, solution – feasible, basic feasible, optimal, infeasible, multiple, optimal, Redundancy, Degeneracy. Graphical and simplex methods. Variants of simplex algorithm – Artificial basis techniques, Big M Method, sensitivity analysis, Special cases in simplex

Queuing Theory-

Introduction, terminology, Customer Behaviors, Different Queuing Models, (M /M /1): (GD/∞/∞) Model, , (M /M /1): (GD/N/∞) Model, (M /M /1): (GD/ N / N) Model, (M /M /C): (GD/∞/∞) Model (M /M /C): (GD/N/∞) Model, (M /M /C): (GD/ N / N) Model, Tandem queuing concept– M/Ek/1 Model Simulation: Definition, Introduction to Monte Carlo Simulation., Application, Different Problems solved using Monte Carlo Simulation, Understanding the results

Game Theory & Replacement Analysis-

Introduction, two -person zero sum game, minimax and maximin principle, saddle point, methods for solving game problems with mixed strategies, Graphical and iterative methods, solving game by LP Method. Replacement of capital equipments that deteriorates with time, time value of money (a) remains same (b) changes with constant rates during period. Equipment renewal policy, group and individual replacement. Individual Replacement, Group Replacement Policies, Problems

SECTION-1I

Multi Objectives Optimization & Multi criteria decision making methods -

Goal Theory Programming, Priority and non Priority Goals, Minimization of deviations of Goal, Under achieving and over achieving of Goal, Simplex method applied for Multi Objective Optimization problems. Multi criteria decision making methods like SAW, TOPSIS, PROMETHEE, Electra etc.

Integer And Dynamic Programming -

Integer Programming: Branch & bound method, Maximization case and minimization case, cutting plane method, superior cut design, Design of first cut , second cut.

Dynamic Programming: Introduction, application, capital budgeting, cargo loading, reliability problem, Shortest distancing method, different problems solved by dynamic programming

Decision Tree & Non linear Programming -

Logic Decision making under risk (EMV criteria) and Decision making under uncertainty. Laplace method, Hurwics Method, Salvage Method, Maxi Min Method. Minimax method, Non linear Programming methods like Lagrangian, Kuhn Tucker ,

List of Practicals: (Any Six)

1. Assignment on Simplex methods in Linear Programming Problems
2. Assignment on Sensitivity Analysis in Linear Programming Problems
3. Assignment based on any two Models of queuing theory
4. Assignment based on Multi stage queuing Model
5. Assignment based on replacement model
6. Assignment based on Game theory
7. Assignment based on Integer programming
8. Assignment based on Dynamic programming
9. Assignment based on Goal Programming
10. Assignment based on Decision making tools

List of Projects:

1) Queuing model application in Banks
2) Queuing model application in OPD of Hospital
3) Queuing model application in Shop floor activities
4) Single Objective Optimization project
5) Replacement projects
6) Game Theory Projects
7) Goal Programming projects
8) Dynamic programming Project
9) Integer Programming Project
10) Decision Making tree Project

List of Course Seminar Topics:
1. Duality concept in L P Model
2. Simplex Method in L.P. Model
3. Tandem queuing Concept
4. Waiting time calculation in service sector
5. Strategy management
6. Individual Replacement policy
7. Group Replacement policy
8. Topsis Application
9. Promethee application
10. Shortest Distancing concept

List of Course Group Discussion Topics:
1. Dual simplex concept in L P Model
2. Sensitivity Method in L.P. Model
3. Customer behaviour Concept
4. Simulation in service sector
5. Time value for money in replacement
6. Salvage value concept in replacement
7. Multi criteria Decision making
8. Branch Bound method
9. Kuhn Tucker method
10. Lagrangian Method

List of Home Assignments:

Design:
1. Designing of Single server design system
2. Designing of Multiple server design system
3. Designing of Single server finite holding capacity system design
4. Designing of Multiple server finite holding capacity system design
5. Design of Tandem queuing system

