

E.G.S. PILLAY ENGINEERING COLLEGE (AUTONOMOUS)

Approved by AICTE, New Delhi

(Affiliated to Anna University, Chennai | Accredited by NAAC with 'A++' Grade)

Accredited by NBA (Tier-1)

NAGAPATTINAM – 611002



B.E. – COMPUTER SCIENCE AND ENGINEERING R-2023

SECOND YEAR

CURRICULUM AND SYLLABUS FOR FOURTH SEMESTER

SEMESTER IV							
Course Code	Course Name	Category	L	T	P	C	Contact Hours
2302CS401	Database Management Systems	PCC	3	0	0	3	3
2302CS402	Computer Networks	PCC	3	0	0	3	3
2302CS403	Artificial Intelligence and Machine Learning	PCC	3	0	2	4	5
2302CS404	Design and Analysis of Algorithms	PCC	3	0	0	3	3
2302CS405	Object Oriented Programming in Java	PCC	3	0	0	3	3
2301GEX07	Environmental Sciences and Sustainability	BSC	2	0	0	2	2
	Laboratory Course						
2302CS451	Database Management Systems Laboratory	PCC	0	0	2	1	2
2302CS452	Computer Networks Laboratory	PCC	0	0	2	1	2
2302CS453	Object Oriented Programming Laboratory	PCC	0	0	2	1	2
2304GE401	Professional Development Course II	EEC	0	0	2	1	2
	Mandatory Course I	MC	3	0	0	0	3
2301LS401	Life skill course 4#	MC	0	0	0	0	0
	Total		20	0	10	22	30

L-Lecture | T-Tutorial | P-Practical | CA-Continuous Assessment | ES-End Semester

2302CS401	DATABASE MANAGEMENT SYSTEMS											L	T	P	C
												3	0	0	3
PREREQUISITE:															
1. Computer Programming Languages, Data structures , Algorithms															
COURSE OBJECTIVES:															
1.To understand the fundamentals of data models and conceptualize and depict a database system using ER diagram															
2. To make a study of SQL and Normalization															
3. To impart knowledge in transaction processing															
4. To be acquainted with data storage and security techniques of a query processing.															
5. To have a knowledge about the non-relational databases															
COURSE OUTCOMES:															
On the successful completion of the course, students will be able to															
CO1:	Design an ER model for a real world scenario.														
CO2:	Apply the Normalization techniques for standardizing data														
CO3:	Investigate transaction processing to maintain consistency in a database,														
CO4:	Acquire the knowledge about an efficient storage techniques to improve the performance of the databases														
CO5:	Analyze the running environment of an application using Mongo DB														
COs Vs POs & PSOs MAPPING:															
	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
	CO1	2	1	2	2	-	-	-	-	2	2	2	2	1	2
	CO2	2	2	3	3	2	-	-	-	2	3	3	3	1	2
	CO3	2	2	3	2	1	-	-	-	2	1	1	2	2	2
	CO4	1	2	3	2	-	-	-	-	3	2	3	3	2	3
	CO5	1	1	3	2	1	-	-	-	2	2	2	2	2	3
COURSE CONTENTS:															
MODULE I	INTRODUCTION TO DATABASE SYSTEM													9 Hours	
Introduction to database system - File System Vs DBMS- Data Base Architecture--Data Models, Schema and Instance - Three schema Architecture and Data Independence - Components of DBMS - E/R Model- Conceptual data Modeling- Entities-Relationships-Entity relationship model - Mapping Cardinalities- E-R diagrams-Examples.															
MODULE II	DATABASE DESIGN & NORMALIZATION													9 Hours	
SQL-DDL- DML-DCL-TCL-Embedded SQL-Static Vs Dynamic SQL - Views - Constraints - Triggers- Query processing and optimization. Dependencies and Normal forms: dependency theory - functional dependencies - Armstrong's axioms for FD's - closure of a set of FD's - minimal covers - definitions of 1NF - 2NF - 3NF and BCNF - decompositions and desirable properties of them - algorithms for 3NF and BCNF normalization - 4NF and 5NF.															
MODULE III	TRANSACTION PROCESSING													9 Hours	
Transaction Concepts - ACID Properties-Need for Concurrency Control -Schedules- Serializability: Conflict and View - Concurrency Control - Locking Mechanisms - Two phase locking- Time Stamp based Concurrency Control -Deadlock-Recovery Techniques-Immediate update- Deferred update- shadow paging.															
MODULE IV	INDEXING AND DATABASE SECURITY													9 Hours	
Data Storage & indexing: Physical Storage-RAID -File Organization - Indexing structures -primary and secondary index structures- Hashing Techniques -Single level and Multi-level Indexes-B+ tree Index Files-B tree Index Files. Database Security: Common Threats and Challenges - Access Control - DAC, MAC and RBAC models - Intrusion Detection - SQL Injection															
MODULE V	ADVANCED DATABASES													9 Hours	
Introduction: Object Oriented Databases, XML Databases, Document databases - Memory Databases- Graph databases, Need for NoSQL, different NoSQL data models: Key-value stores - Column families - DistributedNoSQL databases. MongoDB: Documents-Collections-Databases-Creating updating and removing documents- Querying- Type-Specific Query.															

