Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Technology

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

Structure & Syllabus of

SY. (Common)

Pattern ' '

Effective from Academic Year 2021-22

Prepared by: - SY (Common)

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

Signed by

Chairman – BOS **Chairman – Academic Board**

Institute Vision:

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

Institute Mission:

- To impart knowledge and skill-based Education in Collaboration with Industry, Academia and Research Organizations.
- To strengthen global collaborations for Students, Faculty Exchange and joint Research
- To prepare competent Engineers with a spirit of Entrepreneurship
- To Inculcate and Strengthen Research Aptitude amongst the Students and Faculty

Department Vision:

- To inculcate multidisciplinary culture amongst students with knowledge from diverse areas of engineering

Department Mission:

- To provide a scholarly environment for the development of computing skills and competencies
- To cultivate research culture resulting in knowledge-base and innovative technologies
- To impart technical knowledge related to emerging multidisciplinary areas of Engineering
- To prepare students for solving problems of societal benefits and make them responsible citizens.

Title: Course Structure **FF No.: 653**

Branch: SY-Common **Year: S.Y.** **Academic Year: 2021-22**

Semester: I / II **Module: III** **Pattern:**

Sr. No.	Subject Code	Subject Name	Teaching Scheme (Hrs/Week)			Examination scheme							Total	Credits
			Theory	Lab	Tut	CA				MSA	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
	ME 2205	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

Table of Contents

COURSE CODE: MD2201 **COURSE NAME: 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 Operating 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-informatics

Job Mapping:

Job opportunities that one can get after learning this course

1. Data Scientist
2. Data Analyst
3. AI Engineer
4. Data Architect.
5. Data Engineer.
6. Statistician.
7. Database Administrator.
8. Business Analyst
9. Business Intelligence Developer
10. Infrastructure Architect
11. Enterprise Architect
12. Machine Learning Engineering
13. Machine Learning Scientist

FF No. : 654

COURSE CODE: CS2221 COURSE NAME: 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 totransfer 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 offersincreasing 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 covered☺** Smart lighting, Home Intrusion Detection, Smart Parking, Weather Monitoring System, Weather Report Bot, Air Pollution Monitoring, Forest fire Detection, Smart Irrigation, IoT Printer, IoT in Manufacturing Industry, IoT in Process Industry, IoT in Quality, Control Applications in Industry, IoT in Material Handling System in Industry, IoT in Automobile Industry, Navigation System, Connected Vehicles, Industry 4.0 **(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 andInnovation to Market Deployment", ISBN:987-87-93102-94-1, River Publishers
3. Joe Biron and Jonathan Follett, "Foundational Elements of an IoT Solution," by Joe Biron

MOOCs Links and additional reading material:

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

Course Outcomes

1. Demonstrate fundamental concepts of Internet of Things (CO 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, IoTSoftware 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

COURSE CODE: CS2218

COURSE NAME: OBJECT ORIENTED PROGRAMMING

Course Prerequisites:
Basic course on programming

Course Objectives:

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

Credits: 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 in Java
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:
   a. divide by zero
   b. Array index out of bounds exception
   c. Null pointer Exception
5. Write a java program to solve producer-consumer problem where there are two producer threads and one consumer thread.

6. Implement various operations using JDBC Connectivity.
7. Display bank account information (Use interface and inheritance using java)
8. Develop a GUI in java which reads, update the file.

List of Course Projects:

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

COURSE CODE: IT2201

COURSE NAME: 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 Architecture.

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

COURSE CODE: ME2205 **COURSE NAME: 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.

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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 3Dprinting

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*