Case Study:
1. Individual Replacement policy
2. Group Replacement policy
3. Game Theory application
4. Big M method application
5. Graphical Method application

Blog
1. Topsis method
2. Promethee method
3. Electra method

4. SAW method
5. AHP method

Surveys
1. Use of Optimization in product mix case
2. Use of simulation in production line management
3. Use of Integer programming
4. Use of dynamic programming in salesman allocation to different districts
5. Use of non linear optimization in real life

Suggest an assessment Scheme:
Mid semester - theory - 15
End semester theory - 15
Lab assignments - 10 marks
Home assignment - 10 marks
Course project - 10 marks
Seminar/Group discussion - 10 marks
Orals - 20 marks

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

1. Taha H A Operation Research and Introduction 9th Edition Pearson Education 2014
2. Gupta & Hira Operations Research Revised Edition Chand & Co. 2007
3. Paneerselvam Operations Research Second Edition Prentice Hall of India 2009

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

1. Hiller and Libermann Introduction to Operation Research 9th Edition McGraw Hill 2011
2. S.D. Sharma Operations Research 15th Edition Kedarnath, Ramnath & Co
3. J K Sharma Operations Research 3rd edition Laxmi Publications 2009

Moocs Links and additional reading material: www.nptelvideos.in

Course Outcomes:

1. Understand scope of optimization in industrial and business organizations.
2. Recommend specific type of queuing system for the given situation
3. Explain the need of optimization and its various uses.
4. Apply Game theory and Replacement analysis techniques.
5. Understand Integer and Dynamic Programming techniques in real life situations.
6. Application of Decision making under uncertainty.

CO PO Map

C01-Po1
C02-Po2
C03-Po2
C04-Po3
C05-Po4

CO attainment levels
CO1- 3
CO2- 3
CO3- 3
CO4- 4
CO5-4

Future Courses Mapping:
Advanced optimization techniques

Job Mapping:
Optimization oriented jobs of industry

Title: Course Structure				**FF No.: 653**
Branch: Industrial Engg	**Year:** B Tech	**Academic Year:** 2021-22	**Semester:** I & II	**Module:** VII & VIII
Pattern: D-21				

Final Year B. Tech. Industrial Engineering AY 2021-22 (C21)

Sr. No.	Subject Code	Subject Name	Teaching Scheme (Hrs/Week)			Examination scheme							Total	Credits
			Theory	Lab	Tut	CA				MSE	ESA			
						HA	Lab	Seminar	GD	MSE	ESE	CVV		
S1	MD4202	Project Management	2	-	-	10	-	-	-	30	30	30	100	2
	MD4205	Marketing Management	2	-	-	10	-	-	-	30	30	30	10	-
	MD4206	Financial Management & Costing	2	-	-	10	-	-	-	30	30	30	10	-
S2	IE4211	Design For X and Product Life Cycle Management	2	-	-	10	-	-	-	30	30	30	100	2
	????	???? ????	2	-	-	10	-	-	-	30	30	30	10	-
S3	IE4212	Data Analytics for Engineers	2	-	-	10	-	-	-	30	30	30	100	2
	????	???? ????	2	-	-	10	-	-	-	30	30	30	10	-
S4	IE4274	Major Project	-	-	-	-	-	-	-	-	-	-	100	10
	IE4285	Major Project	-	-	-	-	-	-	-	-	-	-	100	10
		Total												**16**
S1	IE4271	Industry Internship	-	-	-	-	-	-	-	-	-	-	100	16
	IE4272	Research Internship	-	-	-	-	-	-	-	-	-	-	100	16
	IE4273	International Internship	-	-	-	-	-	-	-	-	-	-	100	16
	IE4276	Capstone Project	-	-	-	-	-	-	-	-	-	-	100	16
		Total												**23**

FF No. : 654

MD4201:: ENGINEERING AND MANAGERIAL ECONOMICS

Course Prerequisites:

Concepts of various costs, income and expenditure

Course Objectives:

1. To understand the Fundamental Economic Concepts
2. To understand the techniques of Inflation Factor
3. To understand market structure and pricing theory
4. To understand the concept of depreciation and its effects
5. To understand cash flows analysis

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

Tut: ……... Hours/Week

Lab: ……... Hours/Week

Course Relevance: Basic knowledge of Economics for working in industry

SECTION-1
Introduction To Economics- Flow In An Economy, Concept Of Engineering Economics – Engineering Efficiency, Revision of concepts like Economic Efficiency, Scope Of Engineering Economics – Element Of Costs, Marginal Revenue, Sunk Cost, Opportunity Cost, Break Even Analysis -P/V Ratio, Elementary Economic Analysis **Interest Formulae and Applications** –Time Value Of Money, Single Payment Compound Amount Factor, Single Payment Present Worth Factor, Sinking Fund Factor, Equal Payment Series **Methods Of Comparison Of Alternatives** – Present Worth Method (Revenue Dominated Cash Flow Diagram), Future Worth Method (Revenue Dominated Cash Flow Diagram, Cost Dominated Cash Flow Diagram), Annual Equivalent Method (Revenue Dominated Cash Flow Diagram, Cost Dominated Cash Flow Diagram), Rate Of Return Method, Examples In All The Methods.

SECTION-1I

Replacement And Maintenance Analysis – Types Of Maintenance, Types Of Replacement Problem, Determination Of Economic Life Of An Asset, Replacement Of An Asset With A New Asset – Capital Recovery With Return And Concept Of Challenger And Defender, Simple Probabilistic Model For Items Which Fail Completely

Depreciation- Introduction, Straight Line Method Of Depreciation, Declining Balance Method Of Depreciation-Sum Of The Years Digits Method Of Depreciation, Sinking Fund Method Of Depreciation/ Annuity Method Of Depreciation, Service Output Method Of Depreciation

Evaluation Of Public Alternatives- Introduction, Examples, Inflation Adjusted Decisions – Procedure To Adjust Inflation, Examples On Comparison Of Alternatives And Determination Of Economic Life Of Asset

List of Tutorials: (Any Three)

1. Currency Fluctuations
2. types of taxes (Direct & Indirect)
3. Numerical on Depreciation
4. Numerical on Discount Rate, Compound Rate,
5. Numerical on Present Worth, Future Worth,
6. Numerical on Annual Worth
7. Numerical on Annuity
8. Numerical on Perpetuity.
9. Numerical on Life Cycle Costing
10. Types of Competitions

List of Practicals: (Any Six)

1. Case on effect of Currency Fluctuations on decision making
2. Study of types of taxes applicable to the industry and its impact on profitability.
3. Numerical on Depreciation
4. Numerical on Discount Rate, Compound Rate,
5. Numerical on Present Worth, Future Worth,
6. Numerical on Annual Worth
7. Numerical on Annuity
8. Numerical on Perpetuity.
9. Numerical on Life Cycle Costing
10. Study of Various Types of Competitions and its applicability to industrial sectors

List of Projects:

1. Currency Fluctuations on decision making
2. Study of types of taxes (Direct & Indirect) applicable to the industry of student's choice and its impact on profitability.
3. Depreciation
4. Discount Rate, Compound Rate,
5. Present Worth, Future Worth for investments
6. Annual Worth
7. Annuity
8. Perpetuity.
9. Life Cycle Costing - Product / Service
10. Study of Various Types of Competitions in any industrial sector.

List of Course Seminar Topics:

1. Element Of Costs
2. Break Even Analysis
3. P/V Ratio
4. Concept Of Challenger And Defender
5. Interest Formulae And Their Applications
6. Types Of Maintenance
7. Declining Balance Method Of Depreciation
8. Effect of Currency Fluctuations on decision making
9. Future Worth for investments
10. Determination Of Economic Life Of An Asset

List of Course Group Discussion Topics:

1. Marginal Revenue
2. Opportunity Cost
3. Sunk Cost
4. Time Value Of Money
5. Replacement Of An Asset With A New Asset
6. Comparison Of Alternatives And Determination Of Economic Life Of Asset
7. Evaluation Of Public Alternatives during inflation
8. Types of taxes (Direct & Indirect) and domestic competition
9. Types of taxes (Direct & Indirect) and international competition
10. Procedure To Adjust Inflation - Government's role

List of Home Assignments:

Design:

1. Design Investment Plan
2. Design Replacement Plan for an Equipment
3. Design financial alternatives for working capital
4. Design optimum maintenance plan
5. Design life cycle costing for product / service

Case Study:

1.Case study on Currency Fluctuations
2. Case Study on types of taxes (Direct & Indirect)
3. Case Study on Depreciation
4. Case study on Replacement Of An Asset With A New Asset
5. Case study on Alternatives And Determination Of Economic Life Of Asset

Blog

1.Currency Fluctuations and hedging
2. Types of Competitions in an industrial sector
3. Alternatives And Determination Of Economic Life Of Asset
4.Future Worth for investments
5.Types of taxes (Direct & Indirect) and its impact on profitability

Surveys

1. Investments
2. EMI
3. Replacement of cars/mobiles
4. SIP of Mutual Funds
5. Equity Markets Investments

Text Books:

1. Panneer Selvam, R, "Engineering Economics", Prentice Hall Of India Ltd, Second Edition ,New Delhi, 2013
.2 Banga and Sharma, "Industrial Organisation and Engineering Economics", Khanna Publishers,Twenty Fifth ,2006

Reference Books:

1. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics And Analysis" Engg. Press, Texas, 2010.
2 Degarmo, E.P., Sullivan, W.G And Canada, J.R, "Engineering Economy", Macmillan, New York, 2011.
3 Zahid A Khan: , "Engineering Economy", Dorling Kindersley, 2012

Moocs Links and additional reading material: www.nptelvideos.in

1. Economics for Engineers - NPTEL course

Course Outcomes:

1. The students will be able to understand the Fundamentals Economics

2. The students will be able to understand effect of Inflation and value of money
3. The students will be able to analyse market situation with respect to economics
4. The student will be able to calculate depreciation and its effects
5. The student will be able to analyse cash flows
6. The student will be able to understand direct and indirect taxes

CO PO Map
CO 1,2,3,4,5,6 -> PO 1,6,7,8,9,10,11,12

CO attainment levels
CO 1 - 3
CO 2 - 3
CO 3 - 4
CO 4 - 4
CO 5 - 4

Job Mapping:
Financial Consulting Organisations, Banking

FF No. : 654

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

Tut: 0 Hours/Week

Lab: **0** Hours/Week

Course Relevance:.....

SECTION-1
Product Life Cycle & Product Design 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 **Design for Manufacture & Assembly** 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-1I

Design for Quality, Reliability and Maintainability

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

Design for X (Specific Purpose)

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)

1. Product Design and New Product Development
2. Human factors in Engineering design
3. Selection of Material
4. Selection of Shapes
5. Basic principles of DFMA
6. Design for casting
7. Design for machining
8. Design for material forming
9. Design for plastic processing
10. Optimization of design
11. Design for Specific Purpose – DFX (Logistics, Cost, Aesthetics, Environment etc.)

List of Practical's: (Any Six)

Case studies & Problem solving and sketching figures for *any 06* of following:

1. Product Life Cycle Management
2. Design for Manufacturing – Conventional Processes
3. Design for Assembly: Welding/ Brazing
4. Design for Assembly: Adhesive and Bolting Processes
5. Design for quality
6. Quality Function Deployment
7. Design for reliability
8. Failure Mode Effect Analysis –FMEA
9. Design for Safety
10. Design for Maintenance
11. Design for Specific Purpose – DFX (Delayed differentiation, Sustainability etc.)

List of Projects:

1. Product Design
2. New Product Development - NPD
3. Product Life Cycle Management
4. Technology Development
5. Design for Manufacturing (Boothroyd Dewhurst DFMA Software)
6. Design for Assembly(Boothroyd Dewhurst DFMA Software)
7. Design for Quality and Reliability
8. Design for Maintainability
9. Design for Specific Purpose (DFx) viz. Recycling, Reverse Logistics etc.
10. Failure Mode Effect Analysis(FMEA software)
11. Quality Function Deployment
12. Design for Safety and Environment.