TOTAL: 45 HOURS
TEXT BOOKS :
<ol style="list-style-type: none">1. Abraham Silberschatz, Henry F.Korth and S.Sundarshan “Database System Concepts”, Seventh Edition, McGraw Hill, 2017.2. Elmasri Ramez , Navathe Shamkant, “Fundamentals of Database Systems”, Seventh Edition, Pearson Education, 2017
REFERENCES:
<ol style="list-style-type: none">1. Thomas M. Connolly and Carolyn E. Begg, —Database Systems - A Practical Approach to Design, Implementation, and Management, Sixth Edition, Pearson Education, 20192. Raghu Ramakrishnan, Johannes Gehrke - Database Management Systems- Third Edition, McGraw-Hill College Publications, 20143. Shannon Bradshaw (Author), Eoin Brazil (Author), Kristina Chodorow (Author)- MongoDB: The Definitive Guide - Powerful and Scalable Data Storage, Third Edition-Shroff/O'Reilly, 20204. https://nptel.ac.in/courses/

2302CS402	COMPUTER NETWORKS												L	T	P	C
													3	0	0	3
PREREQUISITE:																
1. Basic ideas of computers.																
COURSE OBJECTIVES:																
1. To understand the basics of networks and its devices.																
2. To understand the functions and techniques of layers.																
3. To gain knowledge of addressing and routing protocols.																
4. To visualize the end-to-end flow of information.																
5. To familiarize the functions and protocols of the application layer.																
COURSE OUTCOMES:																
On the successful completion of the course, students will be able to																
CO1:		Explain the basic concepts of networks.														
CO2:		Understand the basics of how physical and data link layer is working.														
CO3:		Analyze routing algorithms.														
CO4:		Understand the basics of how data flows from one node to another.														
CO5:		Analyze the working of various application layer protocols.														
COs Vs POs & PSOs MAPPING:																
	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
	CO1	-	2	-	-	-	-	-	-	-	-	-	-	3	-	
	CO2	-	1	-	-	2	-	-	-	-	-	-	2	-	2	
	CO3	-	2	-	-	3	-	-	-	-	-	-	-	-	3	
	CO4	-	-	-	1	2	-	-	-	-	3	-	-	-	-	
	CO5	-	3	2	-	-	-	-	-	-	-	-	-	-	-	
COURSE CONTENTS:																
MODULE I INTRODUCTION														9Hours		
Data Communications - Network Criteria - Components of Networks -Types of Connection - Direction of Data Flow - Network Topologies - Protocols and standards-Categories of Networks -Network Models: The OSI Model-Networking Devices.																
MODULE II PHYSICAL AND DATA LINK LAYER														9Hours		
Physical Layer- Types of errors-Media Access Control: CSMA, CSMA/CD-Data Link Layer - Framing - Flow control - Error control-Error Detection Techniques- HDLC and other Data Link Protocols.																
MODULE III NETWORK LAYER														9Hours		
Internetworking - IPV4 - IP Addressing -Subnetting - IPV6 -Routing Protocols: Distance Vector Routing-Link State Routing- IP Protocols: ARP, RARP, ICMP, DHCP.																
MODULE IV TRANSPORT LAYER														9Hours		
Introduction - Transport-Layer Protocols: UDP - TCP: Connection Management - Flow control - Congestion Control - Congestion avoidance-Quality of Service.																
MODULE V APPLICATION LAYER														9Hours		
Domain Name Space - HTTP - FTP - Email protocols: SMTP - POP3 - IMAP - MIME -SNMP.																
TOTAL: 45 HOURS																
TEXT BOOKS:																
1. Behrouz A. Forouzan, "Data Communication and Networking", 6th Edition, Tata McGraw-Hill, 2022.																
2. William Stallings, "Data and Computer Communication", 10th Edition, Pearson Education, 2017.																
REFERENCES:																
1. Larry L. Peterson and Bruce S. Davie, Computer Networks, 6th Edition, Elsevier, 2020.																
2. Andrew S. Tanenbaum, Computer Networks, 6th Edition, Pearson Education, 2022.																
3. James F. Kurose and Keith W. Ross, Computer Networking: A Top-Down Approach Featuring the Internet, 8th Edition, Pearson Education, 2022.																

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| 4. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", McGraw Hill, 2012. |
| 5. https://nptel.ac.in/courses/106105183 . |

2302CS403	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING											L	T	P	C
												3	0	2	4
PREREQUISITE:															
COURSE OBJECTIVES:															
1. Problem formulation, analysis and solutions.															
2. Artificial Intelligence and machine learning (AI&ML) is a new technology.															
3. AI&ML fast growing discipline and is full of rigorous practical analysis.															
COURSE OUTCOMES:															
On the successful completion of the course, students will be able to															
CO1: Understand the AI concepts															
CO2: Construct the AI concepts.															
CO3: Build network concepts of AI															
CO4: Understand basic applications and issues of Machine Learning															
CO5: Understand the different types of datasets															
COs Vs POs & PSOs MAPPING:															
	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
	CO1	-	2	-	-	-	-	-	-	-	-	-	-	3	-
	CO2	-	1	-	-	2	-	-	-	-	-	-	2	-	2
	CO3	-	2	-	-	3	-	-	-	-	-	-	-	-	3
	CO4	-	-	-	1	2	-	-	-	-	3	-	-	-	-
	CO5	-	3	2	-	-	-	-	-	-	-	-	-	-	-
COURSE CONTENTS:															
MODULE I INTRODUCTION														6 Hours	
Concept of AI, history, current status, scope, agents, environments, Problem Formulations, Review of tree and graph structures, State space representation, Search graph and Search tree.															
MODULE II SEARCH ALGORITHMS														9Hours	
Random search, Search with closed and open list, Depth first and Breadth first search, Heuristic search, Best first search, A* algorithm, Game Search.															
MODULE III PROBABILISTIC REASONING														10 Hours	
Probability, conditional probability, Bayes Rule, Bayesian Networks- representation, construction and inference, temporal model, hidden Markov model.															
MODULE IV INTRODUCTION TO MACHINE LEARNING CONCEPTS														10 Hours	
What Is Machine Learning?, How Do We Define Learning?, How Do We Evaluate Our Networks?, How Do We Learn Our Network?, What are datasets and how to handle them?, Feature sets, Dataset division: test, train and validation sets, cross validation.															
MODULE V BASICS OF MACHINE LEARNING														10 Hours	
Applications of Machine Learning, processes involved in Machine Learning, Introduction to Machine Learning Techniques: Supervised Learning, Unsupervised Learning and Reinforcement Learning, Real life examples of Machine Learning.															
TOTAL: 45 HOURS															
LIST OF EXPERIMENTS:															
1. Write a programme to conduct uninformed and informed search.															
2. Write a programme to conduct game search.															
3. Write a programme to construct a Bayesian network from given data.															
4. Write a programme to infer from the Bayesian network.															
5. Write a programme to run value and policy iteration in a grid world.															
6. Write a programme to do reinforcement learning in a grid world.															
7. Mini Project work															
TOTAL: 30 HOURS															
REFERENCES:															

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach" , 3rd Edition, Prentice Hall
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill
3. Trivedi, M.C., "A Classical Approach to Artificial Intelligence", Khanna Publishing House, Delhi.
4. SarojKaushik, "Artificial Intelligence", Cengage Learning India, 2011
5. David Poole and Alan Mackworth, "Artificial Intelligence: Foundations for Computational Agents", Cambridge University Press 2010

2302CS404	DESIGN AND ANALYSIS OF ALGORITHMS	L	T	P	C
		3	0	0	3

PREREQUISITE:

	1. Data Structures
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COURSE OBJECTIVES:

	1. Learn the algorithm analysis techniques.
	2. Become familiar with the different algorithm design techniques.
	3. To illustrate the method of backtracking and branch and bound techniques to solve the problems like n-queen problem , graph coloring , TSP respectively .

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1:	Analyze the time and space complexity of algorithms.
CO2:	Derive and solve recurrences describing the performance of Divide and Conquer algorithms and Greedy Algorithms.
CO3:	Recite algorithms that employ this paradigm. Synthesize Dynamic Programming Algorithms, and Analyze them.
CO4:	Apply Backtracking concept to solve various problems
CO5:	Apply Branch and Bound concept to solve various problems

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	2	2	2
CO2	3	3	2	2	-	-	-	-	-	-	2	-	2	2
CO3	3	3	3	2	2	-	-	-	-	-	3	-	3	3
CO4	3	3	3	3	2	-	-	-	-	-	3	-	2	2
CO5	3	2	2	2	-	-	-	-	-	-	2	2	2	2

COURSE CONTENTS:

MODULE I	INTRODUCTION TO ALGORITHMS AND ANALYSIS	9Hours
Notion of an Algorithm - Fundamentals of Algorithmic Problem Solving - Important Problem Types - Fundamentals of the Analysis of Algorithm Efficiency - Analysis Framework - Asymptotic Notations and its properties - Mathematical analysis for Recursive and Non-recursive algorithms.		
MODULE II	DIVIDE-AND-CONQUER & GREEDY ALGORITHMS	9Hours
Introduction to Divide and conquer methodology - Merge sort algorithm- Quick sort algorithm - Binary search algorithm -Strassen’s Matrix Multiplication -Finding Max & Min GREEDY METHOD: General method, Applications- Fractional knapsack problem - Container loading Problem.		
MODULE III	DYNAMIC PROGRAMMING	9Hours
Introduction to Dynamic Programming algorithm - Warshall’s and Floyd’ algorithm - Optimal Binary Search Trees - 0/1 Knapsack Problem and Memory Functions-Travelling Salesman Problem.		
MODULE IV	BACKTRACKING	9Hours
Introduction to Backtracking algorithm- n-Queens problem - Graph Coloring Problem-Hamiltonian Circuit Problem - Subset Sum Problem.		
MODULE V	BRANCH AND BOUND	9Hours
Introduction to Branch and Bound algorithm- Assignment problem - Knapsack Problem - Traveling Salesman Problem		

TOTAL: 45 HOURS

REFERENCES:

1. R. C. T. Lee, S. S. Tseng, R.C. Chang and T. Tsai (2006), Introduction to Design and Analysis of Algorithms A strategic approach, McGraw Hill, India.
2. Aho, Ullman, Hopcroft (2009), Design and Analysis of algorithms, 2nd edition, Pearson education, New Delhi
3. Allen Weiss (2009), Data structures and Algorithm Analysis in C++, 2nd edition, Pearson education,

New Delhi
4. Harsh Bhasin, Algorithms Design and Analysis I, Oxford university press, 2016.
5. S. Sridhar, Design and Analysis of Algorithms I, Oxford university press, 2014.
6. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, PHI Learning Private Limited, 2012.
7. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006.
8. https://onlinecourses.nptel.ac.in/noc24_cs23/preview