List of Course Seminar Topics:

1. Role of Product Design in Business
2. New Product Development as competitive advantage
3. Product Life Cycle Management – Extended strategies
4. Technology Development
5. Design for Manufacturing- Principles and Applications
6. Design for Assembly- Principles and Applications
7. Design for Quality and Reliability - Principles and Applications
8. Design for Maintainability – MTBF, MTTR, MTTF
9. Design for Specific Purpose (DFx) viz. Recycling, Reverse Logistics etc.
10. Failure Mode Effect Analysis(FMEA software)
11. Quality Function Deployment
12. Design for Safety and Environment.

List of Course Group Discussion Topics:

1. Product Life Cycle Management is essential or just marketing jargon
2. Product Design is competitive advantage or NOT?
3. DFMA – Pros and Cons in real life
4. Challenges of DFMA implementation
5. Relevance between “Selection of Equipment” and MTBF / MTTF / MTTR
6. What is more important MTBF / MTTF / MTTR ? When? Why?
7. Are Sustainability and Profitability mutually exclusive?
8. How to select a manufacturing process for a part given?
9. How to select an assembly process for a product given?
10. Importance of Maintenance while buying or selection of a new machine / product?

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 - theory - 15
End semester theory - 15
Lab assignments - 10 marks
Home assignment - 10 marks
Course project - 10 marks
Seminar - 10 marks
Group discussion – 10 Marks
Orals - 10 marks

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

1. Dieter George E, Engineering Design, 3rd 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

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 Convential 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 1,2,3,4,5,6 -> PO 1,6,7,8,9,10,11,12

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

FF No. : 654

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 Handing 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, MLTool, BI Tools

SECTION-1I

Machine Learning :
Data Visualization - Matplotlib, Data Analysis Using Python Modules- Numpy, Pandas,Tableau Machine Learning Algorithms Supervised Learning Regression Linear Regression (Simple and Multiple) Logistic Regression.
Machine Learning Algorithms :
Supervised Learning Regression Linear Regression Multiple Linear Regression Bias-Variance Trade-Off
Classification Modelling :
Logistic Regression, K-Nearest Neighbors (KNN), Simple Vector Machine (SVM), Decision Trees o Ensemble Methods - Random Forest
Unsupervised Learning Clustering :
K-Means Clustering Hierarchical Clustering DBSCAN

List of Practicals: (Use of Excel / R / Python / Minitab / SAS / SPSS/Google Data Studio)

1. Data analysis using Google data studio
2. Data analysis and visualization using Tableau
3. Estimation in Statistics using Python
4. Test of significance for means, proportion, variance using Python
5. Regression, Correlation problems from kaggle using Python
6. Develop a python application that extracts the information on Land Cover and Land Use from a satellite image. Design a python program to extract the meaningful information from the images available from satellite.

List of Projects:

1. Questionnaire design in Marketing
2. Exploratory Research using secondary data from websites / magazines
3. Exploratory Research using primary data for canteen / hostel / flats
4. Descriptive Research
5. Data analysis in MS Excel
6 Discrete probability distributions in industry
7 Design of field surveys for food apps
8 Methods of sampling
9 Continuous probability distributions in industry
10 Sensex Analysis
11 Brent Crude Analysis
12 Correlation between various sectors
13 Forecasting of values
14 Academic result analysis
15 Developing small tools/programs in R/Python

List of Course Seminar Topics:

Bayesian Data Analysis
Educational data mining
Business intelligence predictive Analytics
Big data and Business Intelligence(BI) or Market Intelligence (Related: Big Data)
Open source Data Mining
Data Mining System
Data mining Trends
Health data mining
Web Analytics solution
Data Mining marketing
Data Mining in Search Engine Analytics (related SEO)
Tools for Data Cleaning and Munging
Text Classification
Evaluation Methods for Machine Learning
Integrating Big Data platforms with traditional DW/BI environmentsData visualization and in-memory data
NoSQL BI Tools and applications
Analyzing Big Data using Self-Service BI Tools,
Using Data virtualization to simplify access Big Data and traditional DW/BI systems
SQL connectivity initiatives to Big Data
Managing stream computing in a Big Data environment
MapReduce developer tools
Creating Sandboxes for Data Science projects
Tools for ETL processing
Creating a multi-platform analytical ecosystem
The role of Data Virtualization in a Big Data environment
Multi-platform optimization – the new trend in Big Data Analytics
Governing data in a Data Science environment

Analytical databases and DW appliances
Graph databases
Streaming data at high velocity
Structured data analysis
Multi-structured data analysis

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" ,OReilly Media Inc. 2013
2. Samir Madhavan, "Mastering Python for Data Science", PACKT publishing, 2015
3. Jake Vanderplas, "Python Data-science Handbook" , OReilly Media Inc. 2017
4. Joel Grus, "Data science from Scratch , First Principles with Python" , OReilly 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
[4].Tom Mitchell, "Machine Learning", 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]. MadhavanMukund, (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

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

FF No. : 654

IE4211::FINANCIAL MANAGEMENT & MANAGEMENT ACCOUNTING

Course Prerequisites:

Basic concepts of cost, profit, loss, debit and credit.

Course Objectives:

Students will be able to:
1.Understand ,analyze and interpret financial statements
2.Understand concept of financial accounting for analysis of financial statements of a business.
3.Develop an ability of decision making about investments.

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

Tut: ……... Hours/Week

Lab: **……...** Hours/Week

Course Relevance: Basic knowledge of Finance for working in a industry

SECTION-1
1. Financial Statement Analysis- Nature and Scope of Finance Function; Financial goal profit vs. wealth, Maximization; Scope and Functions of Financial Management, Financial Planning and Forecasting. Budgets & Budgetary Control: Types of Budget, Preparation of Budgets: Operational & Financial Budgets, Financing and Dividend decisions. Types of accounts, bookkeeping, Profit and Loss Account and Balance Sheet, Cash Flow Statement **2. Capital Budgeting and ratio Analysis** -Ratio Analysis Classification, Ratio Analysis and its limitations. Types of Ratios, Activity Turnover, Profitability, Liquidity, etc., B: Common Size Statement, Index Statement, Capital Budgeting - Nature of Investment decisions; Investment evaluation criteria - Non-DCF & DCF Techniques, PBP, Discounted PBP, PI, ARR, Annual Worth **3. Working Capital Management** - Meaning, significance and types of working capital; calculating operating cycle period and estimation of working capital requirements; sources of working capital, NPV and IRR comparison; Capital rationing. Various committee reports on bank finance; Dimensions of working capital management.
SECTION-1I

4. Introduction to concept of Cost and Overheads - Cost, Cost Centre, Cost Unit, Elements of Cost: Material Cost. Different methods of pricing of issue of materials Labour Cost: Direct & Indirect cost, Different methods, Direct Expenses:Constituents and Significance, Prime Cost, Classification: Production, Office & Administration, Selling & Distribution. Treatment of Overheads: Collection ,Primary and Secondary Distribution and Absorption of Overheads Machine, Labour hour rate,Under/Over Absorption of Overheads, Preparation of Cost Sheet

5. Costing Methods - Job Costing, Unit Costing, Contract Costing, Process Costing, Activity Based Costing Simple numerical on various methods of costing to enable ascertains cost of product. Standard costing: Concept, Standard Cost, Standard costing. Calculation of Variance Numerical on calculation of variances, Variance – Variance Analysis

6. Marginal Costing and Break Even Analysis - Fixed & Variable (Marginal) Cost, Marginal Cost. Applications of Marginal Costing in Decision-making: Product Mix, Profit Planning, Make or Buy Decisions. Limiting Factor, Cost Volume Profit Analysis, Concept of Break-Even, P/V Ratio and Margin of Safety