2302CS405	OBJECT ORIENTED PROGRAMMING IN JAVA											L	T	P	C
												3	0	0	3
PREREQUISITE:															
1. Programming in C & C++ 2. Introduction to Computer															
COURSE OBJECTIVES:															
1. To demonstrate adeptness of object oriented programming in developing solutions to problems demonstrating usage of data abstraction, encapsulation and inheritance.															
2. To understand the concepts behind object-oriented programming using JAVA.															
3. To analyze and understand the functionality of program code written in JAVA.															
COURSE OUTCOMES:															
On the successful completion of the course, students will be able to															
CO1:		Understand the features of Java supporting object oriented programming													
CO2:		Develop the concepts for Array in java , defining Package													
CO3:		Apply the concepts for Java Inheritance, Polymorphism ,Interfaces and demonstrate the working of string builder and string buffer in String handling													
CO4:		Develop the Exception Handling and defining Multithreading													
CO5:		Develop the working of EventHandling, Applet and JAVA swing.													
COs Vs POs & PSOs MAPPING:															
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	2	-	-	-	-	-	-	2	2	-	1
CO2	3	2	1	-	3	-	-	-	-	-	-	2	2	-	1
CO3	3	2	2	-	2	-	-	-	-	-	-	3	3	1	1
CO4	3	3	3	-	3	-	-	-	-	-	-	3	3	-	1
CO5	3	3	3	-	3	-	-	-	-	-	-	3	3	-	1
COURSE CONTENTS:															
MODULE I INTRODUCTION TO JAVA														9Hours	
Overview of Java-data types-variables-operators-control statements-object and classes- methods access specifiers-static members-finalize methods-constructors.															
MODULE II ARRAY AND PACKAGE														9Hours	
ARRAY: Defining an Array, Initializing & Accessing Array, Multi -Dimensional Array. PACKAGE: Organizing Classes and Interfaces in Packages, Package as Access Protection, Defining Package, CLASSPATH Setting for Packages, Making JAR Files for Library Packages, Import and Static Import Naming Convention For Packages.															
MODULE III INHERITANCE, POLYMORPHISM , INTERFACES AND STRING														9Hours	
Inheritance-super keyword-types of inheritance - polymorphism- method overriding-method overloading abstract class-inner class-interfaces-reflections.String methods-special string operation- Operation on String, Mutable & Immutable String, Using Collection Bases Loop for String, Tokenizing a String, Creating Strings using String Buffer.															
MODULE IV EXCEPTION HANDLING AND MULTITHREADING														9Hours	
EXCEPTION HANDLING : The Idea behind Exception ,Exceptions & Errors ,Types of Exception ,Control Flow In Exceptions, JVM reaction to Exceptions ,Use of try, catch, finally, throw, throws in Exception Handling ,In-built and User Defined Exceptions, Checked and Un-Checked Exceptions. MULTITHREADING: Understanding Threads , Needs of Multi-Threaded Programming ,Thread Life-Cycle, Thread Priorities, Synchronizing Threads, Inter Communication of Threads ,Critical Factor in Thread.															
MODULE V EVENT HANDLING , APPLETS AND JAVA SWING														9Hours	
EVENT HANDLING : Event-Driven Programming in Java, Event- Handling Process, Event Handling Mechanism, Event Classes, Event Sources, Event Listeners, Adapter Classes as Helper Classes in Event Handling. APPLETS: Creating an Applet -using of applets - A simple Applet- an applet with swing Components- Animation in Applets - A simple Game with an applet - Applet Parameters - Playing Audio in Applets.															

JAVA SWING: Introduction to JFC and Swing, Features of the Java Foundation Classes, Swing API Components.
Total: 45Hours
TEXT BOOKS :
1. Schildt, Herbert. Java: The Complete Reference, Twelfth Edition. United States: McGraw Hill LLC, 2021.
2. Dr.R. NageswaraRao , “Core Java - An Integrated Approach(Black Book)”, DreamTech Press , 2017 Edition.
REFERENCES:
1. Herbert Schildt, “The Java 2: Complete Reference”, Fourth edition, TMH, 2002 .
2. Cay S. Horstmann , “Core Java, Volume I: Fundamentals”, 12th Edition.
3. H.M.Deitel, P.J.Deitel, “Java how to program”, Fifth edition, Prentice Hall of India private limited,2003.
4. Ken Arnold, James Gosling, David Holmes, “THE Java™ Programming Language”, Addison Wesley Professional, Fourth Edition.
5. Cay S. Horstmann, Gary Cornell , “Core Java Volume I- Fundamentals ” , Pearson India Education Services Pvt. Ltd. Eleventh Edition
6. Uttam K. Roy ,” Advanced Java Programming”, Oxford University Press , 2015.
7. https://nptel.ac.in/courses/106/105/106105151/
8. https://nptel.ac.in/courses/106105191/
9. https://www.mygreatlearning.com/academy/learn-for-free/courses/java-programming
10. https://www.codecademy.com/catalog/language/java

2301GEX07	ENVIRONMENTAL SCIENCES AND SUSTAINABILITY											L	T	P	C
												2	0	0	2
PREREQUISITE:															
1. Basic environmental studies															
COURSE OBJECTIVES:															
1. Realize the interdisciplinary and holistic nature of the environment.															
2. Understand how natural resources and environment affect the quality of life and stimulate the quest for sustainable development.															
COURSE OUTCOMES:															
On the successful completion of the course, students will be able to															
CO1:	Describe the importance of ecosystem.														
CO2:	Describe the various environmental issues and its prevention.														
CO3:	Organize various natural resources and the immediate need to conserve it.														
CO4:	Select the various ways of conservation of biodiversity.														
CO5:	Investigate the different types of pollution and its effects.														
COs Vs POs & PSOs MAPPING:															
	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
	CO1	2	1	-	-	-	-	3	-	-	-	-	-	-	-
	CO2	2	1	-	-	-	-	3	-	-	-	-	-	-	-
	CO3	3	2	1	1	1	1	3	2	2	2	3	2	-	-
	CO4	3	2	1	1	1	1	3	2	2	2	3	2	-	-
	CO5	3	2	1	1	1	1	3	2	2	2	3	2	-	-
COURSE CONTENTS:															
MODULE I	ECOSYSTEM												8 Hours		
Concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers. Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, rivers, oceans)															
MODULE II	ENVIRONMENTAL ISSUES AND SOLUTIONS												7 Hours		
Current Environmental Issues: Acid rain, Ozone layer depletion, Global warming, Greenhouse effect Solutions: 12 principles of green Chemistry - Rainwater harvesting.															
MODULE III	BIODIVERSITY												10 Hours		
Introduction to biodiversity - genetic, species and ecosystem diversity – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.															
MODULE IV	NATURAL RESOURCES												10 Hours		
Forest resources: Use and over-exploitation, deforestation-timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over utilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, waterlogging, salinity – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Energy Conversion Processes Biogas – production and uses, anaerobic digestion – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.															
MODULE V	ENVIRONMENTAL POLLUTION												10 Hours		

Definition – Source, causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution – (f) Nuclear pollution (g) Thermal pollution role of an individual in prevention of pollution.
TOTAL: 45 HOURS
LIST OF EXPERIMENTS:
MINI PROJECT ADDITIONAL TOPICS
Soil Science
1. Effects of climate change on soil erosion.
2. The role of land management in maintaining soil health.
3. Effects of salinity in coastal region Agricultural activity.
4. The effects of climate change on agriculture.
Urban Ecology
1. How road construction impacts biodiversity and eco systems.
2. The effects of urbanization and city planning on water cycles.
3. Impacts of noise pollution on human health.
Pollution and Bio-remediation
1. The role of bio-remediation in removing “forever” chemicals from the environment.
2. Impacts of air pollution on human health.
3. How to improve plastic recycling processes?
4. Individual measures to reduce consumption and creation of micro plastics.
General Topics
1. Impact of Urbanization on Local Biodiversity
2. Renewable Energy Options for Sustainable Living.
3. Waste Management Strategies in Urban Areas
4. Climate Change and Its Effect on Local Ecosystems
5. Air Quality Monitoring in Urban Centers
6. Water Quality Assessment in Local Water Bodies
7. Green Roof Technology and Its Environmental Benefits
8. Impact of Plastic Pollution on Marine Life.
9. Eco-friendly Practices in Agriculture:
10. The Role of Community Gardens in Urban Sustainability
11. Alternate energy sources for community Development.
12. E-Waste Management.
13. Energy Audit of a building.
14. Rainwater harvesting system.
15. Population growth variation among nations.
16. Population explosion.
17. Family welfare programme.
18. Women welfare programme.
19. Child welfare programme.
20. Environmental impact analysis.
21. Role of information technology in environmental protection and human health.
REFERENCES:
1. Trivedi.R.K., "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media, 3rd edition, BPB publications, 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, "Environmental law", Prentice hall of India PVT LTD, New Delhi, 2007.
4. Rajagopalan, R, "Environmental Studies-From Crisis to Cure", Oxford University Press, 2005.
5. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2006

6. https://en.wikipedia.org/wiki/Carbon_capture_and_storage
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7. Ravikrishnan "Environmental Science and Engineering" Sri Krishna Hi-tech Publishing Company Pvt
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2302CS451	DATABASE MANAGEMENT SYSTEMS LABORATORY											L	T	P	C
												0	0	2	1
PREREQUISITES:															
1. Computer Programming Languages															
COURSE OBJECTIVES:															
1. Learn to create and use a database															
2. Be familiarized with a query language															
3. Have hands on experience on DDL Commands															
4. Have a good understanding of DML Commands and DCL commands															
5. Familiarize advanced SQL queries.															
6. Be exposed to different applications															
COURSE OUTCOMES:															
After completion of the course, Student will be able to															
CO1:	Design and implement a database schema for a given problem-domain														
CO2:	Create and maintain tables using various PL/SQL statements														
CO3:	Apply Triggers, Views and constraints commands to solve real time problems														
CO4:	Create reports using functions and procedures														
CO5:	Apply front end and back end tools for real time projects														
COs Vs POs & PSOs MAPPING:															
	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
	CO1	3	3	3	3	-	-	-	-	3	1	3	2	1	1
	CO2	2	3	3	2	1	-	-	-	1	2	3	3	1	2
	CO3	3	3	2	1	1	-	-	-	1	1	1	3	3	2
	CO4	2	3	3	3	1	-	-	-	1	1	3	2	2	3
	CO5	3	3	2	2	2	-	-	-	2	2	3	1	1	3
LIST OF EXPERIMENTS:															
1. DDL and DML commands															
2. Transaction control commands and Aggregate Functions															
3. Joins and Nested Queries															
4. Constraints and Views															
5. High level programming language extensions Control structures															
6. Cursors															
7. Triggers															
8. Procedures, Functions and Report															
9. Create an XML database and validate it using XML schema															
10. Create Document, column and graph based data using NOSQL database tools															
11. Case study on Banking and Finance System															
a. Build Entity Model diagram. The diagram should align with the business and functional goals stated in the application.															
b. Apply Normalization rules in designing the tables in scope.															
c. Prepared applicable views, triggers (for auditing purposes), functions for enabling enterprise grade features.															
d. Build PL SQL / Stored Procedures for Complex Functionalities, ex EOD Batch Processing for calculating the EMI for Gold Loan for each eligible Customer.															
12. Database Design and implementation with any one front end tool (Mini Project)															
Sample list of Projects															
a. Hospital management															
b. Ticket reservation System															
c. Society Financial Management															
d. Property Management -eMall															
e. Inventory Management for a EMart Grocery Shop															
f. Timetable Management System															

g. Hotel Management System h. Online Course Registration System i. Library Management System j. Cop Friendly App -Eseva	
TOTAL: 45 HOURS	
REQUIREMENTS:	
Hardware: Standalone desktops 30 Nos. (or) Server supporting 30 terminals or more.	
Software: Front end: Visual Studio or Java or Equivalent Back end: Oracle / MySQL/ Sql Server DB2 or Equivalent.	
FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :	
	Under MoU with Oracle Academy, a programme Oracle Workforce Development Programme (OWDP) is conducted. In this programme extensive hands-on training on SQL and PL/SQL will be given to students during the Lab sessions. <ul style="list-style-type: none"> • Writing SQL queries for Hierarchical retrieval of data (tree structured data) • Querying Data Dictionary static Views • Using stored procedures and Functions for implementing object level data security
REFERENCES:	
1. http://ilearning.oracle.com	
2. http://coursera.org/	
3. http://nptel.ac.in/	