List of Tutorials: (Any Three)

1.Capital financing
2.Working capital finance
3.Preparation of Journal entries, Ledgers
4.Profit and Loss Account and Balance Sheet
5.Ratio Analysis
6.Investment decisions
7.Product Costing
9.Service Costing.
10.Process Costing

List of Practicals: (Any Six)

1. Case study on sources of capital and working capital
2. Case study on assessment of working capital
3. Studying and understanding Financial Statements - Profit and Loss
4. Studying and understanding Financial Statements - Balance sheet
5. Studying and understanding various financial ratios used in practice
6. Studying and understanding various financial ratios for decision making
7. Case study on Analysis of published results of an organisation – Manufacturing
8. Case study on Analysis of published results of an organisation – Service industry
9. Prepare a cost sheet to estimate the cost of any product10. Prepare a cost sheet any process
11. Case study on use Marginal Costing to determine Break Even Point and profitability 12. Case study on use Marginal Costing to determine profitability

List of Projects:

1.Budgeting including sources of capital financing
2.Budgeting including sources of working capital finance
3.Preparation of Journal entries, Ledgers
4.Preparation Profit and Loss Account and Balance Sheet
5.Preparation of Balance Sheet
6.Ratio Analysis based on real life data from project on Profit and loss and Balance sheet
7.Compare Analysis of published results of organisations to enable investment decision
8.Apply Product Costing to estimate cost of any process used in practice
9.Apply Service Costing to estimate cost of any process used in practice
10.Apply Process Costing to estimate cost of any process used in practice
11.Apply Standard Costing to estimate cost of any process used in practice
12.Apply Marginal Costing to determine Break Even Point and profitability

List of Course Seminar Topics:

1.Sources of Capital Financing
2.Working Capital Management
3.Profit and Loss Account
4.Balance Sheet
5.Turnover and Ratios
6.Taxation
7.Product Costing
8.Service Costing
9.Process Costing
10.Investment Decisions

List of Course Group Discussion Topics:

1.Sources of Capital Financing - Bank or Investors.
2.Working Capital Management - Which is better - Less or More?
3.Profit and Loss Account
4.Balance Sheet - Effect on share prices.
5.Turnover and Ratios - which should be focused on?
6.Taxation - Fair or Unfair in India
7.Product Costing - does it drive Profits or Markets?
8.Service Costing - Quality or Cost?
9.Process Costing - Automation or Manual Labour?
10.Investment Decisions - Guts or Statistics?

List of Home Assignments:

Design:

1. Design a cost estimate for running a Shoe Company.
2. Design a cost estimate for running a Fabrication Shop.
3. Design a cost estimate for running an Online Book Company.
4. Design a cost estimate for running a Grocery Company.
5. Design a cost estimate for running a Data Science Company.

Case Studies :

1.Ratio Analysis based on real life data from project on Profit and loss and Balance sheet in any one sector Company (KPO/BPO, Manufacturing, Pharma,....

2.Compare Analysis of published results of organisations to enable investment decision

3.Apply Product Costing to estimate cost of any process used in any one sector Company (KPO/BPO, Manufacturing, Pharma,....

4.Apply Service Costing to estimate cost of any process used in any one sector Company (KPO/BPO, Manufacturing, Pharma,....

5.Apply Process Costing to estimate cost of any process used in any one sector Company (KPO/BPO, Manufacturing, Pharma,....

Blog

1. Taxation
2. Product Costing
3. Service Costing
4. Process Costing
5. Investment Decisions

Surveys

1. Interest Rates
2. Domestic Investment Decisions
3. Industrial Investment Decisions
4. Government Schemes
5. Suggestions about taxation.