2302CS452	COMPUTER NETWORKS LABORATORY											L	T	P	C
												0	0	2	1
PREREQUISITES:															
1. Basic Computer knowledge. 2. C++ or Java Programming.															
COURSE OBJECTIVES:															
1. Be exposed to implementing simulation tools.															
2. Learn to implement protocols and algorithms.															
3. Getting exposure in routing concepts and NS simulator.															
COURSE OUTCOMES:															
After completion of the course, Student will be able to															
CO1:	Understand the uses of commands.														
CO2:	Implement the socket concepts.														
CO3:	Apply simulation tools for implementing networking algorithms.														
CO4:	Apply the different routing algorithms.														
CO5:	Understand protocols and error correction codes.														
COs Vs POs & PSOs MAPPING:															
	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
	CO1	3	3	3	3	-	-	-	-	3	1	3	2	1	1
	CO2	2	3	3	2	1	-	-	-	1	2	3	3	1	2
	CO3	3	3	2	1	1	-	-	-	1	1	1	3	3	2
	CO4	2	3	3	3	1	-	-	-	1	1	3	2	2	3
	CO5	3	3	2	2	2	-	-	-	2	2	3	1	1	3
LIST OF EXPERIMENTS:															
1. Learn to use commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping and traceroute PDUs using a network protocol analyzer and examine.															
2. Write a HTTP web client program to download a web page using TCP sockets															
3. Applications using TCP sockets like: a. Echo client and echo server b. Chat c. File Transfer															
4. Simulation of DNS using UDP sockets.															
5. Write a code simulating ARP /RARP protocols.															
6. Study of Network simulator (NS) and Simulation of Congestion Control Algorithms using NS.															
7. Study of TCP/UDP performance using Simulation tool.															
8. Simulation of Distance Vector/ Link State Routing algorithm.															
9. Performance evaluation of Routing protocols using Simulation tool.															
10. Simulation of error correction code (like CRC).															
														Total:45Hours	
Additional Experiments:															
1. Implementation of RPC															
2. Implementation of Ping command.															
REFERENCES:															
1. http://www.ee.surrey.ac.uk/Teaching/Unix/unixintro.html															
2. https://kb.iu.edu/d/afsk															
3. http://www.ch.embnet.org/CoursEMBnet/Pages05/slides/Unix05.pdf															
4. http://www.comptechdoc.org/os/linux/usersguide/linux_ugshellpro.html															
5. http://www.cs.jhu.edu/~yairamir/cs418/os4/sld025.html															
REQUIREMENTS:(A batch of 30 students)															

Hardware Requirements: Standalone Desktop Computer or Server Supporting Software Requirements: Java
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2302CS453	OBJECT ORIENTED PROGRAMMING LABORATORY												L	T	P	C
													0	0	2	1
PREREQUISITE:																
1. Programming in C / C++																
COURSE OBJECTIVES:																
1. Justify the philosophy of object-oriented programming and the concepts of encapsulation, abstraction, inheritance, and Polymorphism.																
2. To make the student learn an object oriented way of solving problems using java.																
3. To make the students to write programs using multi-threading concepts and handle exceptions																
COURSE OUTCOMES:																
On the successful completion of the course, students will be able to																
CO1:		Understand the features of Java supporting object oriented programming														
CO2:		Develop the concepts for Array in java , defining Package														
CO3:		Apply the concepts for Java Inheritance, Polymorphism ,Interfaces and Demonstrate the working of string builder and string buffer in String handling														
CO4:		Develop the Exception Handling and defining Multithreading														
CO5:		Develop the working of Event Handling, Applet and JAVA swing.														
COs Vs POs & PSOs MAPPING:																
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2		
CO1	1	1	1	-	-	-	-	-	2	2	-	-	1	2		
CO2	1	1	1	-	-	-	-	-	2	2	-	-	1	2		
CO3	2	2	2	2	-	-	-	-	2	2	-	-	2	2		
CO4	2	2	3	3	-	-	-	-	2	3	2	-	2	2		
CO5	3	3	3	3	3	-	-	-	3	3	3	3	3	3		
LIST OF EXPERIMENTS:																
1. Basic Programs for Java Concepts																
2. Program to implement Array and Package																
3. Program to implement Multiple Inheritance																
4. Program to implement Polymorphism																
5. Program to implement various String methods																
6. Program to implement Exception handling in various cases																
7. Program to implement Multi-threaded programming																
8. Program to implement Event Handling																
9. Program to implement Applet																
10. Program to implement Java Swing																
TOTAL: 45 HOURS																
ADDITIONAL EXPERIMENTS :																
1. Write a Java program to develop simple application (project) using OOP's concept.																
REFERENCES:																
1. https://lecturenotes.in/practicals/19363-lab-manuals-for-object-oriented-programming																
2. http://studentsfocus.com/cs6461-object-oriented-programming-lab-manual																
3. http://bietbvm.ac.in/public/testimonia																
4. http://www.srmuniv.ac.in/sites/default/files																
REQUIREMENTS: (A batch of 30 students)																
Hardware Requirements: Standalone Desktop Computer or Server Supporting																
Software Requirements: JDK 8 or 11 or 16 for windows 64 bit OS.																

2304GE401	PROFESSIONAL DEVELOPMENT COURSE II											L	T	P	C
												0	0	2	1
PREREQUISITE:															
Basic Mathematics & English Language Skills															
COURSE OBJECTIVES:															
1. Enhance Self-Awareness															
2. Improve Communication Skills															
3. Improve Problem-Solving Skills															
COURSE OUTCOMES:															
At the end of the course, the student should be able to															
CO1:	Solve problems on Partnership, Mixture & Alligation and age least time using shortcuts and apply real life situations.														
CO2:	Calculate concepts of speed, time and distance, understand timely completion using time and work.														
CO3:	To envision their career and to acquire basic knowledge about resume and other interview essentials.														
CO4:	The students will be accoutered with relevant application of different segments of grammar that will vitalize their knowledge of application and usage in the module and skillful in framing sentences and identifying basic errors in the sentence.														
CO5:	The learners are encouraged for kinesthetic learning and to make them absolutely fair in the knowledge application of grammar and its usage.														
COs Vs POs & PSOs MAPPING:															
	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
	CO1	3	3	-	-	-	-	-	-	-	-	-	2	-	-
	CO2	3	3	-	-	-	-	-	-	-	-	-	2	-	-
	CO3	-	-	-	-	-	-	-	3	3	3	1	2	-	-
	CO4	-	-	-	-	-	-	-	3	3	3	1	2	-	-
	CO5	-	-	-	-	-	-	-	3	3	3	1	2	-	-
COURSE CONTENTS:															
MODULE I	Arithmetic Ability												10 Hours		
Time and Work, Time and Distance, Profit and Loss, Simple Interest and Compound Interest, Problem on Ages															
MODULE II	Goal setting and Interview essentials												10 Hours		
Goal setting - SWOT analysis, Formal/Informal self introduction, Listening skills, Resume building - Simple resume building, Importance of proofreading, Making perfect resume, Glimpse of basic computer skills and shortcuts.															
MODULE III	Grammar												10 Hours		
Parts of speech, Articles, Prepositions, Tenses, Active Voice and Passive Voice, Direct and Indirect Speech, Synthesis of Sentences, Degrees of Comparison, Question Tags, Error Identification, Sentence Improvement.															
TOTAL: 30 HOURS															
REFERENCES:															
1. Arun Sharma, How to Prepare for Logical Reasoning for CAT*, 4th edition, McGraw Hills publication, 2017.															
2. R S Agarwal, A modern approach to Logical reasoning*, revised edition, S.Chand publication, 2017.															
3. B.S. Sijwalii and InduSijwali, A New Approach to REASONING Verbal & Non-Verball, 2nd															

edition, Arihant publication, 2014
4. Objective General English by SP Bakshi.
5. A Modern approach to verbal and non-verbal reasoning by R.S. Agarwal.
6. Complete reference campus recruitment book.
7. Grammar for IELTS by Hopkins.
8. English Grammar in use by Murphy.

MANDATORY COURSES I

2301MC401	DESIGN THINKING FOR INNOVATION	L	T	P	C
		3	0	0	3
PREREQUISITE:					
	The course assumes no prior skill or background in design, art, engineering, or prototyping. It is open to all undergraduates and graduate students with an interest in learning design thinking, and is especially recommended for those students planning social-venture and other kinds of design interventions				
COURSE OBJECTIVES:					
	1. Understand the terminology and conceptual models used in design disciplines				
	2. Understand how teaching and learning occurs in the design process				
	3. Recognize the ethical and social dilemmas and obligations of the practice of design				
	4. Diagnose common adoption barriers in individuals, groups and organizations.				
	5. Develop a design theory from independent and qualitative research and observations				
	6. Participate in and lead innovation in creative and collaborative settings				
	7. Undertake complex and unstructured problem-solving challenges in unfamiliar domains				
COURSE OUTCOMES:					
Upon successful completion of the course, students will be able to					
CO1:	Describe Key Concepts and basics of Design Thinking Principles				
CO2:	Elaborate the Design Thinking Approach through IDEO's method & Customer Journey Maps				
CO3:	Conduct user interviews and synthesize learnings to uncover insights and identify opportunities for innovation				
CO4:	Develop Design Driven Innovative Solutions to Real World Problems				
COURSE CONTENTS:					
Module I	INTRODUCTION TO DESIGN THINKING				8 Hours
Human Centered Design, Why Design Thinking, 5-Step Design Thinking Process, Applications, Creative Confidence, The culture of Innovation					
Module II	DESIGN THINKING APPROACH				12 Hours
IDEO's method of Design Thinking, Divergent Thinking & Innovation Funnel, Customer Journey Maps to uncover Innovation Opportunities, Case Study : Turing Creative Ideas into Viable Companies					
Module III	EXPLORING DESIGN THINKING TOOLKIT				5 Hours
Discovery, Interpretation, Ideation, Experimentation, Evolution					
Module IV	DESIGN CHALLENGE PROJECT : PHASE-1				5 Hours
Define a Challenge, Project Plan, How Might We statements, Project Timeline, Project Checklist					
Module V	DESIGN CHALLENGE PROJECT : PHASE-2				15 Hours
Discovery - Understand the Challenge, Prepare Research, Gather Inspiration, Interpretation - Tell Stories, Search for meaning, Frame Opportunities, Ideation - Generate Ideas, Refine Ideas, Experimentation - Make Prototypes, Get Feedback, Evolution - Track Learnings, Engage Others					
					TOTAL: 45 HOURS
FURTHER READING:					
1. Design for Social Impact : How to by IDEO.org					
2. Design Thinking ToolKit by IDEO.org					
3. The Field guide to Human Centered Design by IDEO.org					
REFERENCES:					
1. Creative Confidence: Unleashing the Creative Potential Within Us All Book by David M. Kelley and Tom Kelley, 2013					
2. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation Book by Tim Brown, 2009					
3. The art of Innovation by Tom Kelly, 2011					
4. Design Thinking for Strategic Innovation: What They Can't Teach You at Business Or Design School Book by Idris Mootee, 2013					

5. The Design of Everyday Things Book by Don Norman, 1988
6. The Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems Book by Michael Lewrick, 2017
7. https://nptel.ac.in/courses/109104109/