Text Books:

1. Prasanna Chandra, Financial Management – Theory and Practi ce, Edition 8, 2011, Tata McGraw Hill Education,

2. B. K. Bhar, Cost Accounting– Methods and Problems, Academic Publishers,1980

3. M.Y. Khan and P K Jain, Financial Management: Text, Problems and Cases, Tata McGraw Hill Education

4.Amitabha Mukherjee and Mohammed Hani, Modern Accountancy, Edition 2, 2002, Tata McGraw Hill Education

Reference Books:

1. Paresh P. Shah, Financial Management, Reprint No. 2 2011, Biztantra, New Delhi,

2. S. N. Maheshwari, Introduction to Accountancy, Edition 11, 2013, Vikas Publishing House

3. M. Y. Khan, P. K. Jain, Management Accounting –Text, Problems, Cases, Edition No. Tata McGraw Hill Publishers, 2013

Course Outcomes:

1.Understand and analyze financial statements and budgeting, interpret accounting ratios
2.Understand the concepts of Capital Budgeting and Working Capital management
3.Understand the mechanics of financial accounting for preparation of financial statements to ascertain the performance and financial position of a business
4.Classify, apply different types of costs and overheads to ascertain costs of a product/ process
5.Apply costing methods as per the suitability for various production processes and services.
6.Develop decision making of optimum product mix, profit planning, make or buy decisions

CO PO Map

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

Job Mapping:

Better growth opportunities for higher Management positions.

FF No. : 654

IE4209::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

Tut: 0 Hours/Week

Lab: **0** Hours/Week

Course Relevance: This course will provide basic knowledge of Marketing for working in a business environment.

SECTION-1
1. Concepts of Marketing 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 **2. Marketing Information Systems And Research** Components of marketing information system–benefits & uses marketing research system, marketing research procedure, Demand Estimation research, Test marketing, Segmentation Research - Cluster analysis, Discriminant analysis. Sales forecasting: objective and subjective methods **3. Marketing of Industrial Goods** 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.

SECTION-1I

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)

1. Study of Consumer behavior
2. Market segmentation Analysis
3. Marketing information system analysis
4. Data collection techniques for Market Research
5. Sample selection & Questionnaire design for Market Research
6. Product Line Management Analysis
7. Study of Pricing policies
8. Branding decision analysis
9. Labeling & Packaging decision analysis
10. Development of advertising plan

List of Practicals: (Any Six)

1. Analysis of Factors affecting Consumer behavior
2. Identification of variables for market segmentation
3. Components of marketing information system
4. Cluster analysis for Market Research
5. Questionnaire design for collecting primary data for Market Research
6. Case study on Marketing of Industrial Goods
7. Case study on Product Line Management
8. Product life cycle analysis
9. Case study on Product Promotion strategies
10. Case study on Pricing policies
11. Case study on Labeling & Packaging
12. Case study on Branding

List of Projects:

1. Consumer Behavior Analysis
2. Development of Market Segmentation Plan for specific product/ Service
3. Exploratory Research for Market Competition Analysis
4. STP (Segmentation, Target, Positioning) Analysis
5. Analysis of B2B Marketing
6. Forecasting for Market Analysis
7. Designing Product Promotion Mix
9. Pricing Policy Impact Analysis
10. Market Analysis for New product development

List of Course Seminar Topics:

1. Marketing Concepts
2. Market Segmentation
3. Consumer Buying Behaviour
4. Industrial Marketing
5. Marketing Mix
6. Product Development Strategies
7. Pricing Policies
8. Promotional Strategies
9. Advertising
10. Importance of Packaging

List of Course Group Discussion Topics:

1. Advertisements- helpful to customers or just eye wash
2. Advertising is all glitter and no substance.
3. Consumers are never satisfied.
4. Consumer is the king in today's market.
5. Commitment is more important than other skills in marketing
6. Digital marketing via Blogs versus Video - Which is more effective?
7. Should a start-up invest heavily in Marketing
8. Quality is the key to successful Marketing
9. A career in marketing - Worth it or not?
10. Lying for sale of products should be avoided in Marketing

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.

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.	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

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

CO attainment levels

CO 1 - 3
CO 2 - 3
CO 3 - 3
CO 4 - 4
CO 5 - 4
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