2301MC406	SOCIAL ENTREPRENEURSHIP		L	T	P	C
			3	0	0	3
PREREQUISITE:						
	The course assumes no prior skill or background in design, art or engineering. It is open to all undergraduates and graduate students with an interest in learning design thinking, and is especially recommended for those students planning social-venture and other kinds of design interventions					
COURSE OBJECTIVES:						
	1. Shift the status quo of the world's greatest challenges, fueled by inspiring examples of social entrepreneurship in action					
	2. Think like a social entrepreneur to tackle problems across public, private, and nonprofit sectors					
	3. Carve your own path for making change, whether that be founding an enterprise, serving on a board, or supporting social entrepreneurs in other creative ways					
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to						
CO1:	Explain Social Entrepreneurship Principles and solving biggest problems					
CO2:	Demonstrate Solutions for social problems using Change methods & Sustainability Maps					
CO3:	Build a Scale model for an Idea to solve a social problem					
CO4:	Apply Lean Principles in Social Sector to provide solutions					
CO5:	Design a Business Model for a Social Problem					
Module I INTRODUCTION TO SOCIAL ENTREPRENEURSHIP 12 Hours						
Social Entrepreneurship - Introduction to Donors Choose, Samasource, AravindEyecare, Transformative change, Starting with a Crazy Idea, Activity : Life Map, Identify Mission - Identify a social problem, Understand problem, Understand Customer, Activity : Passion Skill Problem						
Module II CHANGE & SUSTAINABILITY 12 Hours						
Understand a theory of change, Framework for measuring impact, Measurement approach, Impact approach for your own enterprise, Activity : Develop a theory of change; Sustainability - Planning for impact, Achieving financial sustainability, Building financial sustainability, Social Enterprises Revenue Engine, Activity : Solutions Map						
Module III BRING AN IDEA TO SCALE 5 Hours						
Think about Scale, Scaling impact, Tips to scale smart, Ways to scale, Activity : Build a launch plan, Reflection						
Module IV LEAN STARTUP PRINCIPLES FOR SOCIAL SECTOR 8 Hours						
Lean mindset, Lean startup principles, Build-Measure-Learn loop, Doing Lean, Lean Principles for Social Sector, Activity : Develop your value proposition, Hypothesis Generation						
Module V BUSINESS MODELS FOR SOCIAL ENTERPRISE 8 Hours						
Introduction to Business model canvas, Integrating Impact model and business model, Types of business models, Innovations in social entrepreneurship model, Activity : Business model canvas sprints						
TOTAL: 45 HOURS						
REFERENCES:						
1. Social Entrepreneur's Playbook: Pressure Test, Plan, Launch and Scale Your Social Enterprise Book by Ian C MacMillan and James D. Thompson						
2. Social Entrepreneurship in India: Quarter Idealism and a Pound of Pragmatism Book by MadhukarShukla						
3. Getting Beyond Better: How Social Entrepreneurship Works Book by Roger Martin and Sally R. Osberg						
4. Lean Startups for Social Change: The Revolutionary Path to Big Impact Book by Michel Gelobter						
FURTHER READING:						
1. How to Change the World: Social Entrepreneurs and the Power of New Ideas, Updated Edition Book by David Bornstein						
2. Building Social Business: The New Kind of Capitalism That Serves Humanity's Most Pressing Needs Book by Muhammad Yunus						
3. Social Entrepreneurship: What Everyone Needs to Know Book by David Bornstein and Susan Davis						

2301MC408	INTELLECTUAL PROPERTY RIGHTS FOR ENGINEERS	L	T	P	C
		3	0	0	3
PREREQUISITE:					
	The course assumes no prior skill or background in design, art or engineering. This course covers the fundamental aspects of intellectual property (IP): copyright and related rights, trademarks, patents, geographical indications, and industrial designs. It also covers contemporary issues impacting the IP field such as: new plant varieties, unfair competition, enforcement of IP rights and emerging issues in IP.				
COURSE OBJECTIVES:					
	1. A foundation in the basic concepts of IP				
	2. Better understanding of the relationship between IP and other policy areas such as health, climate change, traditional knowledge and emerging technologies				
	3. Practical learning experience in technology transfer and IP license negotiations				
	4. Experience of learning from renowned experts in a multicultural environment and joining an alumnus of students sharing a similar interest in IP				
	5. The chance to identify areas for further IP study				
COURSE OUTCOMES:					
Upon successful completion of the course, students will be able to					
CO1:	Explain various types of IPRs specific to Engineering				
CO2:	Explain concepts such as Copyrights, Trademarks, GIs and Industrial designs				
CO3:	Explain basic concepts of Engineering Patents				
CO4:	Explain concept of Patent Search and various methods to do it				
CO5:	Develop a sample PCT Application and explain examination procedures				
COURSE CONTENTS:					
Module I	INTRODUCTION				9 Hours
Overview of IP, Copyright, Trademarks, Geographical Indicators, Industrial Designs, Patents, Unfair competition, Enforcement of IP Rights, Emerging Issues in IP & IP Management					
Module II	COPYRIGHTS & TRADEMARKS				6 Hours
The concept, Case Study, Historical background, Principles, Notion of Work, Rights and Limitations, Formats & Filing Procedures					
Module III	GEOGRAPHICAL INDICATORS & INDUSTRIAL DESIGNS				6 Hours
The concept, Case Study, Historical background, Principles, Notion of Work, Rights and Limitations, Formats & Filing Procedures					
Module IV	PATENTS				15 Hours
The Macro-Economic Impact of the Patent System, The Patent Application Process, The Different Layers of the International Patent System and Regional Patent Protection Mechanisms, Kinds of Intellectual Property Protection Based on Types of Inventions, Legal Issues of the Patenting Process, Enforcement, New Issues, Important Cases and Discussions, IP and Development - Flexibilities and Public Domain under Patents, Patent Search					
Module V	PATENT COOPERATION TREATY				9 Hours
What is PCT? Use of PCT, Preparing a PCT Application, PCT Services, Patent Agent and Common Representatives, International Search, International Examination					
TOTAL: 45 HOURS					
REFERENCES:					
1. Law relating to IPR by Dr MK Bandarai, Central Law Publication, 2014					
2. Introduction to Intellectual Property Rights, H.S. Chawla, Oxfors & IBH Publishing, 2020					
3. Introduction to IPR by JP Mishra, Central Law Publications					
4. https://patents.google.com/Introduction to IPR books					
FURTHER READING:					
1. Intellectual Property Rights by Pandey Neeraj & Dharni Khusdeep, 2014					
2. Fundamentals of IPR: for students, Industrialist and patent lawyers, Ramakrishna B & Anil Kumar HS, 2017 Drucker					